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Amit Kumar
Stefan Mozar *Editors*

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Preface

Cyber-physical systems (CPS) are hybrid systems that use computation, networking, and physical processes to perform tasks. With feedback loops in place where physical processes affect computations and calculations affect physical processes, embedded computers and networks can both monitor and regulate physical processes. There is significant unrealized economic and societal potential in such systems, and significant investments are being made around the world to further improve the technology and make it more accessible. The technique is based on the older (but still very young) science of embedded systems, which involves placing computers and software in objects whose primary function is not computation, such as automobiles, toys, medical equipment, and scientific instruments, among other things. When the dynamics of physical processes are combined with those of software and networking, the result is CPS, which provides abstractions as well as modelling, design, and analysis approaches for the integrated whole.

CPS is an engineering profession that is primarily concerned with technology, and it has a solid base in abstract mathematical concepts. In computer science, the primary technological difficulty is to combine abstractions that have evolved over centuries for modelling physical processes (differential equations, stochastic processes, and so on) with abstractions that have grown over decades for modelling computer-based processes (algorithms and programs, which provide a "procedural epistemology" [Abelson and Sussman]). The former abstractions are concerned with dynamics (the evolution of a system's state over time), whereas the later are concerned with data transformation operations. Based on the Turing–Church theory of computability, computer science abstracts away fundamental physical features, particularly the passage of time, that are essential to include the dynamics of the physical world in a discourse on language and logic.

We are entering a new era of computing technology. Machine to machine communication, machine to infrastructure communication, machine to environment communication, cyber-physical systems, Internet of everything communication, and Internet of intelligent things communication.

This book contains selected and presented papers from the International Conference on Communications and Cyber-Physical Engineering, 2021, which took place

at CMR Engineering College, Hyderabad, on April 9 and 10. It comprises of carefully chosen manuscripts that have been grouped according to their approaches and contributions to the conference's scope and theme. The algorithms and theories presented in the chapters of this book are at the heart of the technologies and applications covered, which are primarily face recognition, evolutionary algorithms such as genetic algorithms, automotive applications, automation devices with artificial neural networks, business management systems, the Internet of things, machine learning, data science, and modern speech processing systems. This book also covers contemporary advancements in medical diagnostic systems, sensor networks, and VLSI domain systems, among other topics. Whenever possible, a discussion of deep learning algorithms' learning and software modules is included when appropriate. Briefly stated, the book will provide insights into the technological breakthroughs involved in cyber-physical systems and engineering.

Hyderabad, India — Amit Kumar, Ph.D.
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Contents

Blockchain and Tourism: Transformation of Three Research Propositions to the Policy Paradigm

Janardan Krishna Yadav, Deepika Chandra Verma, Srinivas Jangirala, and Shashi Kant Srivastava

Abstract This paper extends Önder and Treiblmaier (Ann Tourism Res 72:180–182, 2018's [1]) propositions regarding blockchain's integration with tourism to valorize the policy angle. This is because policy across countries on blockchain is different. This difference is because of varied levels and stages of acceptance due to differential trust in a distribute ledger.

Keywords Blockchain · Tourism · Policy · Disintermediation · Trust

1 Introduction

Önder and Treiblmaier's [1] have initiated scholarly work on tourism and Blockchain technology. We use their work to bring into discussion the role of national policy on Blockchain and tourism research. Tourism today is tending towards smart tourism [2]. 'Smart' is understood as synchronous operational data, its integration, sharing, modelling, and visualization for better real-time decisions that create value for the end user [3]. It goes beyond the traditional use of internet enabled bookings and record maintenance. In practice, bringing ease to combine lifecycle experience of tourism to create a *wow* experience for the tourists.

This paradigm shift in tourism industry requires large amount of consumer data for better tourist profiling and customized touristic experiences for nearly accurate personalized market offerings. Further, customer-to-customer (C2C) business

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models [4] and peer feedback [5] have also introduced additional intermediaries that work on data aggregation to bring trust into the tourism supply chain.

This very detailed and intimate data about tourists, poses a challenge of data storage and security as the data can be manipulated and misused. Tourism literature recognizes blockchain technology's decentralized and immutable character to support the trust and reputation of tourism companies in the decentralized marketplace [6], where traditional *structural agents*, e.g. 'banks' for transactions, 'quality assurance agents' like TripAdvisor, risk mitigating insurance companies etc. become irrelevant [7].

In the hypothesized tourism supply chain, monetary requirements of tourists are met by cryptocurrencies. Cryptocurrencies are borderless that implies that they are beyond the control and management of conventional monetary policy instruments of central banks like creation of additional cryptocurrencies, fixing interest rates to regulate circulation etc. [8]. In blockchain and tourism research, the role of national policy becomes critical as the anonymity of agents who transact in cryptocurrencies is understood to be used as a means of money laundering, black marketeering, buying and selling of illegal weapons, terrorism financing, drug dealing and human trafficking [9]. In such instances, countries may choose to ban or block cryptocurrencies' exchange. In economies where cryptocurrencies are not banned, their status may differ[1] which may lead to issues in completing certain type of transactions across countries, the usual situation in tourism.

While there has been an increase in the scholarly literature on the intersection of Blockchain and Tourism (more than 8000 Google scholar results), the number of papers published in this area in tourism journals since 2018 are scarce. Thus, theoretical frameworks and refinement of research propositions are still needed to create a comprehensive agenda for tourism-blockchain research.

In this research note we extend three propositions by Önder & Treiblmaier's [1] to urge the researchers within the tourism community to assign a permanent place for the discourse on the divergent policy stance across countries while engaging with the discourse on blockchain and tourism.

2 Propositions

2.1 Propositions 1

It is theoretically recognized that blockchain technology can solve issues of trustworthiness of online consumer reviews of tourism products like hotels, restaurants, and travel agents from manipulation [7]. This is because reviews will be a part of immutable blockchain in a distributed network.

[1] Recognized as money, near money assets, assets, property, limited to transacting in the share market etc.

There are possibilities of blockchain technologies in starting new forms of evaluations and review mechanisms that will lead to trustworthy rating systems. There are possibilities of users with access to multiple computing devices who can very easily maintain multiple identities and duplicate reviews even in a blockchain setup using identity management schemes (IdMs) [10]. The breakdown of blockchain in case of dishonest nodes taking over may also arise [11].

However, given the features and improved protocols of blockchain technology, these instances would also get detected fairly quickly [11, 12]. This does not mean that the use of blockchain has little worth in increasing trustworthiness of online consumer reviews of tourism products. Blockchain technology when used with policy support to address grievances in case of breakdown of the technology at any point can improve trustworthiness of the rating systems within the tourism industry. Therefore, we extend Önder & Treiblmaier's [1] proposition as follows:

Research Proposition 1: New forms of evaluations and review technologies will lead to trustworthy rating systems *if there is adequate support to address instances of multiple identities and complete breakdown.*

2.2 Propositions 2

Tourism as an industry often deals with international transfers of money, and transacting with unknown agents like hotels, airlines, tour groups local to the travel destination which requires trustworthy institutions and contracts. This is insured by institutions like banks that act as trusted intermediaries that charge fees for services rendered.

Cryptocurrencies and smart contracts based on blockchain technology allow for the quick, easy and trustworthy transactions with much lower transaction fees. The scope of such cross-border transactions can get limited due to the differences in the policy stance on cryptocurrencies in different countries. Two issues may arise here. First, differences in the policy stance itself across countries that may hinder transacting in cryptocurrencies. If transacting in cryptocurrencies is illegal, banned or strongly advised against by the central bank of either of the countries, then there is no scope for using such a solution. Second, even if transacting in cryptocurrencies is legal in the destination countries, the scope for blockchain based transactions may be limited due to a difference in classification of cryptocurrencies on the basis of their usage-asset, property, or legal fiat [13].

Research Proposition 2: The widespread adoption of cryptocurrencies will lead to new types of C2C markets *provided, the same legal status is enjoyed by cryptocurrencies across countries.*

2.3 Propositions 3

Tourism literature has touted disintermediation as one of the most prominent impacts of blockchain within the tourism industry. Multiple intermediaries such as Physical Travel Agents, Online Travel Agents (OTAs), C2C and Global Distribution Systems (GDS) are likely to lose their place as prominent agents of the tourism industry because of the promise of increased ease of transactions and removal of commissions. Additional value for tourists can be realized by reducing the power gap by relying on distributed network where each node has the same power. The possibility of this change in the tourism industry is limited to the extent to which the user may participate and the fact that there are supporting institutions across countries to facilitate resolution of issues that may occur as is the case with existing intermediaries like consumers' grievance redressal forums that may also act as tribunals for dispute resolution. This again, is possible if and only if the legality of cryptocurrencies and blockchain supported institutions is not questioned by the laws of the land of the home and destination countries.

Research Proposition 3: Blockchain technology will lead to increased disintermediation in the tourism industry *if towards cryptocurrencies and blockchain are clear and supportive.*

Önder and Treiblmaier [1] have sparked a relevant debate in tourism regarding the scope of blockchain's usage and future impact on the tourism and hospitality industry [7, 14]. This research note extends the viewpoint by emphasizing the pressing issue of divergence in policy paradigm on cryptocurrencies and blockchain technology (in association) across countries.

The possible transition to increased blockchain use in tourism does have tremendous potential, but in practice, may get mired due to national policy differences on Blockchain technology in different countries. This research is an attempt to stimulate academic discussions on policy paradigm of countries on Blockchain technology in reference to tourism industry.

3 Conclusions

In this research note we have extended three propositions by Önder & Treiblmaier's [1] to highlight the role of policy in the discourse on blockchain and tourism. We highlight this positioning through the revisions we propose in the propositions of Önder and Treiblmaier [1].

In this work we extend Önder and Treiblmaier's [1] propositions as follows:

1. New forms of evaluations and review technologies will lead to trustworthy rating systems if there is adequate policy support to address instances of multiple identities and complete breakdown.

2. The widespread adoption of cryptocurrencies will lead to new types of C2C markets provided, the same legal status is enjoyed by cryptocurrencies across countries.
3. Blockchain technology will lead to increased disintermediation in the tourism industry if the policy towards cryptocurrencies and blockchain are clear and supportive.

This work is relevant in drawing out the nuanced issues in the adoption and diffusion of cryptocurrencies as financial innovations. Future researchers can focus on the interlinkages of the related variables.

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A Literature Survey on Speech Enhancement Based on Deep Neural Network Technique

Ramesh Nuthakki, Payel Masanta, and T. N. Yukta

Abstract Speech enhancement is the process of treating noisy speech signals to improve human perception as well as improve system understanding of the signal. To keep the signal undistorted while also reducing noise is a difficult task, which results in a limited performance of speech enhancement systems. For speech signals having medium or high signal to noise ratio value, the aim is to come up with subjectively practical signals, and for signals with low SNR, the aim is to reduce noise level while still retaining the intelligibility. Many noise reduction algorithms improve overall speech quality but little progress has been made to improve speech intelligibility. In this paper the necessity of speech enhancement, its different applications, overview of classification and various methods associated with it has been presented and a substantial literature review on such speech enhancement systems with various methods and platforms is done. Deep convolution neural network-based speech enhancement system is intended by optimizing the loss functions like Extended Short-Time Objective Intelligibility and Mean Square Error. The loss function required for training it are optimized using Harris Hawk Optimization.

Keywords Speech enhancement · Deep convolution neural network · Non-stationary noise · Intelligibility · Noise reduction · Mean square error · Harris Hawks optimization · Extended short-time objective intelligibility

1 Introduction

Speech separation is the process of segregating the desired speech from unwanted noise and interference. It is an important task in signal processing and is used in a variety of applications, such as mobile telecommunication, hearing prosthesis and vigorous speech recognition and speaker dependent applications. The human sensory

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system has an extra-ordinary capability to bring out one particular origin of the sound from a combination of more than one sources. In an acoustic environment, we are capable of effectively listening to one speaker amongst many other speakers and environmental background interferences. Whereas speech enhancement can be defined as the process of improving perceptual features like speech quality, degree of listener fatigue and speech intelligibility. Speech intelligibility is defined as how comprehensible is a speaker's speech to the listener. Therefore, the Speech enhancement algorithms which improve speech intelligibility and quality of single-channel recordings of noisy speech is used in a broad range of applications. Most common solutions of speech enhancement are based on Analysis Modification Synthesis (AMS), in which a Short-Term Fourier Transform (STFT) is used in the part of the analysis to improve the performance in the spectral domain. Discrete-time noisy signals are segmented in short term frames by the help of 50% Hanning Window [1]. The previous noisy speech stage is applied to the transformed magnitude/power domain and the time waveform is synthesized from it. To obtain the enhanced speech the synthesized short time waveforms are applied with a 50% overlap between adjacent frames [2].

2 Literature Review

Boll [3] proposed a stand-alone noise suppression technique which decreases the spectral effects of acoustically appended noisy speech signal. In pragmatic environments, the productive performance of digital speech processors operation may need suppression of noise from the digital waveform. Spectral subtraction provides an effective and processor independent procedure to effectively perform the digital speech analysis. The technique requires about an equivalent computation like high-speed convolution to put down stationary noise in a speech signal by taking difference from the spectral noise bias which is estimated during non-speech activities. Then the secondary procedures are put in application to scale back the effect of ground noise by reducing the residual noise, half-wave rectification and attenuating the extra signal during non-speech phase. Since their algorithm re-synthesizes the waveform for speech signal, it is often used as a pre-processor to narrow-band speech recognition systems, communications via voice or speaker authentication systems. The diagram of the proposed algorithm is shown in Fig. 1.

The result of the half-wave rectifier is the noise distortion, calculated at that frequency to filter down the magnitude scale at each frequency. The bias value is modified for different frequencies and time windows of study. The noticeable outcomes of the noise residue are reduced by using its frame-to-frame changeability. In fact, at a certain input frequency, since the noise residue at each frame of the analysis will randomly vary in amplitude, it is removed by interchanging its present value with the minimum value selected from the neighboring frames of the analysis. Signal control during non-speech activity is the ultimate change in noise reduction as the equilibrium has to be established between the frequency and features of the noise recognized during speech activity and the noise sensed during absence of speech.

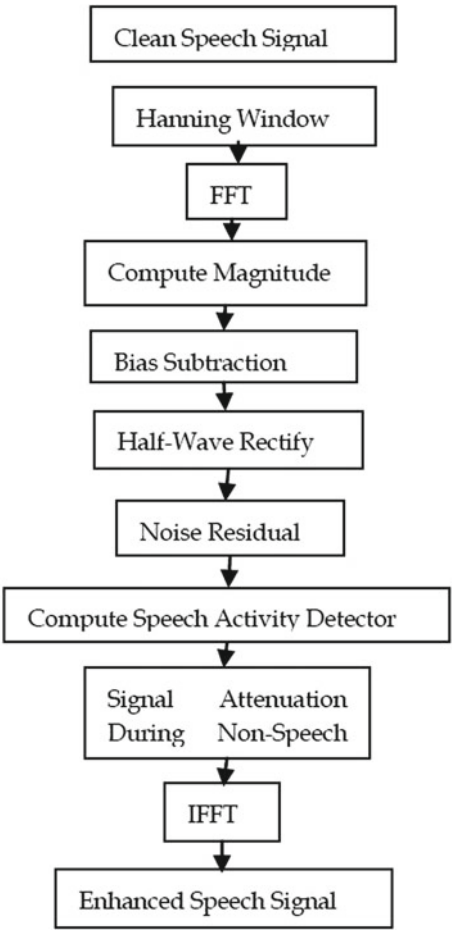

Fig. 1 Block diagram of spectral subtraction

Berouti et al. [4] introduced a system for enhancement of the speech which was manipulated by broadband noise on the basis of spectral noise subtraction technique. The authentic technique means taking the difference between an approximate of the noise power spectra and the speech power spectra, substituting the non-positive differences with zero, reconnecting the resulting power spectra with the actual phase, and finally reconstruction of the time waveform. This technique not only suppresses the broadband noise, sometimes it instigates a disturbing "musical noise" as well. Thus, they have come up with a process that put an end to this "musical noise" while further suppressing the interferences occurring in the background as shown in Fig. 2. The technique consists of subtraction of an overestimation of the noise power spectra and blocking the resulting spectral parameters from decreasing further from a predetermined minimum level (i.e., spectral floor). First, they exclude a factor α (over subtraction factor) from the noise spectrum where α differs for various frames. Second, they prohibit the filtered signal's spectral parameters from decreasing under

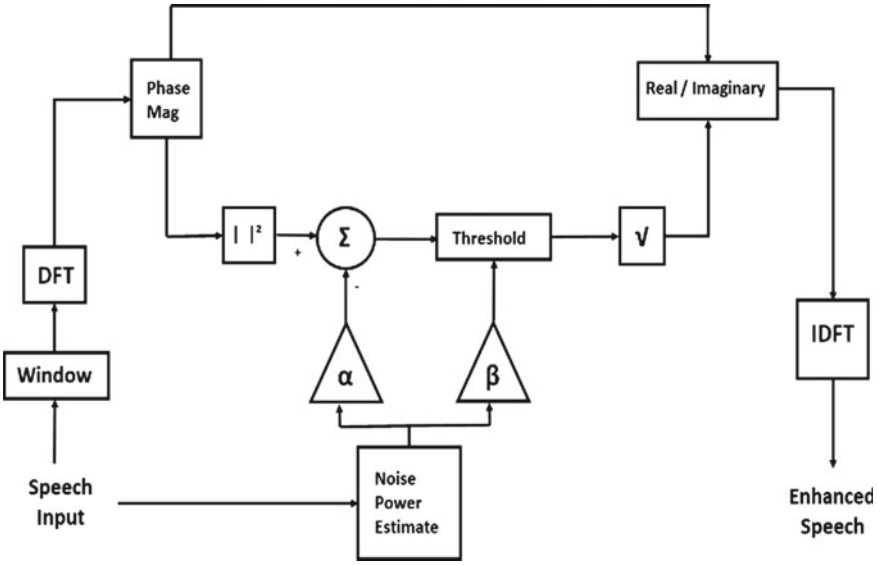

Fig. 2 Power spectral subtraction with spectral floor

a certain minimum preset level β. This technique automatically adapts to a broad range of SNRs, as long as a fair approximation of the noise spectra can be found.

Peyman Goli [5] has proposed a method to boost the traditional MSE cost function to highlight the improvement of intelligibility of speech in speech enhancement systems that are deep neural network dependent. He does so by using a band-importance function based weighted MSE cost function to examine the effective offering of the frequency bands to the intelligibility of speech during the initial training stage. The band importance function is a value describing the relative significance of various frequencies to intelligibility of speech. The band importance value of each frequency lies between 0.0 and 1.0. A value of 1.0 signifies 100% importance. Upon experimentation the results display that the suggested MSE remarkably upgrades the intelligibility of speech, measured in terms of CSII and STOI, in comparison with raw noisy speech at all SNRs. The STOI advancements demonstrate that the mentioned cost function upgrades the cross correlation between the estimated speeches and temporal envelopes of the good over 1/3rd octave frequency bands.

The outcome also shows in various turbulent conditions, even though the mentioned mean square error cost function is way more advanced to the traditional mean square error cost function in the improvement of intelligibility of the speech, it's not the case for speech quality. Although using the proposed MSE leads to improvement in quality over raw noisy speech mostly at lower SNRs, the conventional MSE surpasses the performance of PROP in most of the noisy conditions in PESQ- Perceptual Evaluation of Speech Quality and SD- Spectral Distortion. In the suggested cost function, there is a weighted constraint being used which leads to the decrease in the quality scores of PESQ and SD. This mostly evaluates the quality on the basis of the

difference between clean speeches and the enhanced spectrum, which in comparison with the un-weighted situation improves the separation in all frequencies.

Chung et al. [6] have suggested a noise-adaptive feed-forward DNN technique for enhancing a single-channel speech. The target was to make better use of independent characteristics of noise during the training process of a spectral mapping DNN. They employed adaptation vectors depending on noise, that are procured on the basis of the result of an auxiliary noise classification DNN, to balance the biases and weights of the DNN with three hidden layers for mapping the spectrum. They have divided their work in two stages, i.e., the training stage and the enhancement stage. The specification of the mapped spectrum and classification of noise and adaptation vectors are approximated together throughout the training process. While enhancing the speech, they came up with a combination of a traditional unsupervised algorithm used for enhancing the speech with the suggested DNN dependent procedure to further upgrade the enhanced quality of speech.

Xu et al. [7], in contrast to the conventional noise reduction techniques like minimum mean square error (MMSE), they have proposed a superintendent method for speech enhancement by means of discovering a mapping function within interfering speech signals and clean speech signals developed on DNNs. To tackle a broader scope of additive noises in an environment, a broad training set which consists of many practical mixtures of interference and speech signals is created. Several solutions have been suggested to reinforce the overall speech enhancement techniques that are based on deep neural network, together with a global variance equalization technique to scale back the occurring over smoothing issue of the regression model and thus the dropout and awarding noise training methodologies to additionally upgrade the generalization capability of DNNs to unseen condition. Demonstration findings illustrate that the suggested structure is ready to make significant developments in both objective as well as subjective measures against the normal methods based on MMSE. It was found that the suggested DNN method can properly subdue highly non-stationary noise, that is generally a challenging part. Besides, the developed DNN model is trained with artificially manufactured data, which is additionally effective in handling interfering speech data recorded in actual environments.

Huang et al. [8] have used a joint optimization technique consisting of two deep learning features (i.e. deep and recurrent neural networks) with an additional masking layer, for reconstructing the desired spectrum. Additionally, after taking the output from the network and determining the masking outcomes, they integrated the masking function directly with the neural network. Because the binary mask function isn't smooth, they proposed the direct integration of the soft time–frequency masking function. Further, an additional layer was added to the authentic outcome of the network.

Kolbæk et al. [9] have investigated and explored the generalizability of a Speech Enhancement technique on the basis of deep neural network. Specifically, the performance of noise specific, speaker specific and SNR systems has been studied, for noise general, speaker general and SNR general systems, respectively. Moreover, the performance of these systems for only one DNN based speech enhancement system has been studied first, it is created to be noise type, speaker type and SNR general.

This proposed system and a Short-Time Spectral Amplitude Minimum Mean Square Error (STSA-MMSE) based speech enhancement method are compared. Results show that specialized speech enhancement systems which are based on DNNs, are trained only on one type of noise, single speaker or single SNR, perform better than conventional speech enhancement systems, which are trained on a broad range of the same parameters in terms of determined Speech Quality (SQ) as well as estimated speech intelligibility (SI).

Fu et al. [10] have an end-to-end utterance-based speech enhancement structure to scale back the difference between the represented optimization and therefore the estimation criterion using fully convolutional neural networks (FCNN). For a demonstration, they have implemented the suggested FCN framework which enhances the measurement of STOI. The results of the demonstration show that the Short Time Objective Intelligibility (STOI) of an experiment speech processed by the suggested method was really finer than traditional MSE-optimized speech thanks to the stability between the training and the estimated result. Further, the human subjects' intelligibility and robotic automated speech recognition systems were also advanced by uniting STOI with the model optimization in comparison with those which were produced by minimum MSE criterion.

Gelderblom et al. [11] compared two speech enhancement techniques that are developed on the basis of deep neural networks. The quality of the speech as well as the intelligibility of the speech for both techniques are investigated using subjective measures by conducting a test for speech recognition depending on Hagerman sentences and a few translations from the ITU-T P.835 recommended speech, respectively. The outcomes and the objective measures Short-Time Objective Intelligibility (STOI) and Perceptual Objective Listening Quality Analysis (POLQA) were compared. None of the STOI and POLQA correctly estimated subjective outcomes. While STOI predicted advancement, the subjective test results for both the systems showed some amount of degradation in intelligibility of the speech. POLQA outcomes were overall barely influenced, while the subjective measure outcomes revealed notable changes in overall quality, in negative as well as positive ways, in most of the tests. One of their models was trained to eliminate all the interferences which is an approach commonly seen in the literature of speech enhancement systems.

Jensen et al. [12] have proposed an algorithm which predicts the monaural intelligibility, that holds the capability to replace a few of the auditory sound tests. The suggested technique is similar to the STOI algorithm but unlike STOI it gives output for a bigger scale of input signals. First, they obtained the time–frequency normalized spectrogram and then computed the intelligibility index. It can be observed that ESTOI are often implemented with regards to an orthogonal decomposition of short-time spectrograms into intelligibility subspaces, i.e., a ranking of spectrogram characteristics in agreement with their significance to intelligibility.

Lee et al. [13] have proposed a combined algorithm for deep learning which upskills the estimated value through its variables which are parameterized so as to attenuate the unavoidable error generated by the truncation process. Specifically, they have designed a system that precisely aims at three parameterized variables which

are speech magnitude spectrum, noise magnitude spectrum, and phase difference of unpolluted speech to noise spectrum. Furthermore, to upgrade the performance, they have also investigated the change in dynamic scope of magnitude spectrum managed by a warping function that affects the ultimate outcome in joint deep learning techniques. In the end, they have inspected how the suggested constraint that maintains the aggregate of the estimated speech and noise power spectrum affects the general system performance. The outcomes of the demonstration exhibit that the suggested algorithm surpasses the performance of the traditional algorithm with the truncated phase-sensitive estimation.

Kolbaek et al. [14] have proposed an interconnection between STOI and Short Time Spectral Amplitude Mean Square Error for enhancing the speech. Results show that, for some inferior to widespread conditions, the STSA-MSE and ELC criteria are reasonably similar, and their theoretical claims are supported by empirical data outcomes. Besides, their experimental results show that the quality STSA minimum-MSE estimator was almost flawless provided the target is to reinforce interference speech in a manner, which is perfect with reference to the STOI intelligibility estimator. Maximization of an approximate STOI criteria and minimization of STSA-MSE criteria are the same for some conditions. First, they implement a STFT domain-based speech enhancement system, where the gain factor is computed by either using the conventional STSA-MMSE system or methods which uses machine learning like deep neural network or recurrent neural network. Then they estimate the STOI for various length of the envelope. They have developed an estimator which determines the linear correlation of the envelope. They used two different types of systems for the enhancement process i.e., ELC and MSE each consisting of fifteen feed forward deep neural network.

In the present speech separation techniques, which are based on deep neural networks, a well-liked option for a loss function is the Mean Square Error (MSE). Naithani et al. [15] have proposed a replacement cost function with the goal of advancing the ESTOI measurement. They specialized in implementations where less latency ($\leq$ 10 ms) of the algorithm is vital. They used Long Short Time Memory system (LSTM) and evaluated the suggested method on four different datasets with two speaker combinations from expanded Danish speeches in noise (HINT) dataset. They demonstrated that the suggested loss function shows improvement or neck to neck intelligibility with regards to ESTOI in comparison with an MSE based optimization method while leading to lesser objective separation performance with regards to the source to distortion ratio (SDR). Then proposed a method where they first initialize the system with weights developed for MSE criteria then upskilled with the suggested ESTOI loss criteria. This method reduces the amount of loss in objective separation performance and also maintains the gain in the intelligibility.

Anurag and Dinei [16] deal with upgrading the quality of speech in an office environment where many combinations of stationary noise and non-stationary noise can be found in speech signals at the same time. They proposed many schemes developed on DNN for enhancing speech in such conditions. They analyzed the fruitfulness of DNN architectures for enhancing speech in various noisy environments; in which the noise can either be stationary or even non- stationary as well as a mixture of both.

Outcomes showed that techniques using DNN for enhancing speech in these complicated situations can perform exceptionally well. Their best model gave a mean PESQ gain of 23:97% over all tested SNRs. For lower SNR values, the value is almost 30%, which is very superior to conventional techniques like MMSE based methods. They indicated that augmenting noise cues to the network surely aids enhancement. They furthermore suggested using a running approximate of noise in all the frames for augmentation, which resulted in especially valuable effects at lower SNRs. This is anticipated as most of the noise samples used in the test cases are non-stationary in nature and at low SNR levels, these controlling noise signals must be determined for each and every frame. They have also suggested a sound perception based weighted error training of the suggested method.

3 Proposed Methodology

We intend to propose an MSE and ESTOI based loss objective function for optimizing intelligibility performance of DCNN-HHO based speech separation systems for an efficient speech enhancement system. In this method a new speech enhancement framework is designed with the help of DCNN as shown in Fig. 3. The parameter of the loss objective function utilized in DCNN is optimized by using the Harries Hawks Optimization algorithm [17] to have a better speech result. The HHO is purely inspired by the nature. The major inspiration of this is the cooperative nature of Harris' Hawks while chasing a prey. It has an exploration phase and an exploitation phase. Intelligibility listening tests are essential while developing and evaluating speech processing algorithms. Here the proposed monaural intelligibility prediction algorithm works for a wider range of input speech signals and it does

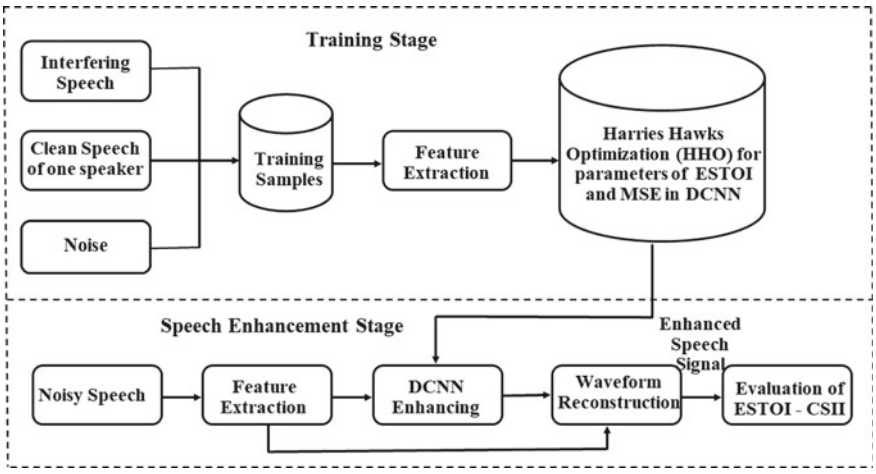

Fig. 3 Proposed block diagram of speech enhancement system using DCNN-HHO technique

not assume mutual independence between frequency bands. The evaluation metric for measuring speech intelligibility is based on an ESTOI measure and the frame-based Mean Square Error (MSE) between estimated signal and speech [18]. The proposed approach includes spectral correlation by comparing the length of spectrograms of clean speech signals and the noisy or processed speech signals. The proposed approach which will be implemented in MATLAB can accurately estimate the intelligibility of speech corrupted by temporally highly modulated noise sources.

4 Conclusion

DNN based on supervised learning provide effective speech enhancement compared to conventional speech enhancement techniques. The performance of the proposed approach will be compared for several noises such as babble, car and helicopter noise for varying SNR levels of −5, 0, 5, 10, 15 and 20 dB correspondingly. Enhancing speech signals encountered in day-to-day life, which are degraded by multiple types of non-stationary noises, is challenging. ESTOI-MSE metrics will be used for evaluation of speech intelligibility that are source to distortion ratio (SDR), source to interference ratio (SIR) and source to artefact ratio (SAR) and it is predicted that speech intelligibility performance can be improved by the proposed method. We know that the quality of DNN improves when more data and larger networks are being applied, therefore, when larger data set and higher computational power will be available in the future, the speech quality and speech intelligibility performance of DNN based speech enhancement systems are expected to improve.

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A Comparative Study of Students Online Learning During Pandemic Using Machine Learning Model

Prit Vasiyani, P. Prakash, and V. Sakthivel

Abstract As we know that COVID-19 Pandemic persists and it is resilient for students to attend classroom due to health concerns. Almost every academic institution has shifted towards an online education system. It is mandatory to encounter problems which are usually faced by students during online education. A survey was conducted to spot whether a student is contented with this new era of online education or not, by foreseeing the complications and outcomes of online education. A questionnaire with variegated sections was shared among students to cover supplementary issues faced by them and a response about the same was received from 263 students in total. Proposed model of classification will acquire data for training from the survey. It will predict the sentiment of students towards online education. Along with the model, the survey data is useful to discover additional problems faced by students and also do the needful in favor of students.

Keywords Classification · Comparison · COVID-19 · E-learning · Machine learning · Online education

1 Introduction

As the Novel Coronavirus (COVID-19) cases are rising day to day, governments around the world have entailed some steps to prevent the proliferation of this highly contagious virus by imposing lockdown, avoiding direct communications as well as restrictions on immigration of tourists. Simultaneously, it altered the institutions towards online education which in turn affected students all over the world.

The Indian Government imposed lockdown starting from 25th March, 2020 to 14th April, 2020 and the period was further elongated till 31st May, 2020 with a few conditional relaxations in some ill-affected areas. The situation resulted in closures of every educational institutes. Though, government had started lifting up on the restrictions, yet COVID-19 cases escalated; hence along with the government, the

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educational academies stood firm to stymie the spread of virus among students. In India, as of 15th November, 2020 many of the schooling institutions have still not been permitted to start with their classroom coaching and so they carry on with the Online Educational System for students to keep them engaged with their academics.

In Online Education students can attend their classes from a congenial environment. For Online Education, institutes are using online communication tools like Google Meet, Microsoft Teams, Cisco WebEx Meetings and many more. There are numerous learning management systems available like Moodle, Google Classrooms, Hurix and the like. Students can additionally use Massive Open Online Courses (MOOCs) or SWAYAM (Initiative by Government of India) for online distance-learning [1]. As lockdown has affected almost 32 Million students in India, the future of the educational coaching is inclined towards e-learning up to a larger extent [2]. It is obligatory to incorporate students' choices as well as issues faced by them regarding above stated educational system.

2 Literature Review

Bae has proposed a framework to intensify conveyance through online learning [3]. It ascertains about the future being more challenging due to more inclination towards online learning. It is suggesting enhanced learning management system and blended learning approach for the same. Blended learning is a combination of multiple learning methods such as classroom learning, online live learning and self-paced online learning. It is suggesting a universal model which helps to improve learning delivery methods for different learning styles.

Kapasia has undertaken a survey to find the impact of lockdown on college students in West Bengal [4]. It contains an analysis of the data collected from the survey to find the status of learning of the students, problems faced, economic condition, health and lecture information. There are 232 participants for the survey which includes students of graduation and post-graduation. It is found that 70% of the total participants are associated with online learning during lockdown. 42% of the participants facing stress and anxiety problems during lockdown. Other than this, some of them not having proper resources or environment.

Lall has carried out an assessment of the students for the online education along with the reasons for their likes and dislikes [5]. There are 200 participants for this assessment. Assessment was carried out through forms. Most commonly stated problems by participants with online class were lack of co-curricular activities, Unable to meet friends and lack of communication.

Nabi has worked out on performance analysis of Logistic Regression, Naïve Bayes, Decision tree and Random forest classification with pima Indian diabetes dataset [6]. The dataset contains 768 records. It is using feature subset selection to reduce the dimensions of the dataset. Then it gets divided into training and testing part. Different algorithms are applied on the data and evaluated for the selection of algorithm. Algorithm with more accurate result is chosen for classifier. As a

result of this study, Logistic regression has higher accuracy compared to other three classification algorithms.

Daoud has compared sundry of boosting algorithms including XGBoost, Light Gradient Boosting Machine and CatBoost [7]. It has utilized home credit dataset which has 216 features and 356K records. It is using 5-fold cross validation process. Conclusions of this study indicates that Light Gradient Boosting Machine has more AUC (Area Under Curve) and demands lesser training time by using number of features and records compared to other two boosting algorithms.

Abhilasha has proposed a logistic regression based sentiment analysis approach with word score heuristics [8]. It explains distinct classifiers such as Logistic Regression, Naïve Bayes and Support Vector Machine. They have used K-Fold Cross Validation for encountering better accuracy, and is not involving any comparison of the algorithms or implementation. They have done preprocessing for removing hashtags, full stop and repeated letters. Then Effective Word Score heuristic approach is used for preprocessed data. List of most frequent words with their polarity is maintained with the assumption that any synonym in the list won't have same polarity score.

Khushbu has put forward a study of Support Vector Machine (SVM) and Neural Network (NN) Approach for classification of data [9]. It contains the advantages and disadvantages of using SVM and NN for Data classification. It involves some literature reviews regarding the classification and management of data with NN such as Convolution NN, Feed Forward NN, Deep NN and SVM approaches for different datasets which includes PolSAR Data, Iris Dataset, Turkish Text Datasets, Cancer and Speech Dataset. Some literatures have suggested hybrid approach consists of SVM and NN for better accurate results.

Alzamzami has ascertained a comparative study of boosting algorithms for general sentiment classification on short texts [10]. They have used Domain-Free Sentiment Multimedia Dataset which was collected using Twitter Stream API. Then the data is pre-processed for discarding the special characters and numbers by manipulating some linguistic hints, lexicons, hashtags, and attributes like Bag-of-Words. They have used multiple classification algorithms for Sentiment Classification such as Logistic Regression, Multinomial Naïve Bayes, SVM, Random Forest, XGBoost, LightGBM and MLP. In the results, LightGBM has highest accuracy i.e. 71.79% followed by Logistic Regression with 71.1% accuracy.

Surendheran has proposed a model with logistic regression which ascertain academic performance of management students [11]. They have collected academic information from 64 students of the institute as a sample. They have carried out hypothesis testing and correlation test to check association of class variable with other features in the dataset. After that, they formed logistic regression model which gives 82.81% accuracy.

Prabhat has ascertained a comparative study of Logistic Regression and Naïve Bayes for classification of sentiments [12]. They have used real time reviews from twitter. Data is preprocessed in the first step and then feature selection is done with feature vector list. Then preprocessed data is trained using Logistic Regression and Naïve Bayes algorithms. As a result, Logistic Regression gives 76.76% accuracy and Naïve Bayes gives 66.66% accuracy.

3 Methodology

The following section explain various steps involved in the proposed system. The step-by-step process of the system is depicted in Fig. 1. It starts with collection of the data. The collected data is then pre-processed to make it useful. Now the pre-processed data is fed into the models such as logistic regression, support vector machine, light gradient boosting machine, or mixture of these models for predicting students' choice on online education. Accuracy, precision and many more metrics are used for evaluation of the model.

3.1 Dataset

Dataset is organized in a CSV file format which contains data collected from a survey that was conducted using google forms to acquire information from students. A questionnaire was shared among students through WhatsApp and E-mail. A response from 263 students in total was received for the survey. The questionnaire comprises of questions about the family background, geographical background, students' outlook

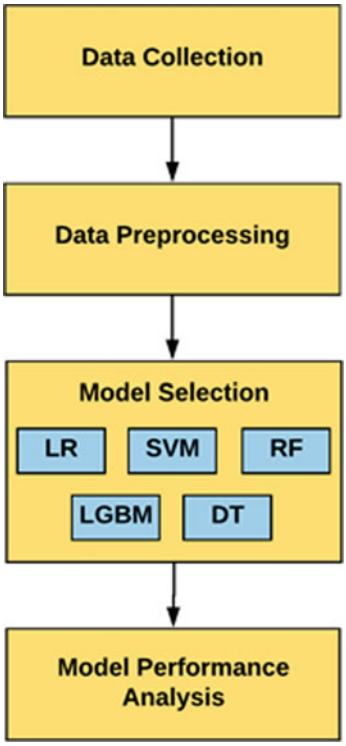

Fig. 1 Flow of the system

about a particular statement, whether they agree or not on that statement et al. It also contains issues faced by the students while learning.

3.2 Data Preprocessing

Data in the raw form has improper names of columns, therefore all the columns are renamed for better understanding and ease. As a part of preprocessing, one hot encoding is used as the raw data which is able to derive categorical features. All the features are converted to binary form and data is converted to 0's and 1's.

4 Models

4.1 Logistic Regression

Logistic regression is best and simple method to predict the label in classification. It finds the decision boundaries in feature space and based on those boundaries it will try to predict the label. In binary classification, sigmoid function is applied on given inputs.

4.2 Support Vector Machine (SVM)

SVM is classification algorithm which follows concepts of linear classification. Basic concept behind SVM is to separate the data into the classes using a line or a hyperplane. It spots out the closest point from the line i.e. support vectors and tries to maximize the distance between support vectors and hyperplane. Hyperplane with maximum margin is considered as Optimal Hyperplane and It is used as decision boundaries to separate each class.

4.3 Light Gradient Boosting Machine (LGBM)

Light Gradient Boosting Machine (LGBM) build trees vertically by using leaf-wise algorithm [13]. The tree is further grown by splitting a leaf which encounters the least amount of loss. It uses Gradient-based One-Side Sampling to indicate importance of each instance of data. It assumes that data with lower gradients have less errors, therefore GOSS ignores these and use the rest for finding best splits. To overcome

this biasness toward larger gradients, it performs random sampling and then it will increase the weight of data instances with smaller gradients for computation of gain.

4.4 Random Forest

Random forest is a classification algorithm which uses a tree-based ensemble approach for classification. It allows the trees to be grown to its maximum depth and trained using random samples of the data. Each learnt tree in the forest is weak learner and it will get combined to create a strong learner. Majority Voting is used for computing the final decision for classification.

4.5 Decision Tree

Decision Tree is tree-based algorithm which uses information gain for finding the best split and based on that it splits the nodes in the decision tree. It is slower compared to other classification models and requires more time for computation for complex data.

5 Comparison of Models

Models are compared with train size 0.7 and test size 0.3. Pre-processed data is fed into the model and used for training and testing. It utilizes k-fold cross validation method for cross-validation and the values of the evaluation score shown in Table 1 is the mean score of all the folds. Number of folds are 10.

Table 1 Comparison table of different models

Classifier	Accuracy	Precision	Recall	F1 Score
Decision tree	0.6675	0.6008	0.6500	0.6178
Light gradient boosting Machine	0.7222	0.7071	0.6500	0.6636
Logistic regression	0.7822	0.7656	0.7125	0.7302
Random forest	0.7228	0.6940	0.6625	0.6628
Support vector machine	0.7056	0.6857	0.7000	0.6563

5.1 Metrics for Evaluation

Following metrics are used for evaluation of the models. TP and TN is True Positive and True Negative values which has same Actual and Predicted Class while FN and FP is false negative and false positive which contains different Actual and Predicted Class. Following Eqs. 1–4 are used for calculating evaluation metrics for a model.

Accuracy

$$Accuracy = (TP + TN)/(TP + FP + TN + FN) \tag{1}$$

Precision

$$Precision = (TP)/(TP + FP) \tag{2}$$

Recall

$$Recall = (TP)/(TP + FN) \tag{3}$$

F1 Score

$$F1\ Score = (2 * P * R)/(P + R) \tag{4}$$

where, P = Precision and R = Recall.

5.2 Results

Figures 2, 3, 4 and 5 depicts ROC (Receiver Operating Characteristic) Curve for all classifiers except Linear SVM.

In Figs. 2, 3, 4 and 5, it is showing better ROC Curve for Logistic Regression compared to other classifiers.

6 Future Work

This study can be further expanded by using a hybrid model which is the combination of multiple classification approaches which results in better accuracy score compared to these models. A hybrid model with multi-label classification can be developed which helps in predicting the sentiments of the student in online education for learning as well as for examinations separately. These models are used for small dataset.

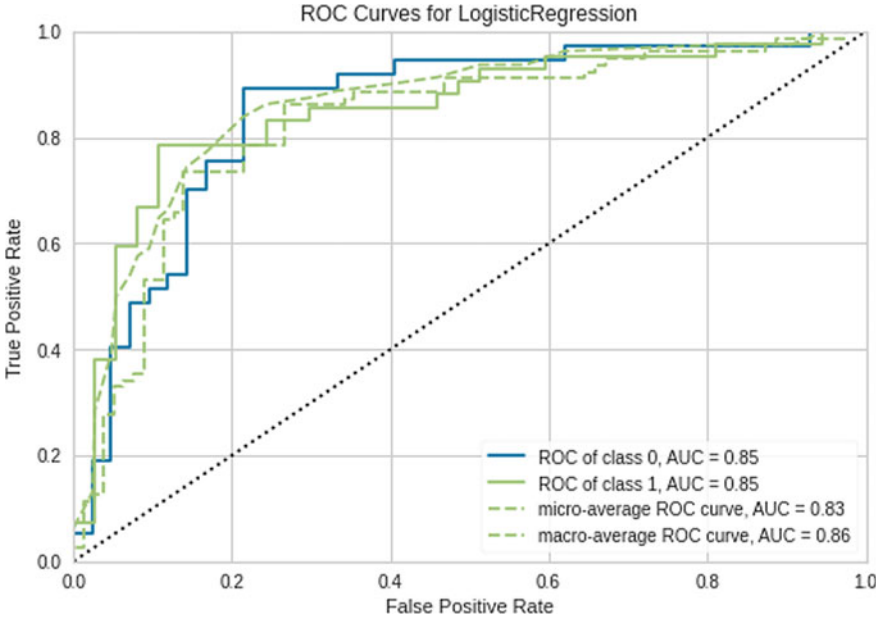

Fig. 2 ROC curve for logistic regression

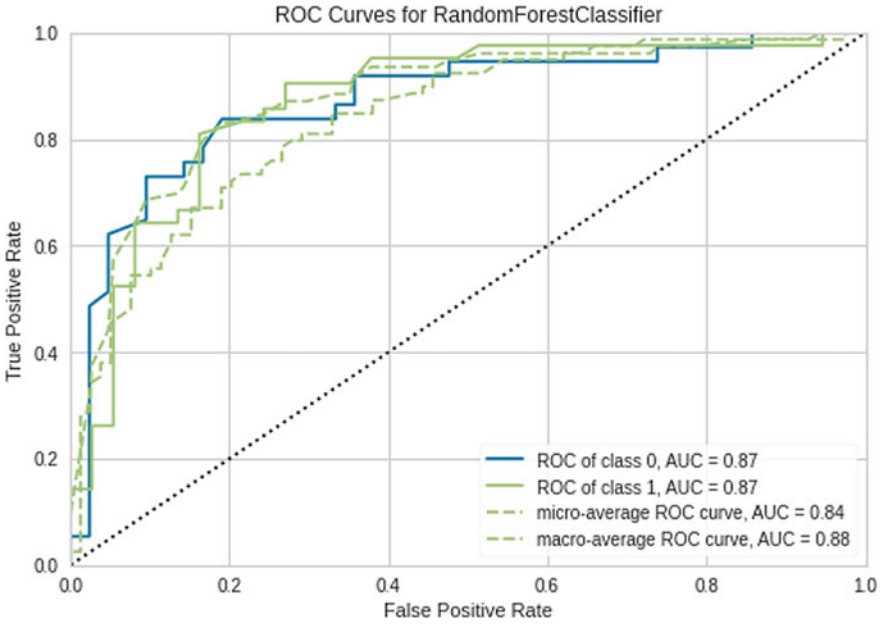

Fig. 3 ROC curve for random forest

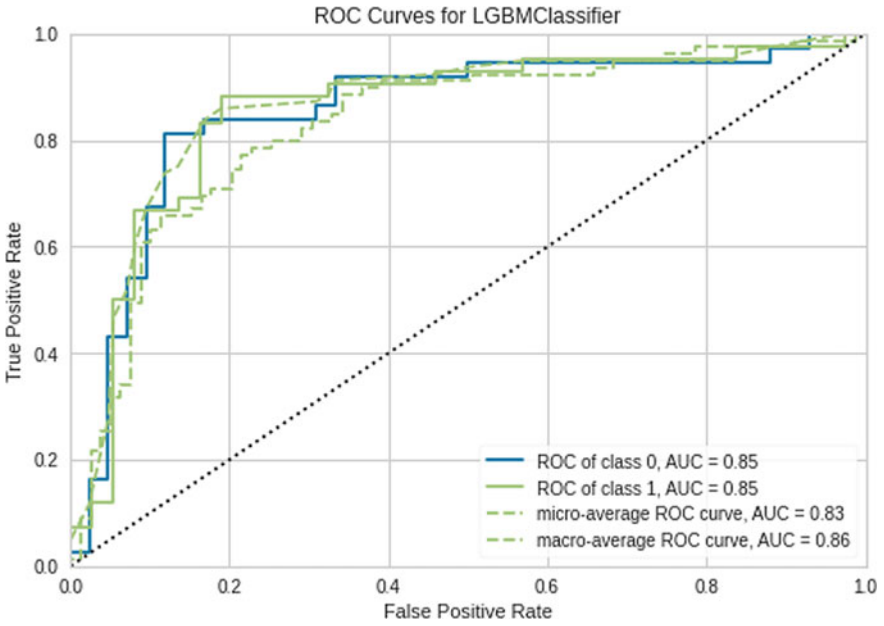

Fig. 4 ROC curve for LightGBM

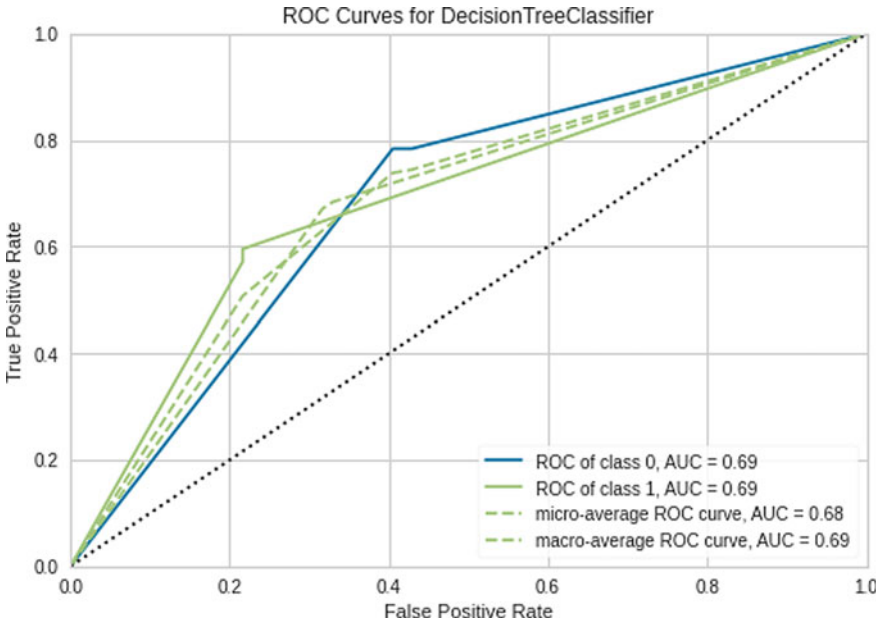

Fig. 5 ROC curve for decision tree

Proposed model can be used for more data resulting into better accuracy. It needs to test on larger audience for effectiveness of this study. LGBM can be improved using hyperparameters tuning for better accuracy as it is much stable and faster algorithm. An exploratory data analysis can also be carried out by doing a same survey for larger group of audience for analysis of online education system in India.

7 Conclusion

The paper concludes that logistic regression is giving better results for predicting students' sentiments and choice for online education and examination. It has 78.22% accurate results. We can use logistic regression for analysis of students' choices regarding online education. Though Light Gradient Boosting Machine is much faster algorithm, it is giving less accuracy in this dataset.

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IoT Enabled Energy Efficient Routing in Forest Fire

S. Srividhya and Suresh Sankaranarayanan

Abstract In Forest Fire monitoring and analysis, traditional Wireless Sensor Networks have played an inevitable role in remote data collection. Today almost all applications like healthcare, energy, Water, and many more have been turned into IoT-based systems and Forest Fire monitoring is no exception to this. The main objective of the Internet of Things (IoT) is to connect different sensors and objects in the forest for monitoring and analysis. So, this Routing Protocol for Low Power Lossy Network (RPL) plays an efficient way for better communication. Since forest fire monitoring is an energy-constrained application, the current layout of the RPL Objective Function (OF) is insufficient to handle all the issues of remote area communication. So, we in this paper have enhanced the RPL Routing Protocol by taking the energy of nodes as Objective Function. The network is analysed based on metrics such as Power Consumption, and duty cycle and compared to different transmission ranges of the sensor node using Cooja simulator.

Keywords IoT · Routing · RPL · Energy · Forest fire

1 Introduction

Natural fire calamities are identified by forest authority and actions are taken for controlling the fire. The major consequences of forest fire not only affect the flora and fauna but also the entire biological surroundings. The major reason for the fires in the forest is due to high temperature, dryness in the land, lightning, soil erosion, etc. Though steps are taken to overcome the human causes, technology has played an important role in early fire prediction, risk management, etc. Automatic systems and related works towards satellite imagery [1] for real-time applications are specified in [2]. A fire detection system based on short-range communication

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has been proposed in [3] which will capture real-time data such as sunlight, smoke, humidity, etc. Researchers worked on efficient ways of communication-related to the detection and monitoring of fire in forests described with centralized wireless sensor networks (WSN).

Unmanned aerial vehicle (UAE) is employed for capturing the images of the forest fire using special cameras. Different locations and views of the drone are analyzed to get better locations. Fixed and rotary wing cases are analyzed by the authors for identifying the best position of UAVs. Then early fire detection is done by LoRaWAN. In [4], the authors described a consolidated work module comprising of various sensors, GPRS, wireless connection through Zigbee, and power supply using the solar for remote forest monitoring. All the sensor nodes are mostly equipped with non-rechargeable batteries. In remote-based applications, the power of the node plays a vital role. Clustering, routing, and aggregation are some of the key areas where protocols have been standardized for optimized power consumption.

In this paper have proposed a modified RPL for forest fire scenario based on objective function with power and compared the performance of the network in terms of Packet Delivery Ratio (PDR), Energy consumption, the Duty cycle for 50 and 80 m Transmission range. The rest of the paper is organized as follows. Section 2 talks on Related work pertaining to research work. Section 3 talks on Energy Efficient IoT Enabled Forest Fire Management followed RPL ICMPv6 message. Section 4 gives the Results and Analysis of proposed work. Section 5 gives the conclusion and future work.

2 Literature Review

In the recent years, development of IoT based applications, routing issues and metrics are studied by various researchers in various simulation platforms. Lot of analyses are done in the variation of RPL protocols for specific network scenarios. Traditionally, hop count of the nodes with its neighbor is taken for RPL parent selection named as objective function 0 (OF0). Then link metric such as expected transmission count (ETX) is mainly considered in the destination-oriented directed acyclic graph (DODAG) formation of RPL (MRHOF) [5]. In [6], the authors proposed a composite metric for RPL. Reliability metrics are considered by the author for an objective function to identify the rank of the node. Reliability features such as node-link and ETX are considered here to make reliable RPL. The authors concentrate on connectivity issues which in turn affect the lifetime. Lifetime and latency agreeable metric (L2AM) that selects the parent node in DODAG by ignoring the highly congestible node and its path. The duty cycle is considered for the DODAG parent node selection process. So, this is not better for environmental monitoring [7].

Four metrics are considered like hop count, ETX, traffic load are weighed using Particle Swarm Optimization (PSO). Though the OMC-RPL uses four metrics, the energy parameter is not considered here. The virtual updation on RPL may not satisfy the applications which are energy-constrained as in forest, disaster. In [8],

the authors proposed a quality-aware RPL metric called QoI–RPL. Discovery of DODAG is done locally based on standard RPL. The parent node is identified using DIO message losses to frame the optimized topology for routing. Here data fusion is also incorporated at the parent node to avoid duplicate transmissions. The exact way Rank is computed depends on the DAG's Objective Function (OF). The Rank may analogously track a simple topological distance, may be calculated as a function of link metrics. Tang et al. proposed a mechanism for congestion avoidance with modification in the objective function of RPL. CARPL [9] calculates the average delay that is formed for the total communication towards the destination node. The average weight is calculated for all the paths towards the routing. Average weight is calculated using the rank of the node, expected transmission (ETX) and the total number of packets received.

3 IoT Environment for Forest Fire Management

IoT-EFM considers sensor nodes for sensing temperature, pressure, humidity, soil moisture, etc. These nodes are referred as motes in IoT environment. All the sensors are equipped with minimal amount of power for sensing and communication. Mostly they are equipped with GPS for identifying its location. Some of the motes are processed based on the data collected from the remote forest area. These motes communicate through Zigbee/IEEE 802.15.4 standard. The border routers collect the data from various sensor towards performing predictive analytics of forest fire. All the sensors are pre-deployed randomly in the forest area. The IoT-EFM [10] is mainly focusing on the efficient routing using Low power lossy networks from the sensors to the Border Router. So before going into details on Energy Efficient RPL for Forest Fire Monitoring, we talk in brief on RPL messages and DODAG formation.

RPL construction comprises destination-oriented directed acyclic graph (DODAG) discovery, formation, and monitoring. RPL is formed with the exchange of ICMPv6 control messages for route formation. These control messages help for exchanging the DODAG information and finally forms a routing topology. Each and every node first sends the DODAG Information Solicitation (DIS) message to enquire its neighbourhood for identifying nearby DODAGs. Destination Advertisement Object (DAO) is used to identify and send the control message in a reverse direction to mark the visited nodes towards the root.

Each and every node's position is fixed with respect to the DODAG root node. The rank of the node increases towards the leaf and decreases towards the root. Rank 0 node acts as a root node. The rank of the node is calculated using an objective function. The formation of topology starts from the root node. First, the root sends the DIO message to all the neighbour nodes which will receive and process the same. The process of broadcasting the DIO to the one-hop neighbours is repeated till the leaf nodes. Once anyone node joins the DODAG, it will extend the path of routing towards the DODAG root. All the intermediate nodes calculate it's RANK in DODAG and share their rank with the root node. If any of the nodes not in the transmission range,

it will send the DIS message with regular intervals to its neighbours. The process is repeated till all the nodes join the DODAG.

4 Results and Discussion

4.1 Simulation Model

The simulations are done in the Contiki Cooja simulator. To illustrate the effect of transmission range in the RPL DODAG design for an energy-constrained forest environment, the simulations are done in two different cases. Case 1 is implemented for the network with a transmission range of 50 m and an interference range of 100 m. Case 2 with the transmission range of 80 m and interference range of 100 m. Unit disk graph radio propagation model is followed throughout the simulation. To ensure the scalability of the E-RPL, 10, 20, 30, 40 and 50 nodes are taken for simulation. Table 1 represents the simulation parameters. Figure 1 shows 20 nodes random arrangement with a transmission range of 50 and 80 m respectively.

Table 1 Transmit and listen duty cycle for 50 and 80 m transmission range

No. of nodes	Transmit duty cycle (%)		Listen duty cycle (%)	
	TX = 50 m	Tx = 80 m	TX = 50 m	Tx = 80 m
10	0.15	0.154	1.5	0.994
20	0.211	0.678	1.253	1.818
30	0.505	1.053	2.072	5.663
40	1.522	1.88	4.2	9.349
50	1.6	2.801	4.757	9.448

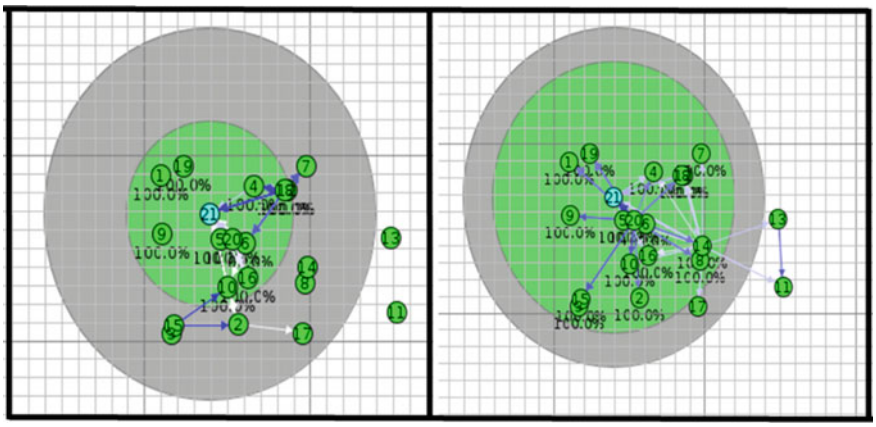

Fig. 1 20 Sky motes deployed randomly in forest region with Inf = 100 m and Tx 50 and 80 m

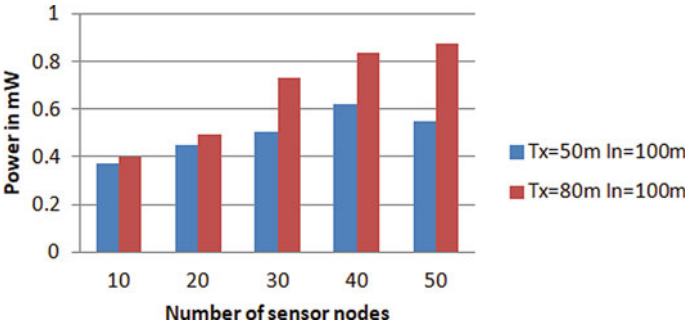

Fig. 2 Average CPU power consumption against scalability of network

4.2 Simulation Results

The proposed E-RPL is simulated in the random deployment of sensor nodes. Figure 2 represents the CPU power consumption of the total nodes. Here the average power consumption is calculated for the entire network. When more nodes are present in the transmission range, the power consumption is more as compared to the fewer nodes in the transmission range. Also, in less transmission range, with respect to scalability and randomness in the deployment, the power consumption for DODAG varies. That is the reason, CPU power consumption is more for the 80 m transmission range for an increasing number of nodes as compared to the 50 m transmission range. Similarly, for the 80 m transmission range, more nodes are covered by routing DODAG. The CPU power consumption ranges from 0.4 to 9 mW approximately for 10 nodes to 50 nodes setup.

In Low power mode, the power consumption is less when compared to normal CPU mode as shown in Fig. 3. A maximum of 0.573 and 0.9 mW power is consumed for the 50 nodes in the network with a transmission range of 50 and 80 m. In LPM mode, a maximum of 0.15 mW power is taken for a 50 node setup with a transmission range of 80 m and an interference range of 100 m. For the 50 m transmission range,

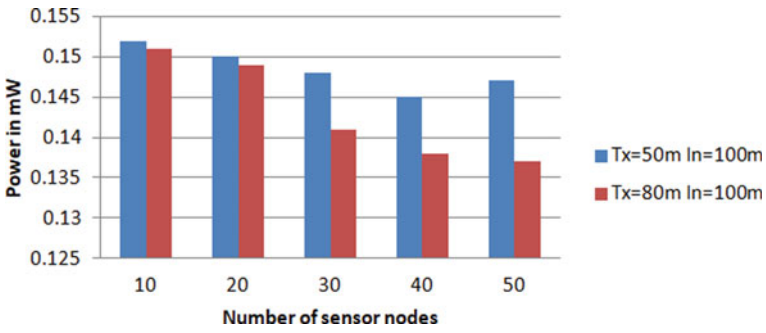

Fig. 3 Average LPM power consumption against scalability of network

a maximum of 0.146 mW power is taken for 50 nodes set up. This clearly shows that in Low Power mode, power consumption is less when compared to normal CPU mode irrespective of the scalability of the network.

The radio transmit and listen duty cycle ratio is observed from the simulation. As specified in the performance metrics, the duty cycle for listening and transmission plays a vital role in the energy-constrained forest environment. When comparing the duty cycle in both the simulation cases of Tx = 50 m and Tx = 80 m, the duty cycle increases for the scalability of nodes and specifically in the transmission range of 80 m. When more nodes participate in routing, the duty cycle increases. The duty cycle of the radio listen is 9, 4.9, 3.1, 1.7, and 1.9% more when compared to the radio transmit duty cycle respectively for 10, 20, 30, 40, and 50 nodes scenario. This shows that a number of sensor nodes are waiting for the notification from the root DODAG for joining the DODAG structure. The duty cycle represents the percentage of the total number of nodes in operative mode.

5 Conclusion and Future Work

In this paper, the issues of energy optimization in RPL for the forest fire environment are analyzed. The impact of the transmission range of the sensor node in the DODAG formation and energy-based optimization for RPL implementation is discussed in the proposed work. Since the forest fires are a power-constrained IoT-based application, the duty cycle of nodes in the remote area having more impact on the total energy consumption. The proposed P-RPL identified the parent node of the DODAG based on the calculation of the rank metric with respect to the power level of the node. The P-RPL is simulated in different scenarios by varying the transmission range of nodes of 50 and 80 m. The experimental results show the performance of the proposed P-RPL in terms of power consumption in CPU and LPM modes by varying the scalability of the network. In future, we propose to bring the concept of aggregation among 6lowpan nodes and aggregate based on region and transmit the data more energy efficiently to Fog/Edge router.

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Exploratory Analysis of Human Mood Swings

Rohith Mahadevan and X. Arputha Rathina

Abstract Humans differ from each other. Every human is unique, and everyone has a different mindset. Human behavior also varies from person to person. They are solemnly dependent on many factors. Human mood swings are basically influenced by internal factors such as hormones, mental health, and depression; external factors such as other people's behavior, health styles, the environment they work in, responses, and critics by the people who influence them the most. Behavioral analysis can be performed using python language for understanding the emotional intelligence of a person. The insights can be very useful in understanding the subject's mood and it gives an outline of their emotions. Data manipulation and data preprocessing is done using pandas. Hence, it gives a crystal clear view of the insights that we wish to see. These data which contribute to emotional intelligence of a person is very much helpful for the person to stabilize their mood.

Keywords Behavior · Tracking mood · Subject rating · Mood swings · Analytics · Interpretation

1 Introduction

The main problem with the young generation is they are exposed to lots of emotions, attractions, interactions and also to other's moods. Especially, teenagers are very delicate and are easily agitated because of mood swings The reason for analysis of mood is because people tend to change, react, respond and act based on their mood. Mood should be very stable for taking responsible decisions. Tracking and analyzing mood deeply helps a person to improve and to rectify their mistakes. It also remains as a hypothesis to predict their mood in future based on the factors that influence them. But it is also possible to track back their mood and to advise them about change of behavior or to suggest a therapy. The main purpose of the research work is how

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to track the mood of the particular person, to visualize their mood with graph, take insights from the analysis and to rectify their mistakes and behavior to improve their lifestyle.

This type of research helps the individual to stabilize their mood. The frequent monitoring of the mood helps them to understand where they lost the track. In [1] the authors suggested various techniques for tracking of mood for bipolar disorder patients. Continuous monitoring of mood with the help of software will greatly help the mentors to analyze people with mood swings [2].

2 Behavioral Analysis

A. Behavioral analysis

For the benefit of the research work 10 volunteers (Instead of names, a pronoun like Subject 1 Subject 2… is used) have been taken and research is conducted on them with their knowledge. Out of 10 people 3 people are randomly taken and their mood is analyzed. The researches have been conducted on them each separately for a month. The factors which are kept as a nominal value for the research is that asking the subject how does he/she feels daily and what is the reason for their mood. Some constraints have been set and given to the subject to pick only one mood based on the present situation.

B. Constraints

The constraints are happy, sad, angry, annoyed, bored, calm, confused, irritated, lazy and neutral (feels like nothing). The subject is also asked to describe their mood along with an explanation for the mentioned mood. The subject rates their mood out of a scale of 10 which should match their mood levels.

C. Data collection and formulation

The volunteer's mood responses are collected daily through WhatsApp and are formulated in a spread sheet. The data which are collected is secured. The data is shown only to the subject and other than anyone else. Each and every subject holds a different spread sheet. It is also important to store the data with respect to date and time to formulate them for analysis Data is formulated in such a way for all the 3 subjects. The entire data is formulated into a CSV file and are subjected to data manipulation and visualization. A sample set of data is shown in Fig. 1.

D. Data cleaning methods

The data that is formulated in csv file is read and the data is cleaned using python libraries such as pandas for data manipulation. Since the data that I collected is from my known circle the data had some contextual sentences as reason for the mood. This context is kept aside. The main feature that is mood is encoded with the help

Data table

	date	time	mood	reason	rating
0	07-01-2020	18:00	happy	spent time with friend and he is comfortable	9.0
1	07-02-2020	21:30	angry	friends didn't help in hectic sitation	0.5
2	07-03-2020	12:50	calm	went to the gym	7.5
3	07-04-2020	10:00	bored	came from the gym	6.5
4	07-05-2020	10:00	bored	came to friend's house	6.0
5	07-06-2020	18:00	sad	brother went to his home so he is worried	3.0
6	07-07-2020	19:00	happy	played game so he is happy	6.0
7	07-08-2020	9:00	lazy	not slept well	5.0
8	07-09-2020	13:00	annoyed	because off yesterday's party	6.0
9	07-10-2020	10:00	confused	thinking about job and future which always mak...	6.0
10	07-11-2020	21:00	irritated	harmonal factors or external factors might ha...	7.0

Fig. 1 Moods of subject 1 with respect to date and time (only 10 samples)

of label encoders for the betterment of visualization. Though only 3 persons mood is analyzed deeply the remaining 7 people's mood is taken in a spreadsheet and analyzed manually for cross checking of mood vs rate in which most of the ratings matched the mood and that is also proved in the below histogram. In [1] the authors did an exploratory data analysis from the data which is collected in hospital. They found a linear relationship with mood and motivation.

3 Approach and Parameters

A. Approach to analysis

The insights and results are directly retrieved from the graph. After data cleaning and preprocessing each and every individual's data is processed separately. Since everything is scalar value, data is taken in such a way that it emphasizes on their present mood. For example if a subject is very happy he or she may rate that mood as 9 or 10. Thus, this level of rating is considered as highest and happiest mood. But ratings differ from person to person. Some gave 6 or 7 to bored but others gave 5 or 4. Irrespective of the situation the people tend to act in a particular way, no matter what. In [3] the authors cited that subject acts according to their belief. This is why we take separate analysis for each person. In addition to the better results, it also gives an opportunity for us to analyze each individual without much flaws and deviations thus knowing their level with previous ratings. Many researches stated that machine learning and data visualization of complex medical data is practically

possible. In [4] the author can successfully predict individual's wellbeing with the help of algorithm.

B. **Parameters**

The most vital parameters are mood ratings and mood. The second vital parameter is time, at which the observation was taken. The final parameter is the reason for the mood. These parameters are fixed in the initial stage and analyzed differently with different criteria. This type of qualitative analysis is possible and in paper [5] the authors analyzed various research papers thus providing strong evidence.

4 In-Depth Analysis of the Results

A. ***Histogram representation***

The moods of all the three subjects are analyzed and they are given an insight of their mood. It is easy to track back their mood for the given month. When it comes to visualizing their mood the ratings are verified with a histogram representation. Below are two histograms of two different subjects. The rating is cross checked manually and with visualization. The subject tends to give a higher rate when he/she is very happy. They give a medium level rating when they are bored, neutral or lazy. The rating level drops and merely touches 0.5 when they are sad, irritated or tensed. Figure 2 explains that the subject doesn't give a rating below 3 which means he/she is having a pleasant mood. But contradicting to that Fig. 3 explains that the subject is prone to mood swings. He/she was sad, tensed or even irritated so that's why the rating level has gone to 0.5–2 range.

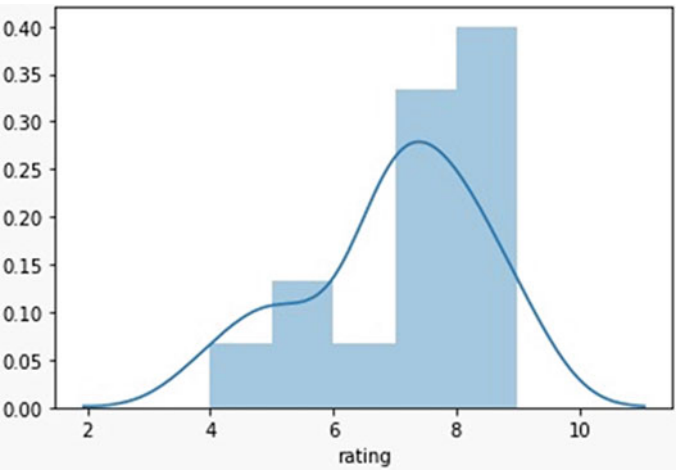

Fig. 2 Mood ratings of subject 3

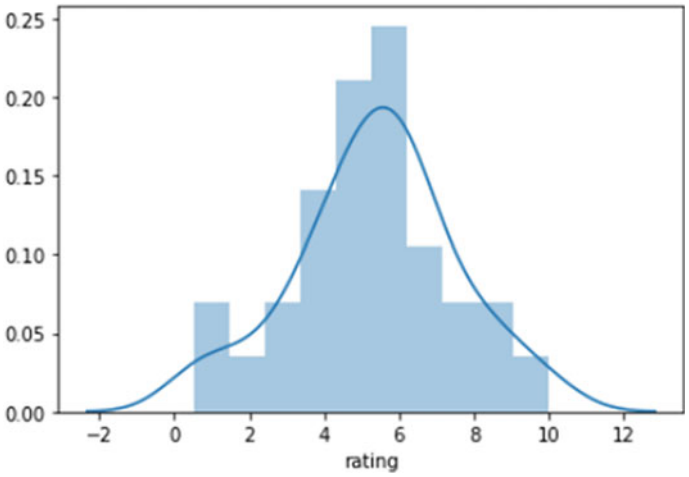

Fig. 3 Mood ratings of subject 1

The distribution seems normal for Fig. 1 in range 7–8.5 while the distribution is normal for Fig. 2 in range 4.5–6. In [2] the author discussed about the various methods for extracting relevant information from actigraphy data and for distinguishing different subtypes of mood disorder recordings and also about the parameter and features of PSYCH project. Those high end configurations of data collection can be ideal for tracking the mood but the reason for the mood should be manually entered by the user from which the future rating can be classified.

B. **Count plot analysis**

In Fig. 4 the distribution is quite normal and it tells that the person had all kinds of mood swings ranging from irritated, sadness to excited, happiness. Below is the count of days of their mood. Each graph holds for an individual (Figs. 5 and 6).

C. **Relplot and timesheet analysis**

The below graphs are analysis of their mood swings and a brief explanation about their moods that are in connection with rating. It is a time series graph and explains a good visualization to analyze their mood. A relplot is also constructed to analyze the occurrence of their mood with respect to time. Time is also a constraint for mood swings. All my subjects seem to exhibit different kinds of mood (Figs. 7, 8 and 9).

5 Mood Swings Detection and Results

These are mood ratings of two subjects. In Fig. 10 the subject experienced a high mood swing from 12-07-2020 to 18-07-2020. In Fig. 11 the subject experienced

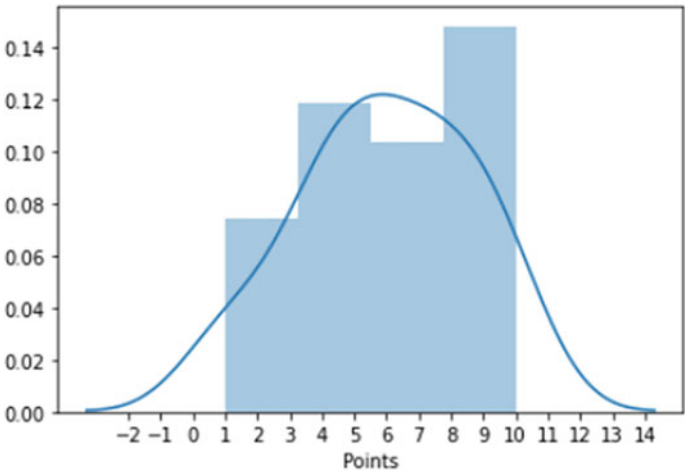

Fig. 4 Mood ratings of subject 2

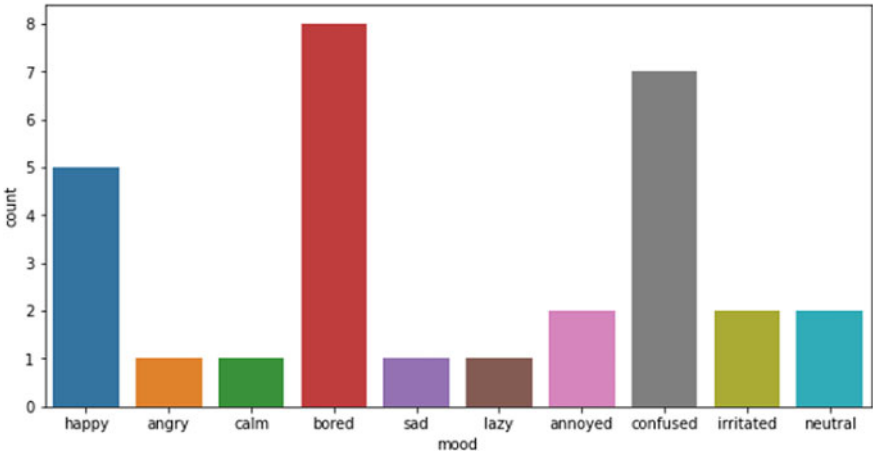

Fig. 5 Types of mood experienced over a month by subject 1

various mood swings from 16-06-2020 to 24-06-2020. The ratings are correlated with the moods that are given and hence verified. These insights give us a better result to improve their mood and to trackback their mood.

The main advantage of manual collection of data is that the subject can be analyzed in person. Through verbal communication the subject's mood can also be diagnosed. This enables us to know whether the user gives correct information about their mood. Automatic devices can be applicable for detecting the mood with the help of body regulations but the ratings can be given by them only after a series of trial and error methods of collecting the information which is manual. For manual collection of

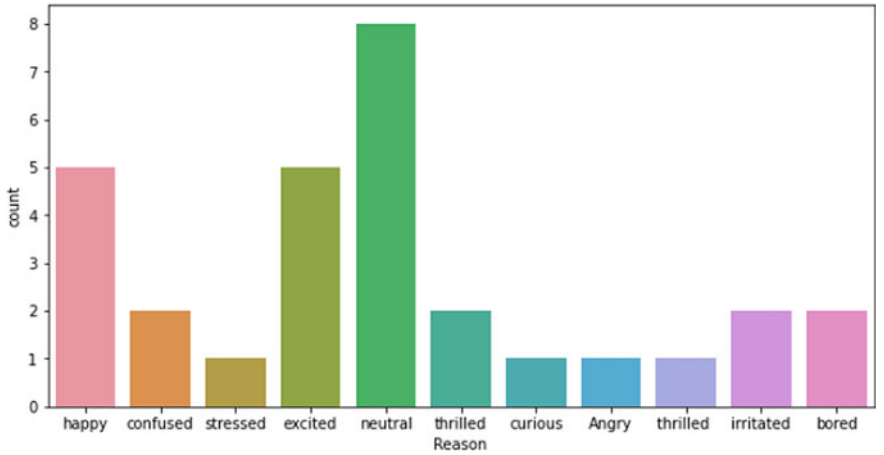

Fig. 6 Types of mood experienced over a month by subject2

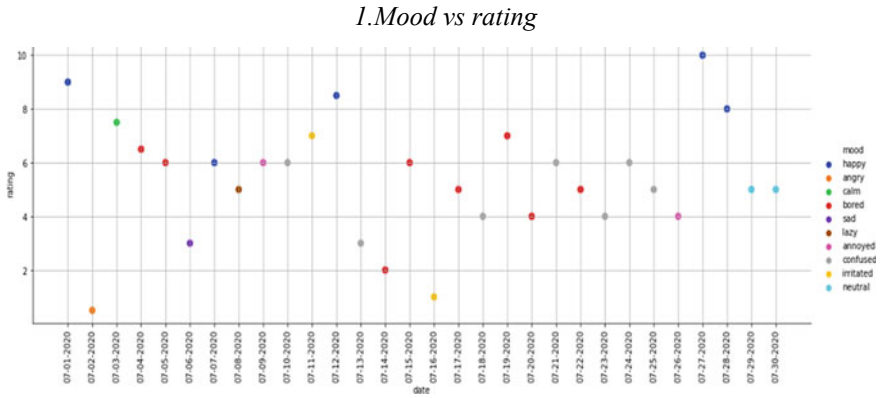

Fig. 7 Mood versus rating analysis of subject 1's mood for a month

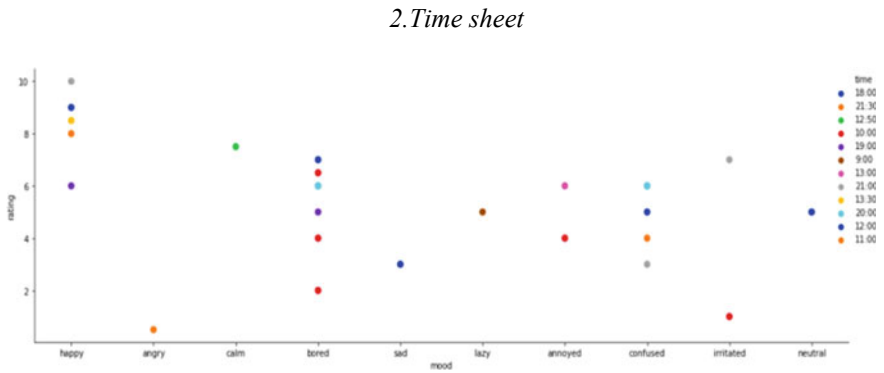

Fig. 8 Time sheet analysis of subject 1's mood for a month

3. Reccurence of mood

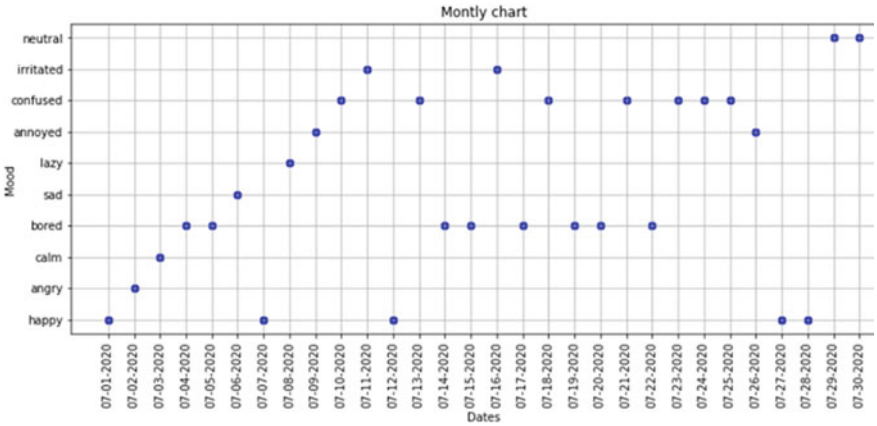

Fig. 9 Different kinds of mood with respect to date

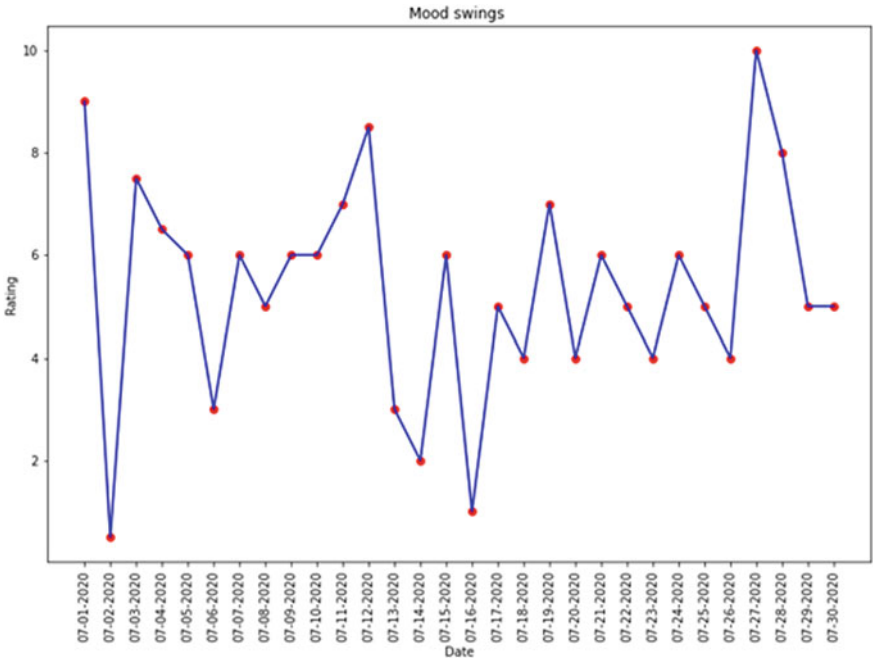

Fig. 10 Mood swings of subject 1

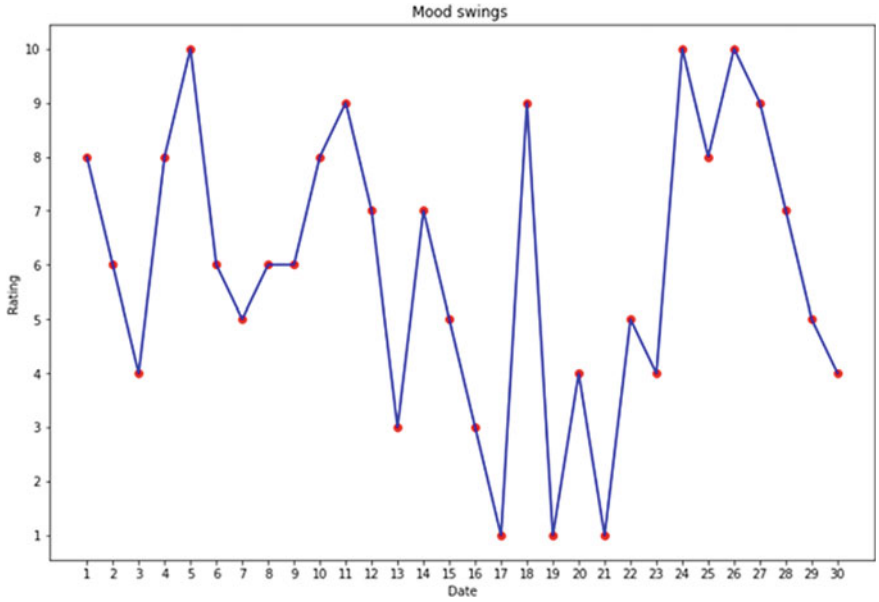

Fig. 11 Mood swings of subject 2

data spreadsheets are used for easy data storage. The time is correctly noted so that it cannot have a flaw. After interrogation with the subject, they are asked to fill their mood at the immediate spot of time.

6 System Design and Architecture

Programming language: Python

Libraries used: Pandas, numpy, matplotlib, seaborn and sklearn

Environment used: Google colab and Jupyter notebook

Variables: Different kinds of moods

Mathematical illustration: Rating for 10 and manual comparison with mood.

7 Conclusion and Future Scope

Building a machine learning model is the futuristic scope of this research. The data is split into training and test phase then sklearn library is used for training the dataset.

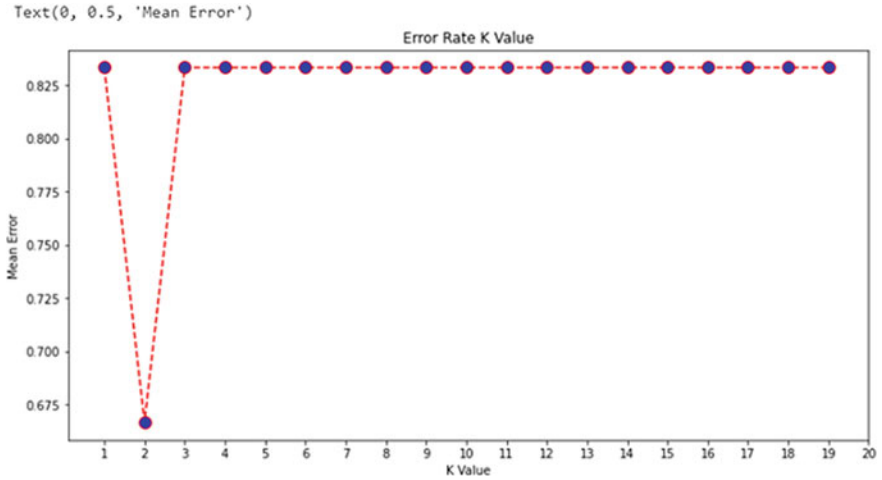

Fig. 12 KNN neighbor with 2 cluster points for subject 1 dataset

Fig. 13 Accuracy of KNN algorithm for subject 1 dataset

```
knn.score(x_test,y_test)

0.3333333333333333
```

The model is trained for each person with their mood. In this initial stage of research building a model fails because of insufficient data. The model gives a poor accuracy rate of 0.33 with KNN clustering with neighbors as 2 and Naïve Bayes model accuracy as 0.25 (Figs. 12 and 13).

The future scope also includes building and training the model with NLP and deep learning techniques with sufficient number of data. So that when we test the data with new set, the mood and the rating will be predicted based on the data which they say. If the data is more then we can expect higher accuracy and better predictions.

Acknowledgements All the research works and analysis are done with the knowledge of the subject and their analysis is presented individually to each one of them.

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Comparative Study on Online Teaching Learning Tools

D. Evangeline and A. Parkavi

Abstract Online teaching learning process or e-learning is widely used teaching methodology during Covid-19 pandemic prevailing globally. This teaching–learning process, contradictory to traditional methodology can be placed under the category of "distance learning". It has challenges of its own. But this process is advantageous than traditional ones, in terms of convenience for students at remote locations. The other advantages are availability of learning resources any time, facilitation of communication between/among teachers and students, auto-documentation of processes, easy conduction and evaluation of assessments, ability to accommodate any number of students, etc., Learning Management Systems (LMS) are abundant today and teachers are at liberty to choose any one among those systems as many are available at free of cost. In this paper, a comparative study on four such tools, namely, ClassDojo, Edmodo, Google Classroom and Schoology is done to guide teachers opting for online teaching–learning process.

Keywords Online teaching–learning process · Learning management system · ClassDojo · Edmodo · Google classroom · Schoology

1 Introduction

In today's world, the indispensability of Internet can be felt in almost all domains. This digital age has made every person across the globe to possess many digital devices. All such devices are connected to the Internet, thereby facilitating any work to be accomplished in an easy manner. Teaching–learning process is no exception to it. Learning Management Systems (LMS) are plenty and available free of cost to teachers engaged in teaching courses at Kindergarten, Elementary/Middle/High

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School and College. These are web-based and available to teachers as mobile applications compatible to Android, iPhone and Windows Operating Systems. Especially the use of educational technology is inevitable during COVID-19 crisis. Now, the entire world's students are progressing in their education because of the availability of such platforms. Otherwise, educational departments of every country across the world would be staggering behind to balance the gap of physical presence of teachers and students in classrooms. In this paper, let us make a comparative study of the above mentioned tools.

2 Survey on Tools

The tools selected here in this paper are considered on the basis of the following factors: being widely available, ability to integrate with existing learning environments, availability at free of cost, different assessments possible, etc., Edmodo is an educational technology company founded in 2008 and headquartered in California. It is a free to use tool but premium services are also available [1]. Edmodo is teacher-centric tool. There are twenty ways in which a teacher can make use of this tool for teaching–learning process. Some of them are [2]: Assessments through quiz or poll, Role playing activities, Peer reviews and critiques, Project writing, Building digital citizenship skills, Foreign language practice, Book clubs, Professional development workshops, School clubs Alumni group [2]. This tool also involves parents in the teaching learning process so that they can keep track of their pupil's progress. ClassDojo is another educational technology tool that provides free service to teachers. And optional subscription package is available to families called "ClassDojo Beyond School" [3]. The company and the tool has received numerous accolades [3]: Today Show's Education Innovation Award in 2011; Forbes' "100 Most Promising Companies of the United States" in 2013; Fast Company's "10 Most Innovative Education Companies in the World" in 2013. Google Classroom is a free education service provided by Google. It was primarily launched to share materials between teachers and students. Classroom incorporates various features of Google like [4]: Google Docs, Google Sheets, Google Slides, Google Forms, and Calendar, etc., so that there can be a paperless education ecosystem. One unique feature of Google Classroom is its originality report generation by using GSuite for Education (free).This version helps in checking the originality of at most three assignments but this operation can be used for many assignments under the paid version. Schoology creates a virtual learning environment for teachers and students. The selling feature of Schoology is its ability to easily integrate into existing LMS and applicability of filters as demanded by users. The basic package is available free of cost to all stakeholders and single sign-on feature [5].

Table 1 Basic comparison of the tools

Type of tool	Number of users in 2020	Number of App downloads	Types of accounts	Type of service provided	Maximum number of users per course
Edmodo	> 100 M	10,000,000+	Teacher, Student, Parent	Free of cost but offers premium services	Unlimited number of students and co-teachers
ClassDojo	> 7 M	10,000,000+	Teacher, Student, Parent, School Leader	Free with some paid services to families and school districts	Unlimited number of students and co-teachers
Google Classroom	> 100 M	100,000,000+	Teacher, Student	Free of cost	Maximum number of teachers is 20 and maximum number of total users is 250
Schoology	> 20 M	5,000,000+	Teacher, Student, Parent	Basic package is Free to all users. Premium packages are available to schools	Unlimited number of students and co-teachers

3 Results and Discussion

3.1 Basic Comparison

The type of service offered by these four LMSs differs in terms of the pricing and services offered for free and paid accounts. Except Google Classroom, other tools offer certain add-on services for paid accounts. All the tools provide the facility for a teacher to invite co-teachers. All the tools are web-based and are also available to the users as Mobile Applications which are suitable for Android and iOS. Except Edmodo, other LMSs are not available as Windows mobile apps. Such comparisons are tabulated in Table 1.

3.2 Digital Pedagogy

Digital pedagogy is described as, using digital tools from critical pedagogical perspective only when necessary [6]. Blended learning courses combine face-to-face

interactions and online teaching delivery methods. Substantial reduction in number of face-to-face interactions owing to sufficient content delivery online is the significant feature of blended learning [7]. Flipped classroom is one type of blended learning.

In Edmodo, "Moderate Posts and Replies" option in advanced settings of course can be used by Teacher, while posting an educational video for students to view and asking them some questions from it, so all students can answer. But one can prevent a student copying another student's answer because when a student posts an answer, it will not be posted to class. It waits for teacher's approval to be visible to everyone. In ClassDojo, there is "Remake Learning Activity" option. Redesigning of activities can be used to alter the project outputs based on the results of previous activities. Later on, teacher should monitor and assess the alterationsLesson playlists can bring in flipped classroom in Schoology. Makerspace is a collaborative workspace for making, learning and sharing; On the other hand, Value Based Education focuses on imparting science education to learners with respect to physical, intellectual, moral, social, spiritual and economic aspects of life [8]. In Project Based Learning (PBL), different groups of students can solve practical problems in the course using their own approaches [9]. Polls and posts feature in many online tools help in Project Based Learning. Education Gamification can be thought of as usage of game based mechanics to promote learning and solve problems [10].

3.3 Security Aspects

Secure Socket Layer (SSL) or Transport Layer Security usually provides security during communication in LMSs. All the tools mentioned here use SSL in some aspect. Edmodo uses it while data is in transit [11]; Schoology and Google Classroom uses it in all aspects [12] and ClassDojo uses it to validate data sent and to validate its integrity [13]. Schoology does not define terms of flagging inappropriate content and does not permit children to share their profiles publicly outside classroom or school. And children's profiles are shared only with those third party service providers in unavoidable circumstances. Based upon their browsing activity, advertisements may be displayed to them. There is no data breach notification policy in Schoology [14]. Gmail, calendar, forms, sheets, slides, classroom, contacts, drive, chrome sync are core services of GSuite for Education services. Industry standards and procedures are in place to enforce security, integrity, confidentiality and protection of unauthorized access of user's data [15]. Edmodo does not create behavioral profiles of users and share it with other third parties. Several checks are made to prevent attacks on services from web browsers and other scripts. It does not explicitly state any data breach procedures [16]. ClassDojo shares the user's data with certain third party providers to develop some services. Encryption and salted hashing is done on user information and credentials. The company claims that whenever data breach occurs, the user will be intimated electronically [17].

3.4 Compliance with Law

Children's Online Privacy Protection Act (COPPA) applies to websites or any online services given to children under 13 years of age to protect the personal information collected from them. All the LMSs discussed here are COPPA compliant. Another law called as Family Educational Rights and Privacy Act (FERPA) also focuses on protection of privacy of student education records. Certain rights related to children's education records are entrusted to the parent till they are 13 and gets automatically transferred to children once they reach 18. All tools except Schoology are FERPA compliant. General Data Protection Regulation (GDPR) expects organization in and out of European Union who are carrying out business in EU to comply with certain rules with respect to data privacy. Edmodo is still working on its practices and policies to become GDPR compliant but it is permitted to handle personal information of residents of EU and Switzerland since it is a participant of EU-US Privacy Shield Program and Swiss-US Privacy Shield Program. Google Classroom and ClassDojo is both GDPR compliant and Privacy Shield Program compliant. But Schoology is not GDPR compliant.

3.5 Result Analysis of Every Tool

Summative and formative assessments can be conducted in all LMS. The result analysis of every individual question is given in Fig. 1. It can be understood that once any assessment is carried out in any of these tools, result analysis of students can be performed. In case of Edmodo, only the results can be exported to a CSV file and the result analysis for the quiz conducted is shown in Fig. 3. The same can be performed in Google Forms also. But it also provides some basic analysis of total distribution of marks, how many students gave the correct response for every individual question, total scores, etc., The screenshots of the same can be seen in Fig. 2. Same type of statistics can be generated in Schoology and ClassDojo.

3.6 User Experience Evaluation

The user experience for the students' perspective is evaluated in this study on basis of the following three questions mentioned below:

Q1: How do you rate the LMS' UI? Options: Excellent, Very good, Good, Average.

Q2: How do you rate the ease of use of LMS when taking assessment tests? Options: Excellent, Very good, Good, Average.

Q3: To what extent, the LMS is able to compensate for real learning environment? Options: Yes, to great extent: Yes, to some extent; No impact; Poor impact.

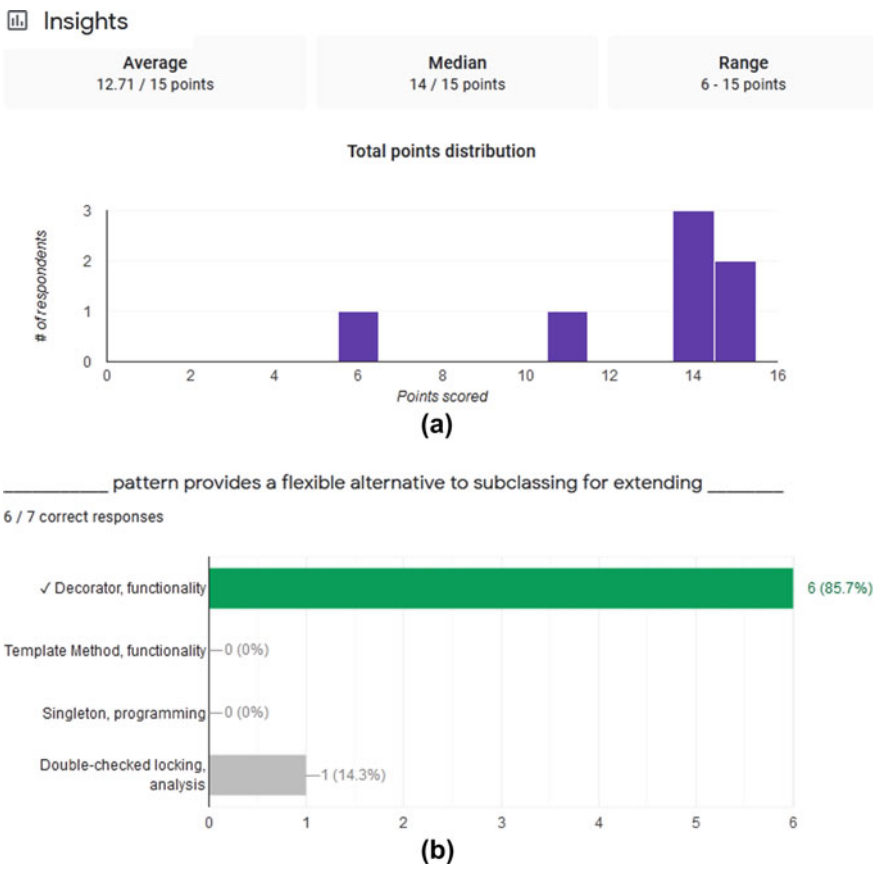
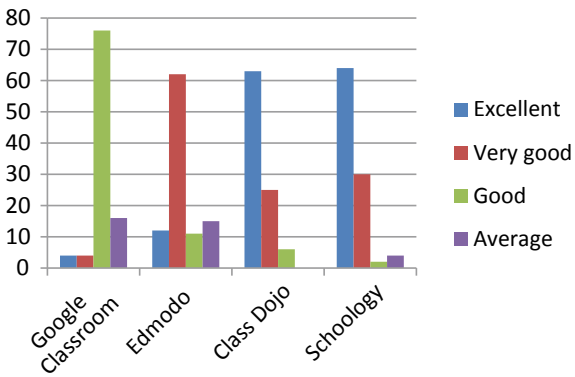


Fig. 1 Result analysis from responses of Google form. **a** Graphical representation of overall performance in the test. **b** Graphical representation of performance in individual question

Now, the study has been conducted with respect to 125 Engineering students for one course and the responses were collected through Google form. Only 100 responses of the students were considered as they have submitted within the time assigned. All the students were made to answer the questions and no missing data was noticed since those questions were marked as mandatory for submission. All the users were exposed to these four tools for a span of 2 months and later on, this evaluation was assessed. Figure 3 shows the responses collected for Q1. One can notice that students have rated ClassDojo and Schoology to have better UI when compared with Edmodo whose UI was rated as "Very good" by them. Google Classroom had a relatively less appealing UI and was given the rating "Good". In Fig. 4., the responses of Q2 are given. Class Dojo and Schoology were termed as "excellent" when it comes to ease of use while taking up assessments. On the other hand, the tools Google Classroom and Edmodo were given received "Very good" rating. It can also be noticed from Fig. 5 that none of the tools were able to replace the real time

Fig. 2 Result analysis from responses of quiz in Edmodo

Fig. 3 Responses for Q1



learning environment involving the physical presence of both the teacher and the student. However, these tools have played a considerable role in compensating the physical absence of the teacher and other students.

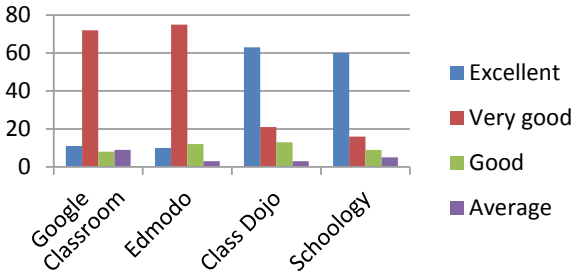


Fig. 4 Responses for Q2

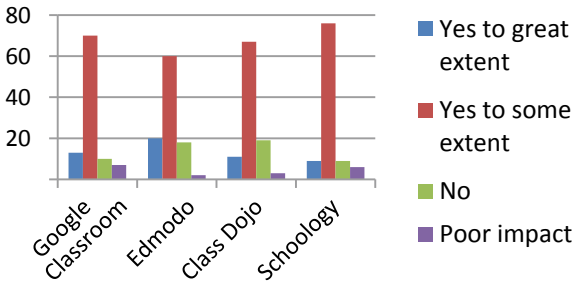


Fig. 5 Responses for Q3

4 Conclusions and Future Scope

In this paper, four educational LMSs are studied to understand their effectiveness in conduction of online classes through analysis of its essential features. It is understood that all the tools are compliant with laws in force and are offering services to students mostly at free of cost and with parental support. All tools are integrated with some other essential apps in education. Data security in all LMSs is monitored closely to avoid breaches. Scrutiny of online behavior and selling of such sensitive data to third party is not supported by many of its stakeholders. There are many advantages of virtual classrooms over traditional classrooms. Yet, there are certain facts like children being overwhelmed by the pressure of getting appreciated for certain online activities. Claims regarding physical and mental health of children and also teachers getting affected are true to certain extent due to online teaching learning environments.

In future, more number of LMSs can be used for online teaching learning process. More focus on different learning aspects and digital pedagogical perspectives and the extent to which each tool supports needs a deep analysis. It can be noted that none of the tools are providing options for negative marks in case of wrong answer and auto grading of descriptive answers. In this study, feedbacks from students were collected and analysis were carried out. Feedback from other stakeholders of each and every LMS must be collected for analysis to understand the different aspects, which highlight the significance of certain features of each tool.

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A Survey on Soft Biometric Techniques

D. Evangeline and A. Parkavi

Abstract It is well known that biometrics can be employed for person identification and is widely adopted in workplaces for attendance monitoring. In recent days, it is applied for criminal and victim identification through soft biometrics which does not possess universality and permanence factors like hard biometrics. This domain of soft biometrics is still in its infancy and needs lot of research directions as researchers are focusing on discovery of certain soft biometric traits, whose accuracy needs to be improved by application of relevant pre-processing techniques. In this paper, survey on such works has been done. Soft biometric traits like wrist, blood vessel patterns, vein patterns, androgenic hair, ear, periocular traits, skin texture, shape of body and certain skin marks are studied elaborately.

Keywords Soft biometrics · Ear · Periocular biometrics · Shape of body · Skin marks

1 Introduction

Biometrics is a means of identification of individuals through their behavior or features [1]. Biometrics is primarily used for authentication. There are many human biometric features like iris, face, palm-print, fingerprint, etc., To improve the accuracy of person identification, many such physiological biometric features can be combined and multi-modal biometric system can be adopted. Behavioral biometrics like gait, speech, etc., has caught the attention of researchers today. All such biometric information from an individual are captured by biometric systems and features are extracted from the biometric image and those features are compared against the templates stored in database [2]. Eventually, the results of comparison can establish

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the identity of individual. Apart from person recognition, deductions of attributes like age, gender, height, weight, BMI, etc., are also possible. The biometric factors are defined by the following characteristics: universality, uniqueness, permanence, collectability, performance, acceptability and circumvention [3]. These characteristics are considered when opting for any biometric system. The other challenge that any traditional biometric trait faces is dealing with occlusions. Mask, scarf, hat, makeup, etc., are some of the occlusions to be dealt in face recognition [4]. When it comes to retina or iris, the occlusions may occur with glasses and lenses. In case of palm-print or fingerprint, it may be some cuts or bruises.

2 Taxonomy

In general, the broad field of biometrics is classified into hard and soft biometrics. Hard biometrics is based on those features which adhere to the seven characteristics of biometrics. On the contrary, soft biometrics lacks uniqueness and permanence. Yet, they can be employed to identify an individual [5]. Soft biometrics can be formally defined as estimation or use of personal characteristics describable by humans that can be used to aid or effect person recognition [6]. Hence, it is evident that while hard biometric features in general can uniquely identify a person and is applicable for authentication, soft biometrics can be applied for victim and criminal identification. Recent studies have proved soft biometrics to be a successful technique to identify criminals in the mob, terrorists in the videos published by them and criminals and victims involved in pornography. But person identification from soft biometrics is very challenging since biometric images are captured in a controlled environment for hard biometric image acquisition, contrary to soft biometric images captured in ill-illuminated environments and the subjects also try to conceal their identity by covering up their faces with mask.

Taxonomy of biometrics is illustrated in Fig. 1. There are many biometric attributes based on which the traits are chosen. Physiological attributes are characteristic of the body. Fingerprint, palm-print, iris, retina and face are some biometric traits chosen on basis of physiological features [18]. Geometric attributes also play a role in biometrics. Hand geometry [19] and finger geometry [20] have also been experimented in biometrics. Considering the auditory attributes, speech recognition is also taken as a valid biometric trait [21]. Even, DNA samples of human can be employed in biometric systems [22]. When it comes to soft biometrics, wrist and ear can be taken as visual attributes, body and face geometry can be taken as anthropometric attributes.

Table 1 shows soft biometric traits related to hard biometrics. With respect to biometrics, demographic attributes refer to attributes like age, gender, race, etc., that is widely observed in population statistics. Attributes like Body Mass Index (BMI), height, weight, skin lesions, wrinkles, etc., can be considered as medical attributes. Mostly, face occluding characteristics like hats, glasses, scarf, hat, etc., are some material characteristics in soft biometrics [2]. While facial expressions, gait, keystroke dynamics and accent in speech are valuable behavioral traits, it is also

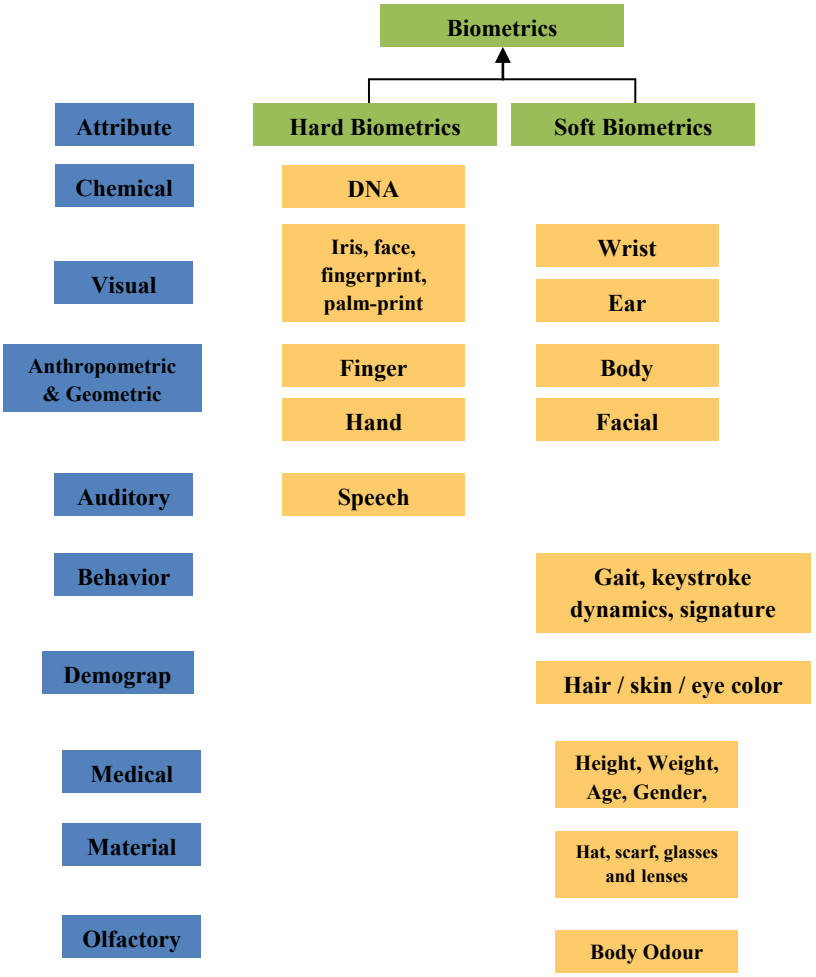

Fig. 1 Taxonomy of biometrics

surprising that attributes like body odor [23], an olfactory attribute could contribute in person identification.

3 Related Work

There are many soft biometrics which have been studied extensively and there are a plenty of new ones under research. Androgenic hairs grow in the follicle and remain there for a year in legs. When it falls out also, it grows at the same place and has a long cycle [24]. As lower legs of criminals are visible in images captured in

Table 1 Examples of soft biometric traits related to hard biometrics

Physiological traits	
Hard biometrics	Soft biometrics
Eye (Retina, Iris)	Periocular [7]
Face	Glass [8], lens, hat, accessories
	Eye/skin/hair color [9]
	Beard/mustache [10]
	Ear shape [11]
Body parts	Blood vessels [12] Vein patterns [13]
	Skin texture [14]
	Body geometry, Silhouette [15]
	Scars, marks and tattoos [16]
Palmprint	Wrist [17]

riots, androgenic hair visible is studied. However, images captured by surveillance cameras were not considered but high quality images captured by reporters using DSLR cameras were regarded within the scope of the paper. External ear is chosen as a soft biometric trait in Purkait [11]. Uniform color distribution, less impact of age, unaffected by change of facial expression or facial makeup, imaging of ear feasible at a long distance are some of the significant reasons that makes it a valid biometric trait. But, it should be noted that elongation of lobule may increase ear length for people over 60 years of age. During imaging of ear itself, ten anatomical landmarks like Superaurale, Subaurale, Intertragica Inferior, Protragion, Antitragus Superior, Incisura Anterior Auris Posterior, Concha Superior, Posterior Most Point on the Antihelical Curvature, Postaurale and Lobule Posterior were identified. Also, seventeen distances were also computed from these landmarks. Since wrists are visible when terrorists hold weapons, when criminals touch victims in sex offences, it was studied extensively [17].

Since non-facial body sites are imaged using high quality cameras in sexual offences, blood vessel patterns between skin and muscle were chosen as soft biometric traits [12]. On basis of the principles of optics and skin biophysics, veins can be uncovered from any part of the body and the same can be used in forensic applications [13]. The upper torso of human body shows less temporal variance with arm and leg motions providing stable features and the silhouette is subject to experimentation as a suitable biometric trait [15]. Features like shoulder length, biacromial breadth, bideltoid breadth, head width, head circumference, head length, chest breadth, neck bustpoint length, neck circumference, shoulder circumference, and shoulder elbow length are some of the traits considered in silhouette. Images captured with surveillance cameras were experimented. As skin is a largest body organ and the same is visible in low-resolution images, skin texture can be developed from the images and the same can be checked for biometric validation for forensic applications [14]. Periocular region is the region around eyes and includes

eyelashes, eyebrows, eyelids, eye shape, etc., Because imaging periocular region does not require user cooperation, it can be employed in person identification for images captured in surveillance cameras also. It can be observed that skin marks [25], tattoos and scars [16] can also be employed in person identification if the images are of high quality. But, focus on person identification from digital videos in crime has brought Relatively Permanent Pigmented or Vascular Skin Marks (RPPVSM) (composed of four types of skin marks—nevi, lentigines, cherry hemangiomas and seborrheic keratoses) to the notice of the researchers [26].

4 Comparative Study and Analysis

The related works are all studied and analyzed in depth with respect to various operations like Image enhancement, Feature Extraction and performance.

4.1 Skin Pixel Identification

Image enhancement is the process of improving image quality and information content of original data after processing. Since superpixels adhere to boundaries and enhance segmentation results, SLIC (Simple Linear Integrative Clustering) is employed to group pixels into meaningful patches while employing wrist as a valid soft biometric [17]. There are 200 superpixels per image. Using the mean and standard deviation statistics from RGB, HSV, LAB, YCbCr, YIQ, normalized RGB colour spaces and seven gradient maps (Sobel in two directions, Prewitt in two directions, Laplacian, Difference of Gaussians, Laplacian of Gaussians), 450 dimensional feature vector can be extracted. EoDT (Ensemble of Decision Trees) is trained with bagging method and classification as skin and non-skin pixels helps in determining the wrist part. While trying to recognize legs in the image, segmentation of skin pixels from non-skin pixels is done by filtering the input RGB image using a 3 * 3 median filter [12]. Taking R_M, G_M and B_M as the filtered R, G and B channels of the image, pixels can be identified as skin if $I_R > \overline{I_R}$ and $I_G < \overline{I_G} + \text{std}(I_G)$. Here, $\overline{x}$ and std(x) must be regarded as mean and standard deviation of x respectively. Morphological operators can be applied on image for noise removal. While performing blood vessel extraction using directional groups, Contrast Limited Adaptive Histogram Equalization (CLAHE) helps in normalizing the contrast of input images [12].

4.2 Positive Sample Generation

In training phase, images from the same body site of the model image are called positive sample whereas the other images are called negative sample [14]. Since the

number of negative samples outnumbers positive samples, more positive samples can be generated using affine transformation on the current positive samples. Model image and other images of same leg are considered as positive samples and other images of the dataset are negative samples. For treating androgenic hair patterns as soft biometrics, since the number of images in the dataset may be less and the algorithm to be robust against pose variations, positive sample generation scheme is adopted [24].

4.3 Low Resolution Alignment

Image alignment is significant since it enriches the features from images captured. For alignment of leg images, edge sampling and image registration is done [24]. The leg boundaries are extracted and the angular samples are given by center line and center point. Uniform sampling on basis of angular distance is done on leg boundaries. Now, pruning and normalization processes are applied to the two point sets which are again aligned using affine Coherent Point Drift method. The transformation matrix, thus generated and bicubic interpolation can help project all the color channels of one image onto another image. While processing skin texture, CPD was employed for image alignment of positive and negative samples and testing images to model images [14].

4.4 ROI Extraction

The Region of Interest (ROI) in WMFA (Wrist Matcher for Forensic Applications) focuses on finding the boundaries around the wrist and the two wrinkles. This is accomplished using a two stage process [17]. A heat map is constructed from these four key points from the training images and using the same, template from heap map is constructed for ROI extraction. Coherent Point Drift (CPD) method is used for finding the correspondence between key points in input image and template key point using affine transformation. After alignment, ROI can be extracted by dropping left and right parts of the input image. For extracting legs in the image captured, Region of interest is defined using six points—two points above knees, two points right below the knees, and two points on the ankles [24]. For periocular biometrics, the reference point for ROI extraction can be considered as center of iris [27], or corner of the eye [28].

4.5 Optical Models

According to Kulbeka-Munk (K-M) model [29], volume fraction of epidermis occupied by melanosomes, volume fraction of dermis occupied by blood and depth of dermis are some bio-physical parameters of the skin that account for skin color formation and even vein patterns in the skin can be unraveled by the inverse process of skin color formation [13]. Since KM model is very sensitive to KM coefficients and hence, the complex skin structure cannot be accurately measured, using another optical model [12], reflectance and transmittance can be computed using Reichman's equations. But both the models are based on the assumption of optical properties of human skin determined by three layers—stratum corneum, epidermis, and blood vessels in dermis. As some blood vessels may be present even below the dermis, hypodermis may be included for determining the blood vessel patterns.

4.6 Feature Extraction, Gridding and Information Fusion

Gabor and LBP features are extracted through dynamic and directional grid systems. But since the dynamic grid system is sensitive to viewpoint variations, blocks are rotated through different angle in directional grid system [14, 24]. The major blood vessels are given by all the optical models and the point sets can be fused to avoid noise. This is feature-level fusion. Similarly, score-level fusion can also be done [12] wherein weighted sum can be employed to combine the dissimilarity values from the optical models. All the above discussed techniques are given in Table 2.

5 Conclusion and Future Works

Androgenic hair patterns in their earlier study and analysis did not employ any gridding systems and the database used is also a relatively smaller one [30]. An extensive study on the same [24] which employed positive sample generation scheme, alignment of leg geometry, gridding and feature extraction yielded promising results compared to the previous study. Images captured using surveillance cameras are not considered in this study. In case of ear biometrics, ears with all anatomical features are considered and genetically deformed ones are not considered in this study [11]. And also, the study was limited to the Indian population. Periocular biometrics has a relatively rich literature wherein faces can be recognized irrespective of age, surgical operations on face [31], cataract surgery on periocular region [32], and gender transformation (Punam Kumari, In Press)@@. Further research on combination of handcrafted and non-handcrafted features for periocular identification, focus on critical components in that region, defining the optimal ROI, integrating semantic information with basic features, addressing the problem of overfitting owing to training with

Table 2 Techniques used in various works

Work	Pre-processing	Feature extraction	Matching
Vascular skin marks [26]	Not available	Quadrant counts and distance method	Global mapping and local mapping model
Silhouette [15]	Sampling at discrete points and uniform binning	Shape context descriptors	Cost matching technique (Hungarian)
Vein patterns [13]	Not available	Kulbeka Munk model to uncover vein patterns from distribution maps of melanin, haemoglobin and depth of dermis	Manual matching
Blood vessel patterns [12]	Automatic adjustment scheme for illumination intensity variation CLAHE for contrast adjustment	Gabor filter; Otsu's binarization and skeletonization Feature level and score level fusion	Coherent point drift (CPD)
Androgenic hair [24]	Positive sample generation and low resolution alignment	LBP and Gabor filters (Dynamic and directional grid systems)	PLS regression
Wrist [17]	SLIC and EoDT for skin identification Two stage scheme for wrist identification	LBP, Gabor filters SIFT,	PLS regression
Skin texture [14]	Positive sample generation and alignment with body boundaries	LBP and Gabor filters (dynamic and directional grid systems)	PLS regression
Ear [11]	Not available	Ten ear landmarks and the distances between them	Euclidean distances

small datasets, handling of medically altered images, and image acquisition from different spectrum [7].

Wrist identification was done for small dataset and low resolution images used here faced the same challenges like any other soft biometric [17]. In case of vein patterns also, small image dataset was used and it is anticipated that local context of vein pixels can improve person identification [13]. It was also observed that the accuracy of person identification through blood vessel patterns was comparatively less than other biometrics like iris, fingerprint, face, etc., Since usually evidence images and videos are compressed using JPEG and MPEG, restoring skin and other features from the same may be very demanding [12]. Skin texture like skin marks can be considered as soft biometric trait when many skin marks on large skin surface is considered.

Skin texture can outperform blood vessel patterns from NIR and color images [14]. When RPPVSM was employed as soft biometric, Complete Spatial Randomness (CSR) Test was laid as the assumption [26]. Only full back torsos were used for the study and the statistical model used here does not assume prior knowledge of the skin of torso. It does not focus on narrow body location. To deal with pose variations and camera viewpoint variations in evidence images, a 3D model can be used for transformation of images to standard pose and viewpoint for direct application of the method in the paper. Though low quality images are sufficient to identify individuals using this technique, emphasis on removal of JPEG blocking artifacts, motion blur in videos, compression problems can help in improving the accuracy. To handle the effect of make-up applied on the skin marks, image tampering method can be applied to pre-process the evidence images and video. RPPVSM identification technique used here is manual and time-consuming. Automated identification can help speed up the entire process.

The use of Shape Context for person identification through soft biometrics can be improved by extrapolating feature extraction over the entire body and exploit large set of soft biometrics [15]. Using other soft biometric traits like color, texture, face and gait along with Shape Context using multi-modal fusion techniques can improve the accuracy of person identification.

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DevOps Sensoring Neuro Cluster

Bipin Kumar Rai, Syed Aamir Hussain Zaidi, and Dhishwari Singh

Abstract The quality of grains and other perishable items stored in a warehouse is usually degraded due to the lack of monitoring and proper maintenance of their required appropriate conditions in such a large area. The proposed methodology deals with storage grains, fruits, etc., and to recognize their pattern of temperature and humidity which will not cause degradation of them. To set up the environment regarding the nature of the crop so that an optimal threshold can be set with a proper format of monitoring and altering.

Keywords Monitoring of warehouse · NodeMCU · DHT-11 · Machine learning · Internet of Things (IoT)

1 Introduction

The monitoring of the conditions of a warehouse according to the suitable atmosphere of the logistics is a very tough task to manage [1]. Storage is not the problem but maintaining the quality of the product is a major problem. In order to ensure the quality, we have to meet the required optimal temperature and humidity of the product. If these requirements are not fulfilled according to the optimal range, then the quality of the product will be degraded for sure [2].

The economy and life fully depends on the agricultural and therefore it very essential to store food grains with proper precautions and care. The storage area are most important to farmers, as the better the storage area, the better will be the quality of food grains [3].

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2 Related Work

Kumar et al. [4] this paper discuss the importance of IoT that has changed the way of living into a high tech lifestyle. This paper also discusses the various challenges and issues of IoT. Sathiyanathan et al. [5] this paper discuss the various IoT application domain to understand the various approaches that have recently been proposed based on a systematic literature review (SLR). Rai [6] discussed issues for maintaining privacy and security in any information system.

Kumar et al. [7] proposed a Smart System that monitors the grains in storage areas. The system monitors parameters like temperature, humidity and light, to control the damage to the grains. Also this systems detects the insects and fungus, two factors which damage the grains are also controlled by temperature, humidity and light. Suryawanshi et al. [8] proposed a system for food grain storage that timely monitors the temperature and humidity, which are the main two factors that can affect the quality of grain. In this, the overall system consists of two components, the host computer, and the lower computer terminal. Yanghui et al. [9] this paper proposed a warehouse environment monitoring system that means the most important parameters, air temperature, and relative humidity. In this paper, the design of warehouse multipoint temperature and humidity monitoring system based on king view. This system can measure multipoint temperature and humidity real-time data by using the temperature and humidity sensor. Karim et al. [10] proposed a kind of storage that can preserve raw foods for a while. In this paper, the proposed system monitors the temperature and humidity using different IoT sensors. Sujeetha et al. [11] clearly discuss ecological conditions and any type of error that can cause misfortune in the pharmaceutical and horticultural enterprises. In this paper, the system can measure the temperature and humidity, so that the productivity in the agricultural sector can increase rapidly. Today's weather forecasting system is based on Satellite and Radar. But this system closely monitors the agricultural field including the humidity, temperature, moisture, light intensity, and water leakage. Mohanraj et al. [12] proposed a Warehouse Monitoring system with the help of IoT Technology. The proposed system capture temperature, moisture, earthquake, and fire-related information using sensors and send alerts using IoT. Kishor et al. [13] focuses the importance of monitoring in today's life and the importance of Internet of Things (IoT) and related technologies. The proposed system uses IoT Technology and consists of Arduino based monitoring and uses NodeMCU wifi module. The system can read the data from the sensors and allows different devices controlling.

Parwez et al. [14] describes various problems faced by Indian Agriculture for food security due to inadequate infrastructure and highly inefficient supply chain. This paper examines the issues in each system of the agriculture supply chain. Chaturvedi et al. [15] discussed the losses of food grain in the country due to the lack of storage facilities and also poor management of the storage available. This paper also highlights the problem of wastage of food grains that are stored against the limited amount.

3 Proposed Solution

NodeMCU and DHT-11 is installed in different sections of the warehouse to record the temperature and humidity of the area. This data is sent through firebase to flask API. The overall setup is to maintain the temperature and humidity according to the threshold of the grain. The readings are visible on the Grafana Dashboard. The website shows the items stored in the warehouse, the instructions for maintaining the appropriate conditions for the grains etc. Also, it shows the locations of the warehouses of the same company around the globe.

3.1 Design

See Fig. 1.

3.1.1 Architecture

We are using NodeMCU because there is a need to transmit sensor data wirelessly and through wifi is most reliable option as of now. NodeMCU is used for making prototypes of IoT devices in network projects. It is used for low-power battery operated operations and so it is feasible.

Other than bluetooth, LORA, Transmitter and receiver connection, NodeMCU can connect to wifi as well as it can transmit data from sensors it is connected with or else it can receive commands in order to execute any task.

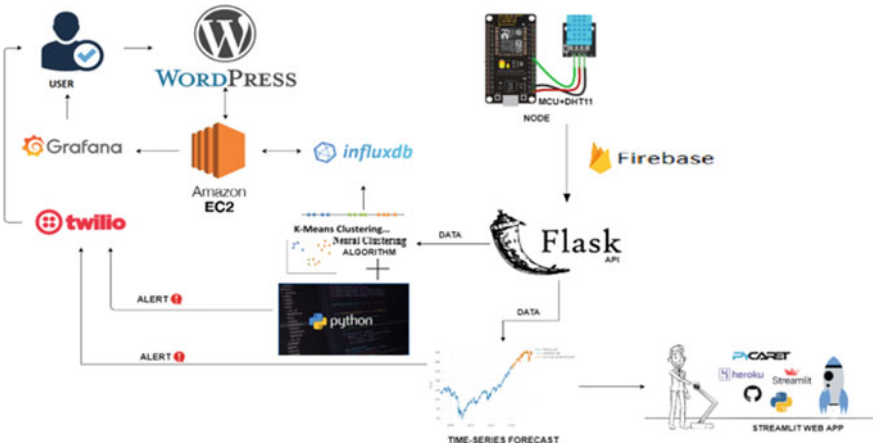


Fig. 1: Architecture

We are using DHT-11 to update the data in every 2 s. DHT-11 is a low-cost sensor for calculating digital temperature and humidity. NodeMCU with DHT-11 is installed in each section of the warehouse for taking the readings of the temperature and humidity of the specific area. The data is sent to Flask API through firebase.

With Firebase we are syncing the offline and online data by NoSQL database. This allows the data available on both offline and online. This boosts alliance on the application data in real time. The main benefits of firebase are it's speed and also uptime is very good.

From the flask API, we are classifying the data into clusters by k-means clustering algorithm and python code for the detection of the condition, if the condition is appropriate or not.

The data after clustering is sent to the influx-db (database) which is a time-series database, performs analytics to get faster detection and resolution and it is hosted using Amazon Ec2. The main advantages of hosting the Amazon EC2 is scalability and load balancing.

We are using Amazon EC2 for Amazon Elastic Compute Cloud (Amazon EC2) is a web service that gives safe, scalable compute volume in the cloud.

We are using Grafana to visualize the data and can use different graphs and plot so that user can get the best experience. We are visualizing appropriate condition of each segment of the warehouse on Grafana dashboard which is monitored by the user of the warehouse. Grafana dashboard is used for large scale deployment.

Also the data from Flask API is sent for time-series forecast by FBprophets of Facebook for the monitoring of temperature and humidity of the particular area at every second which is shown using Streamlit Web-app.

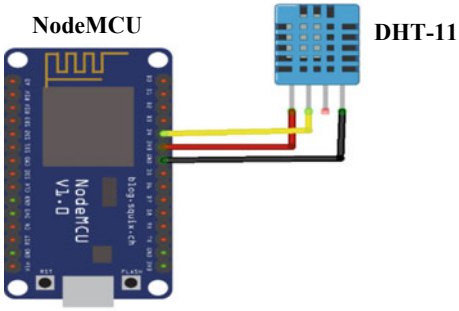
Using Streamlit, we are creating basic and simple user interface for machine learning model. We can build machine learning tools right from the initial phase of the project. We are visualizing code output while examining data. Then this data is used for two purposes one is for forecasting with the help of prophet time series forecasting method displayed using Streamlit.

We are using Prophet to predict the time series data based on our model. Prophet is a plan for forecasting time series data established on an additive model where non-linear trends are fit with daily, weekly, and yearly, and holiday effects.

3.1.2 Circuit Diagram of NodeMCU and DHT-11

See Fig. 2.

Fig. 2: Circuit diagram



3.2 Algorithm

3.2.1 Neural Clustering Algorithm

1. z1 = distance.euclidean (temp, th_temp)
2. z2 = distance.euclidean (hum, th_hum)
3. z = (math.sqrt(z1 + z2))/2
4. res = 1/(1 + np.exp(−z))
5. li.append(res)
6. df['pred'] = li
7. kmeans = Kmeans (n_clusters = 2, random_state = 0).fit(df[['pred']])

3.3 Sigmoid Function

We have used sigmoid function to predict the probability between the range of 0–1 and this function is specially used for models where we have to predict probability as an output. Also it's range is between 0 to 1, which means it exists within this range only.

3.4 Model.fit()

The entire set of data can be fitted into the memory using .fit() function. The outcome is accurate if the model is fitted properly. The assumptions are being made for the training of data. This is an essential process required to gain a high level of accuracy for our model.

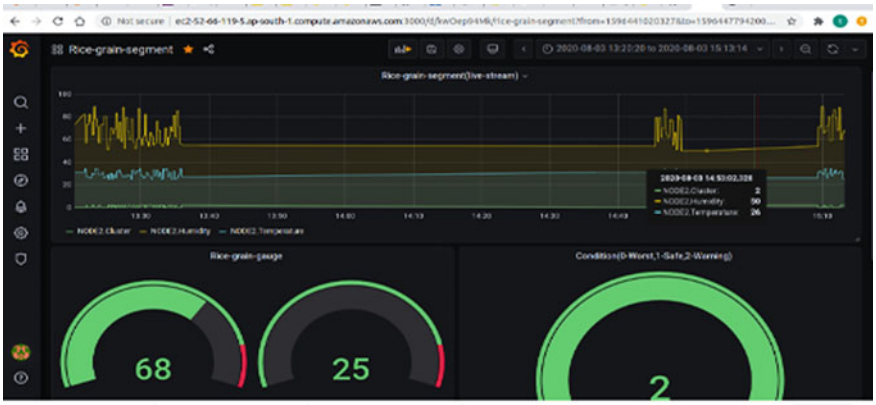


Fig. 3: Grafana dashboard

4 Results

4.1 Model.predict()

Python predict() function enables us to predict the labels of the data values on the basis of the trained model.

The predict() function accepts only a single argument which is usually the data to be tested. It returns the labels of the data passed as an argument based upon the learned or trained data acquired from the model.

Thus, the predict() function works on top of the trained model and makes use of the learned label to map and predict the labels for the data to be tested.

4.2 Grafana Dashboard

Grafana Dashboard showing the current condition according to the threshold of Temperature and Humidity for the stored item (Fig. 3).

4.3 Prophet

Prophet (daily_seasonality = True, weekly_seasonality = False, yearly_seasonality = False.

Prophet Graph showing date on X-axis and corresponding temperature on Y-axis and predicting the Temperature based on some initial readings (Fig. 4).

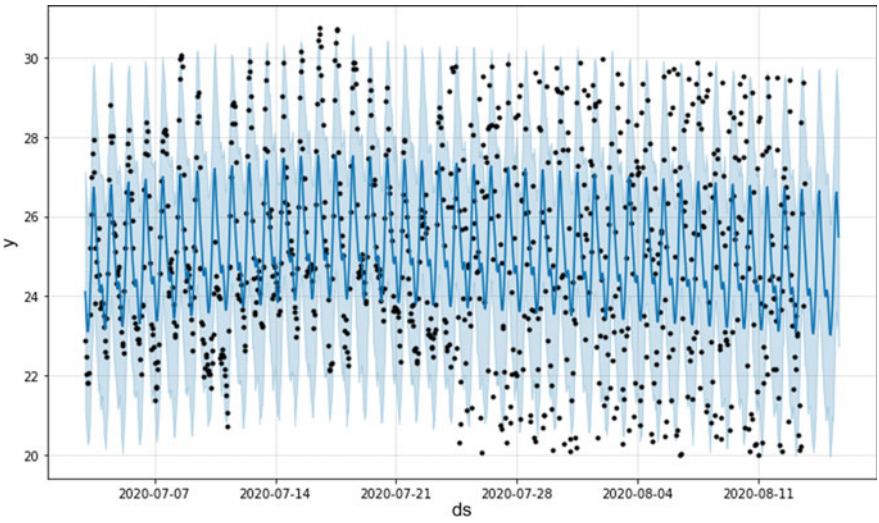


Fig. 4: Prophet temperature reading

4.4 Elbow Method (Finding Optimal Cluster)

Elbow Method Graph showing the optimal number of k that can be used in clustering to get accurate results (Fig. 5).

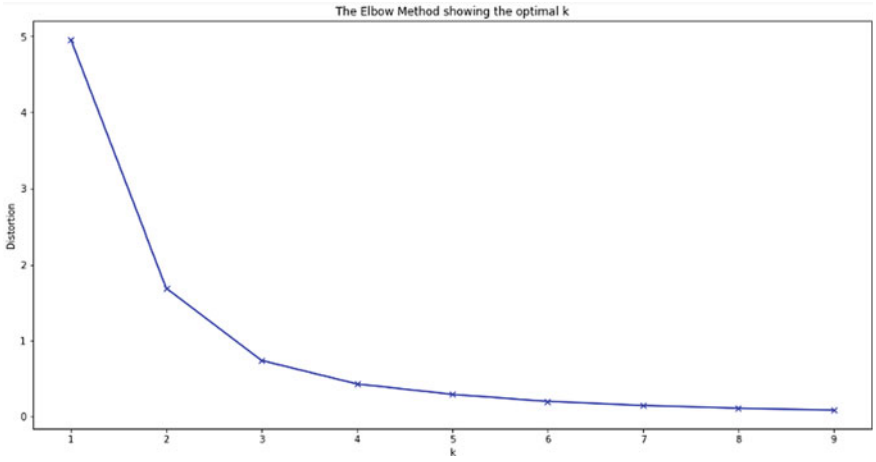


Fig. 5: Elbow method graph for clusters

5 Conclusion

The proposed model has proven to successfully acquire accurate measurements of temperature and humidity. An alarm is sent on to the person in charge or observing person if the value received is above the threshold limit. So, we can easily monitor the items stored in the warehouse and prevents damage to the grains thus maintaining the quality and increasing the life of items stored.

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Simulation of OFDM MIMO with IDMA for Underwater Acoustic Communication

Salma S. Shahapur, Rajashri Khanai, and D. A. Torse

Abstract This paper describes an underwater acoustic communication with Interleaver Division Multiple Access Orthogonal Frequency Division Multiplexing Multiple Input Multiple Output. IDMA OFDM MIMO is emerging technology in underwater acoustic communication for high data rate. However, underwater channels are prone to errors. To perform the reliable communication in underwater communication we propose the IDMA OFDM MIMO technique. Simulation results are investigated for different coding techniques Turbo/LDPC, various modulation procedures Phase Reversal Keying/Quadrature Point Shift Keying/Quadrature Amplitude Modulation and three interleavers Random/Helical/Matrix. Simulation results reveals that the combination Phase Reversal Keying modulation with Turbo encoding and Random interleaver advances the Bit Error Rate performance.

Keywords BER · Coding · IDMA · Modulation

1 Introduction

In underwater wireless acoustic communication nodes are placed at different depths to achieve certain work like oceanographic information gathering, monitoring the pollution in the water, offshore exploration applications. Autonomous Underwater Vehicles or Unmanned Underwater Vehicles consists of underwater acoustic sensor sand are used for undersea survey of expected resources as well as collecting of precise data required for scientific work. For these requests possible, it is necessary to permit communication between the nodes in the underwater. These Autonomous

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Underwater vehicle or Unmanned Underwater Vehicle must be self-configured and send the collected data to the onshore station. For these applications viable Underwater Acoustic Wireless Networking is the best technology. Underwater communication through Acoustic link consists of adjustable number of sensor nodes sand underwater vehicles that are placed in the water to achieve cooperative monitoring responsibilities over the given zone. To attain the objectives in the underwater communication, underwater sensor nodes and underwater vehicles must be wirelessly connected with acoustic link in the ocean atmosphere. In underwater communication for data collection Acoustic communications is used. For long distance transmission through radio waves signal attenuates [1]. In underwater radio waves can be used at lower frequencies (30–300 Hz) and with this range of frequency large antenna is required, transmission power is high. In underwater optical wave when used to send data they suffer from scattering. Thus, in underwater communication acoustic links are preferred for communications [2]. In traditional method to gather the information in underwater sensor nodes are placed in the water, during the monitoring mission data is recorded in the nodes, and those nodes are collected after few months. This style has the disadvantages:

- As the nodes are collected after few months, online monitoring of data is not conceivable. This is serious in case of observation or in ecological monitoring requests.
- The noted information is not possible to measure till the nodes are collected. That will happen after few months.
- It is not possible to interact among ground controller station and the underwater nodes. Hence it is not possible to reconfigure the arrangement.
- If the node fails or system fails, till the nodes are collected it is not possible to configure the system. This causes the complete failure of the system.
- The amount of data that can be recorded by the sensor nodes are limited because of storage devices.

Hence there is a requirement to deploy the nodes in the water such that they do the real time monitoring of selected areas. In the underwater at different depths nodes are placed, these nodes communicate with each other through acoustic link. Nodes collect information and forward to the base station through acoustic link. Since acoustic communication is affected by multipath, noise due to turbulence, shipping, delay. Bandwidth in underwater is severely limited to 5 kHz as the frequency range is less [3]. The communication range is intensely compact. In our work, we propose Multiple Input Multiple Output scheme combined with Interleaver Division Multiple Access and Orthogonal Frequency Division Multiplexing technique using LDPC and Turbo coding structure combined with interleavers as Random, Matrix and Helical and Binary Phase Shift Keying, Quadrature Point Shift Keying, Quadrature Amplitude Modulation techniques. Performance parameters Bit Error ratio and Power is compared for different combinations. In segment II the block illustration of planned scheme is shown. In segment III associated determination is presented. In segment IV results are shown.

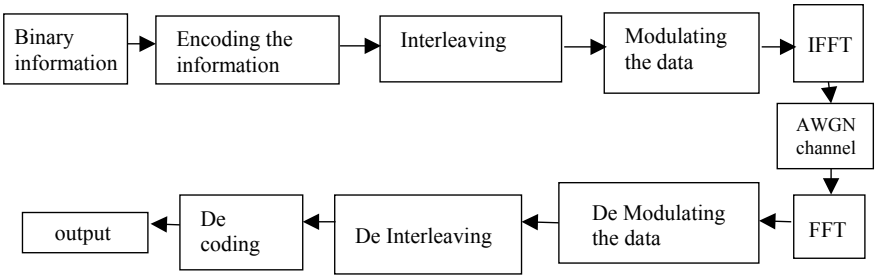

Fig. 1 IDMA OFDM MIMO

2 Block Diagram of IDMA OFDM MIMO

For consistent information broadcast in UWSN, IDMA OFDM MIMO technique as shown in Fig. 1 is executed with numerous coding procedures, dissimilar interleavers and various modulation practices and concert constraints are associated.

3 Related Work

Analytical in Table 1, the literature survey related to the work is presented**.** Using Orthogonal Frequency Division Multiplexing (OFDM) method the bandwidth can be reduced and in comparison, to Frequency Division Multiplexing (FDM), OFDM alleviate the multipath effect [4]. The author has compared for underwater communication the performance parameter such as BER of OFDM and FDM method. Data can be transmitted with more than one antenna and also same data can be received with more than one antenna using Multiple-Input and Multiple-Output (MIMO) arrangement [3]. Communication in underwater using acoustic link, data rate is small and bandwidth is limited [5], using Multiple Input Multiple Output (MIMO) information rate will be increased and bandwidth is controlled. For underwater acoustic communication Multiple access arrangement is used, such that the allocated spectrum and bandwidth can be efficiently used by number of users [6]. IDMA method uses the Inteleaving scheme. In IDMA efficiently data is distributing to the users [7]. The current methods on underwater wireless communication concentrate on only IDMA scheme or only MIMO-OFDM technique [8]. These methods do not resolve the problems of underwater acoustic communication. In terms of bandwidth Frequency

Table 1 Related work

References	Coding technique	Modulation	Interleaver	BER
[8]	Low density parity check	BPSK	Random interleaving	10^{-4}
[1]	Hamming encoder	QAM	Random interleaving	10^{-4}

Division Multiple Access (FDMA) results in inefficient and restrictive performance [9].

4 Methodology Used

In this paper we have used Interleaver Division Multiple Access Orthogonal Frequency Division Multiplexing Multiple Input Multiple Output (IDMA OFDM MIMO) scheme. In IDMA OFDM MIMO technique we checked the different performance parameters Bit Error Ratio (BER), power ingesting. In our work we used LDPC/Turbo coding technique, in the interleaving section we used Random/Helical/Matrix interleavers. In the modulation section Phase Reversal Keying/Quadrature Point Shift Keying/Quadrature Amplitude Modulation procedures is used. Turbo code combined with Random interleaving and Binary PSK variation gives improved BER performance in the underwater Acoustic channel with IDMA OFDM MIMO scheme.

5 Results and Discussion

In the traditional underwater acoustic communication, the noted data cannot be read till the devices are collected that will occur after few calendar months. There is a need for real time underwater communication such that BER should be improved and power consumption should be reduced.

5.1 UWSN with LDPC Coding, Interleaver as Random

Figure 2 shows comparison of Bit Error Rate and Fig. 3 shows the power consumption with LDPC code combined with interleaver as Random and modulation as Phase Reversal Keying, Quadrature Point Shift Keying, Quadrature Amplitude Modulation. Bit Error Ratio is approximately 10^{-3}, the power measured for BPSK is 33 dB and for QPSK/QAM power consumption is 40 dB for E_b/N_o 14−16 dB. Results are tabulated in Table 2.

5.2 UWSN with LDPC Coding, Matrix Interleaver

Figure 4 shows the assessment of Bit Error Rate and Fig. 5 shows the power consumption with LDPC code combined with interleaver as Matrix and modulation as Phase Reversal Keying, Quadrature Point Shift Keying, Quadrature Amplitude Modulation.

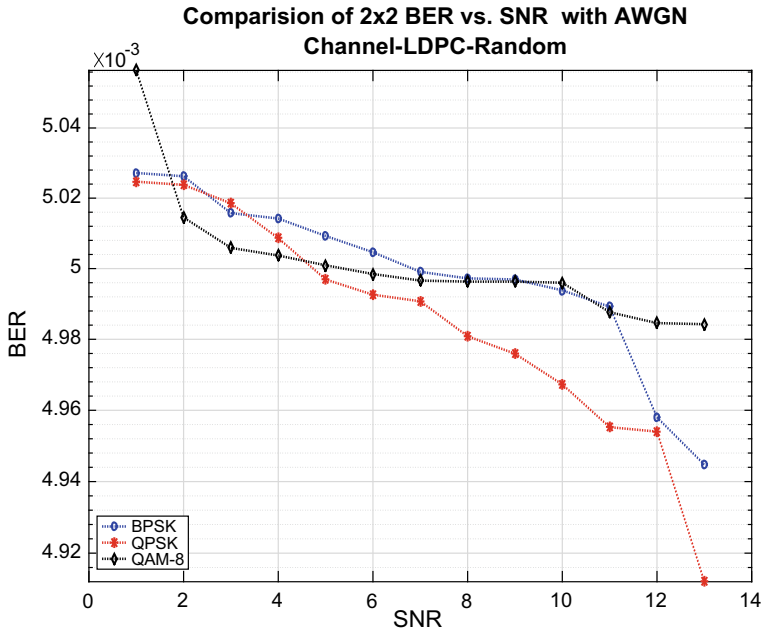

Fig. 2 Bit error rate with LDPC code, random interleaver

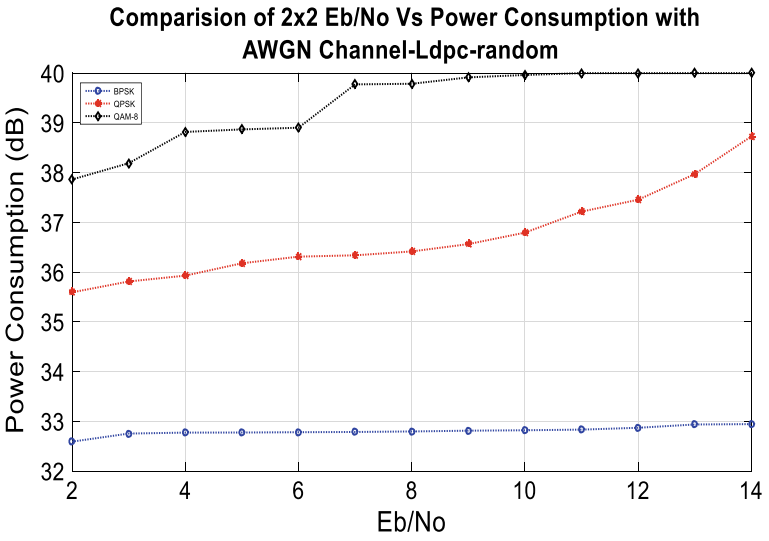

Fig. 3 Power consumption with LDPC code, random interleaver

Table 2 BER and power with LDPC and random interleaver

Modulation method	Coding	Interleavering	Bit error rate	Power in dB
BPSK	Low density parity check	Random interleaver	10^{-3}	39
QPSK	Low density parity check	Random interleaver	10^{-3}	39
QAM	Low density parity check	Random interleaver	10^{-3}	40

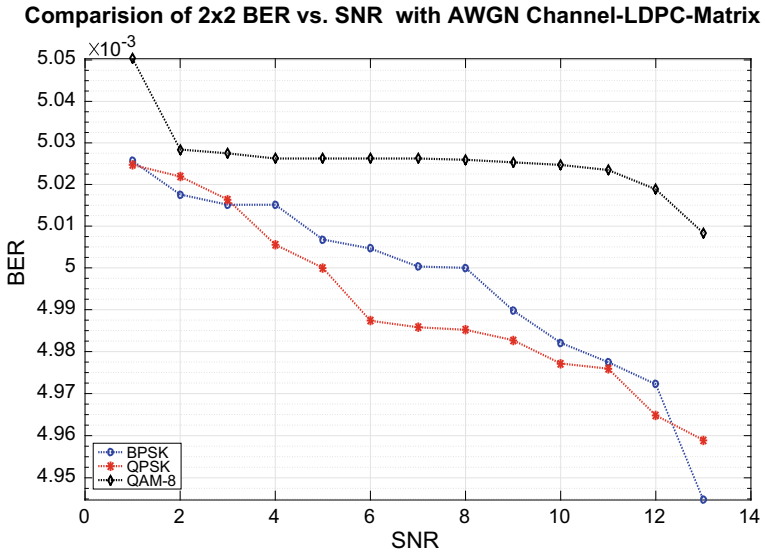

Fig. 4 Bit error rate with LDPC code, matrix interleaver

Results are tabulated in Table 3. Bit Error Rate is approximately 10^{-3}, the power measured for BPSK is 29 dB and for QPSK/QAM power consumption is 39 dB for E_b/N_o 14–16 dB.

5.3 UWSN with LDPC Coding, Helical Interleaver

Figure 6 shows the assessment of Bit Error Rate and Fig. 7 shows the power consumption with LDPC code combined with interleaver as Helical and modulation as Phase Reversal Keying, Quadrature Point Shift Keying, Quadrature Amplitude Modulation. Results are tabulated in Table 4. Bit Error Rate is approximately 10^{-3}, the power measured for BPSK is 36 dB and for QPSK/QAM power consumption is 40 dB for E_b/N_o 14–16 dB.

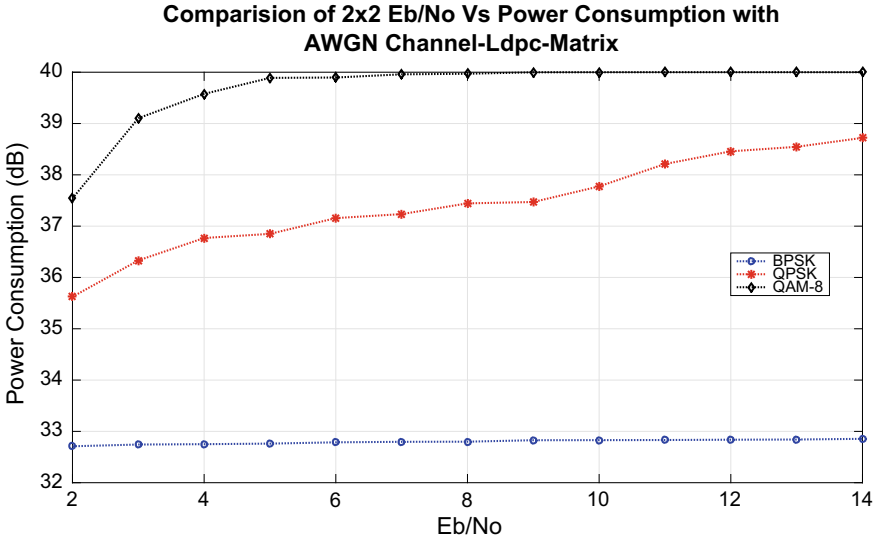

Fig. 5 Power consumption with LDPC code, matrix interleaver

Table 3 BER and power with LDPC and matrix interleaver

Modulation method	Coding	Interleavering	Bit error rate	Power in dB
BPSK	Low density parity check	Matrix interleaver	10^{-3}	33
QPSK	Low density parity check	Matrix interleaver	10^{-3}	38
QAM	Low density parity check	Matrix interleaver	10^{-3}	40

5.4 UWSN with LDPC Coding, Random Interleaver

Figure 8 shows the assessment of Bit Error Rate and Fig. 9 shows the power consumption with Turbo code combined with interleaver as Random and modulation as Phase Reversal Keying, Quadrature Point Shift Keying, Quadrature Amplitude Modulation. Results are tabulated in Table 5. Bit Error Rate for BPSK is approximately 10^{-6}, for QPSK 10^{-4}, for QAM 10^{-3}. The control measured for BPSK/QPSK/QAM is 36 dB for E_b/N_o 14–16 dB.

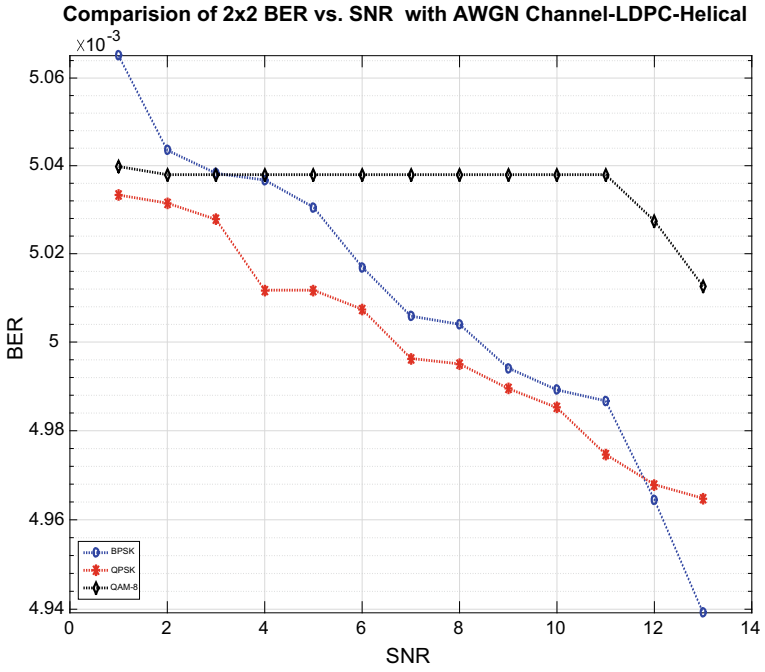

Fig. 6 Bit error rate with LDPC code, helical interleaver

5.5 UWSN with LDPC Coding, Matrix Interleaver

Figure 10 shows the assessment of Bit Error Rate and Fig. 11 shows the power consumption with Turbo code combined with interleaver as Matrix and modulation as Phase Reversal Keying, Quadrature Point Shift Keying, Quadrature Amplitude Modulation. Bit Error Amount is approximately 10^{-3}. The control measured for BPSK/QPSK/QAM is 36 dB for E_b/N_o 14–16 dB. Results are tabulated in Table 6.

5.6 UWSN with LDPC Coding, Helical Interleaver

Figure 12 shows the assessment of Bit Error Rate and Figure 13 shows the control feasting with Turbo encode combined with interleaving as Helical and modulation as Phase Reversal Keying, Quadrature Phase Shift Keying, Quadrature Amplitude Modulation. Bit Error Amount is approximately 10^{-3}. The control measured for BPSK/QPSK/QAM is 30 dB for E_b/N_o 12–14 dB. Results are tabulated in Table 7.

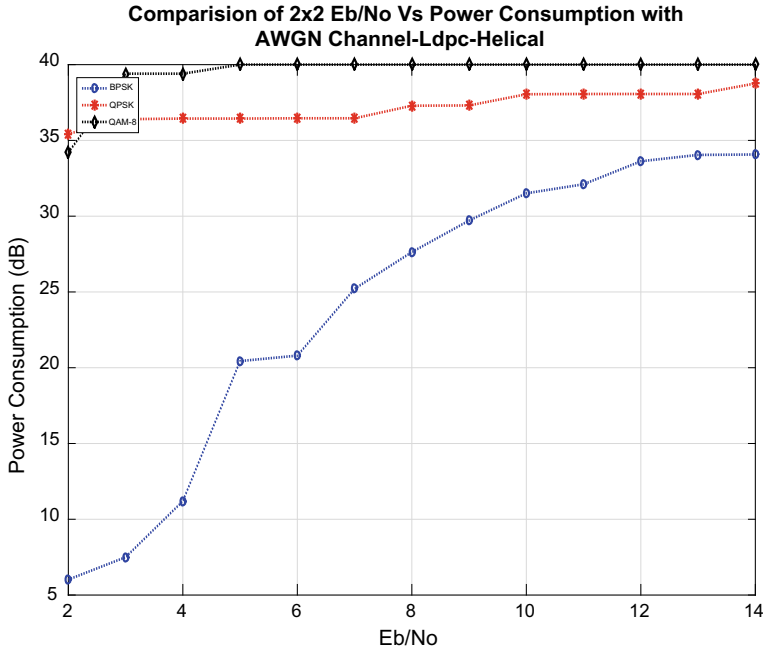

Fig. 7 Power consumption with LDPC code, helical interleaver

Table 4 BER and power with LDPC and helical interleaver

Modulation method	Coding	Interleavering	Bit error rate	Power in dB
BPSK	Low density parity check	Helical interleaver	10^{-3}	36
QPSK	Low density parity check	Helical interleaver	10^{-3}	40
QAM	Low density parity check	Helical interleaver	10^{-3}	40

6 Conclusion

In this paper, to improve the reliability of information send from the underwater to the base station we propose IDMA OFDM MIMO with two channel coding methods, three interleavers, three modulation methods. Simulation is performed in the MATLAB. From simulation results we conclude that BPSK modulation technique with LDPC code and Matrix interleaver have BER of 10^{-3} and energy ingesting is 29 dB at SNR 14-16 dB. Grouping of Binary Phase Shift Keying with Turbo encoding (Random Interleaver) progresses the BER up to 10^{-6}, energy ingesting is 35 dB at 14–16 dB. Simulation result offers trade-off between BER and power consumption.

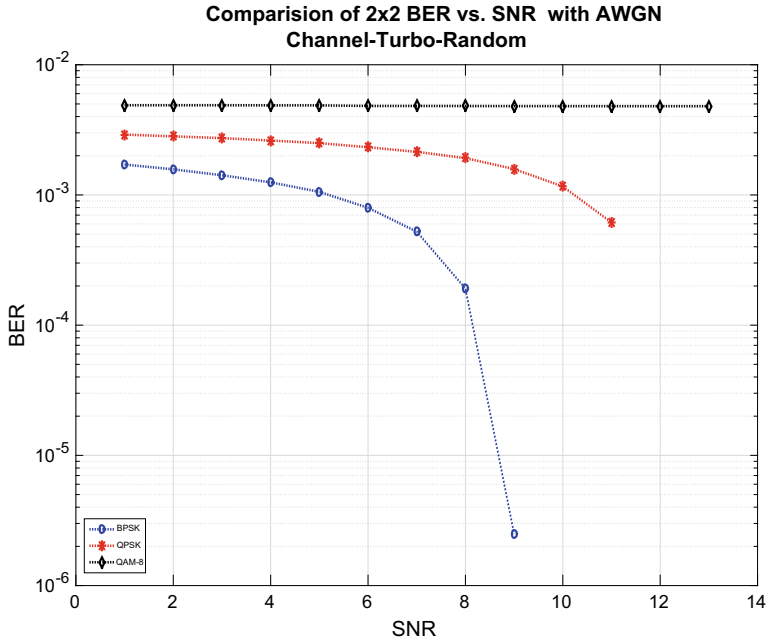

Fig. 8 Bit error rate with Turbo code, random interleaver

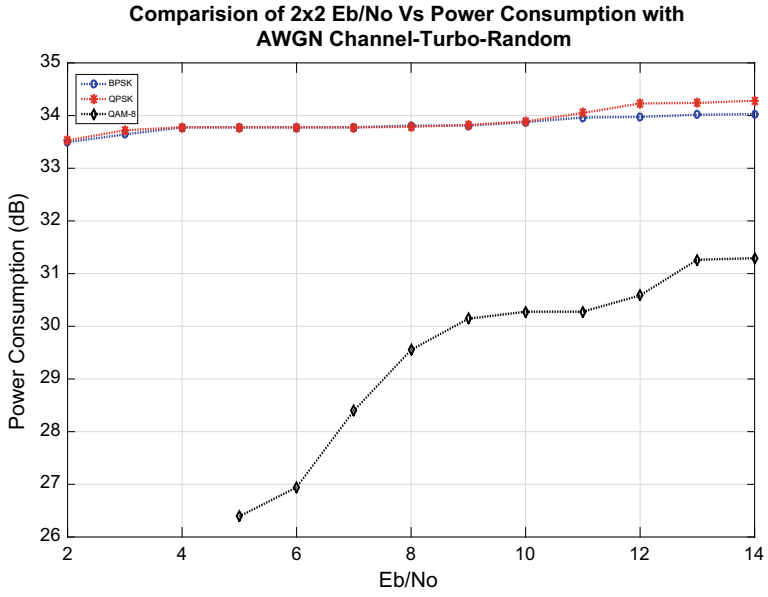

Fig. 9 Power consumption with Turbo code, random nterleaver

Table 5 BER and power with Turbo and random interleaver

Modulation method	Coding	Interleavering	Bit error rate	Power in dB
BPSK	Turbo code	Random interleaver	10^{-6}	35
QPSK	Turbo code	Random interleaver	10^{-3}	35
QAM	Turbo code	Random interleaver	10^{-3}	32

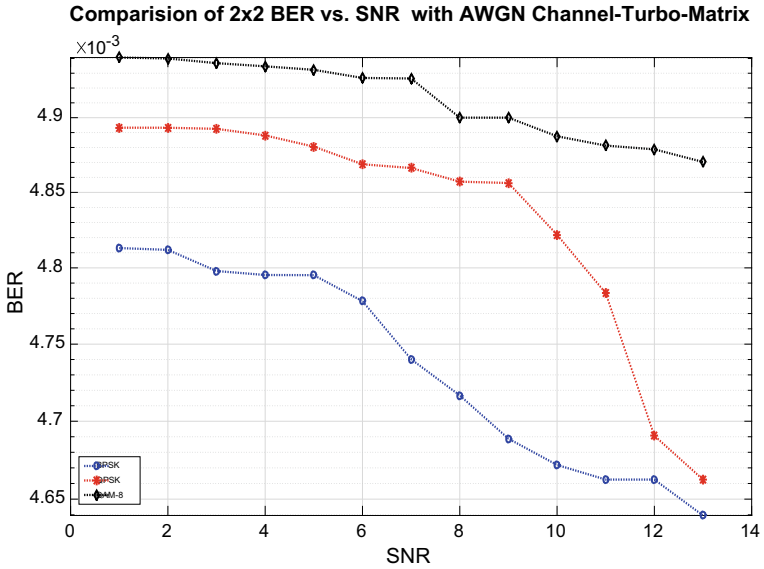

Fig. 10 Bit error rate with Turbo code, matrix interleaver

In the future work the above results can be combined with MAC layer as cross layer approach.

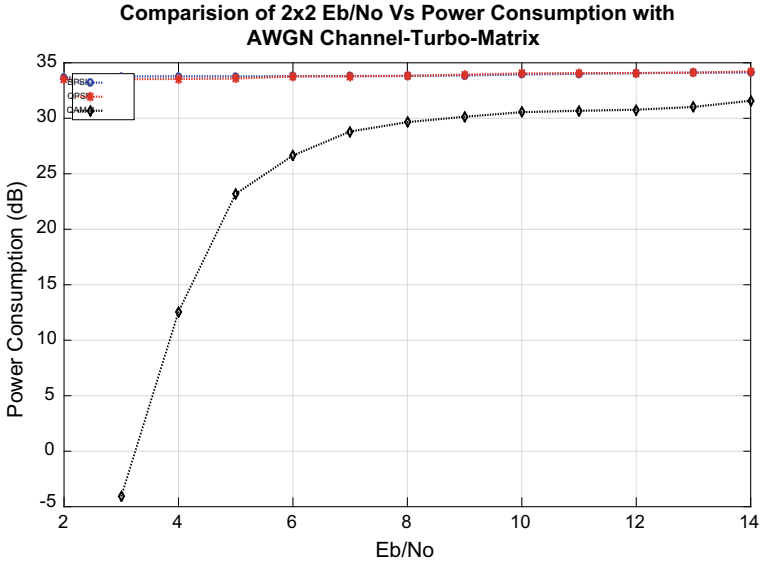

Fig. 11 Power consumption with Turbo code, matrix interleaver

Table 6 BER and power with Turbo and matrix interleaver

Modulation method	Coding	interleavering	Bit Error Rate	Power in dB
BPSK	Turbo coding	Matrix interleaver	10^{-3}	34
QPSK	Turbo coding	Matrix interleaver	10^{-3}	34
QAM	Turbo coding	Matrix interleaver	10^{-3}	32

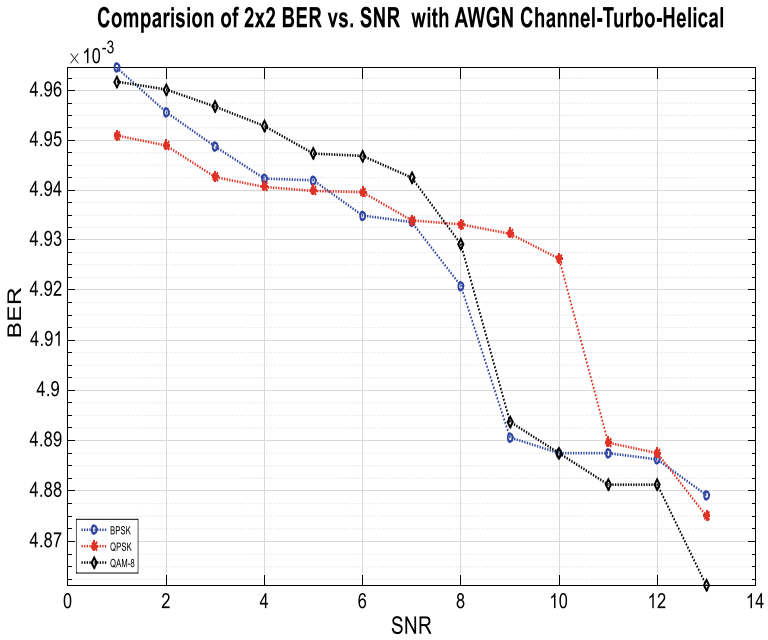

Fig. 12 Bit error rate with Turbo code, helical interleaver

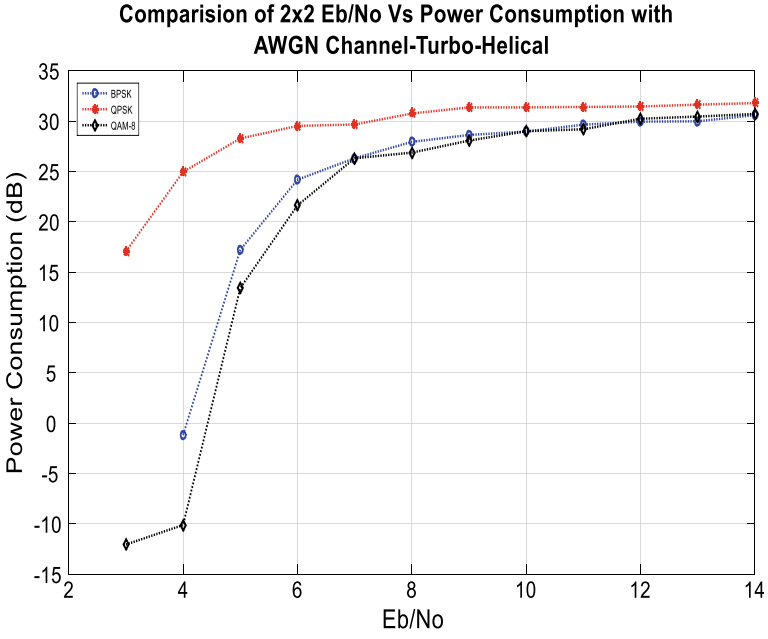

Fig. 13 Power consumption with Turbo code, helical interleaver

Table 7 BER and power with Turbo and Helical interleaver

Modulation method	Coding	Interleavering	Bit error rate	Power in dB
BPSK	Turbo coding	Helical interleaver	10^{-3}	32
QPSK	Turbo coding	Helical Interleaver	10^{-3}	31
QAM	Turbo coding	Helical interleaver	10^{-3}	31

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Image Despeckling Using Hybrid Method

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Abstract The Synthetic Aperture Radar (SAR) is a satellite imaging which is severely degraded by noise and appears as granular pattern which affects the overall quality of the image and causes difficulty in interpretation and further processing like segmentation, detection and recognition of the target in the image for computer vision systems and also for manual interpreters. Speckle noise is multiplicative nature and it is complicated to filter it. In this paper a hybrid methods consisting of Frost filter and bayes thresholding are implemented for the removal of Speckle noise and qualitative measures like PSNR and MSE are evaluated.

Keywords Speckle noise · Denoising · SAR image · Frost filter · Bayes thresholding

1 Introduction

An image gets corrupted due to noise and the sources of noise in an image most often occurs image acquisition of image, storing image, transmitting of images, compressing images etc. [1, 2]. The image may be corrupted by different types of noises like Gaussian noise, salt and pepper noise and speckle noise therefore it is necessary to apply different techniques for different types of noises. The basic step in an image processing is Image denoising which is to remove various kinds of noises present in the image. Image denoising finds its application in image processing and computer vision problems. Various methods are used for denoising an image and the important feature of a good image denoising model is to completely remove noise as far as possible while preserving the edges. The image denoising technique will be mainly depending on the type of the image and noise in cooperating with it [3]. Speckle noise which is multiplicative in nature and it contains high frequency components. So a low pass filter is used to remove the high frequency noise. To remove speckle noise from images till now many filters are used [4].

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Some filters are good in visual interpretation where as some are good in smoothing capabilities and noise reduction. Mean, Median, Lee, Frost, Enhanced Frost are few examples of Filters [2]. Some of filters use windowing technique to remove speckle noise and it is called as kernel [5]. The size of this window can vary from 3 × 3 to 33 × 33 and it must be odd number. In order to achieve better results window size should be smaller [2].

2 Noise Model

In general there are two basic types of noises that affect an image; an additive noise and a multiplicative noise. An image which is degraded by an additive noise can systematically mode-led and can be easily removed with lesser efforts. While a multiplicative noise gets multiplied with each pixel values of an image. Speckle noise is a multiplicative in nature.

Let I(i, j) be an image, $N(i, j)$ be the noise, $Y(i, j)$ be degraded image with multiplicative noise then

$$\mathrm{Y(i, j)} = \mathrm{I(i, j)} * \mathrm{N(i, j)} \tag{1}$$

By applying logarithmic to Eq. (1) multiplicative noise is converted into additive noise which is given by

$$\mathrm{Y(i, j)} = \mathrm{I(i, j)} + \mathrm{N(i, j)} \tag{2}$$

SAR images are affected by speckle noise and which is caused by random interference of backscattered echoes caused due to roughness of the target object is complex to model and difficult to reduce the speckle from degraded image since it also contains useful information. Synthetic Aperture Radar (SAR) is a satellite imaging which are severely degraded by noise and appears as granular pattern which affects the overall quality of the image which causes difficulty in interpretation and further processing like segmentation, detection and recognition of the target in the image for computer vision systems and also for manual interpreters. So it is mandatory to remove speckle from SAR images for the image processing community, for performing better post processing operations on SAR images and for effective human interpretation too.

3 Speckle Reduction Techniques

There are two approaches in which speckle noise can be reduced they are

1. Spatial Domain Technique
2. Transform Domain Technique.

Both the technique has its own advantages and disadvantage and they are applied in accordance to the requirements. In Spatial filtering the filtering operations directly performed on the pixels of an image. In this process filter mask is moved from point to point in an image. The response of the filtering operation at each point (x, y) is calculated using a predefined relationship.

Spatial domain filtering is categorized into two types: Non-adaptive and adaptive. In non-adaptive method of filtering the parameters of the full image is considered but not the local properties of the image. This property of non adaptive filtering is not suitable for non-stationary signals. FFT is an example for non adaptive filtering. This filter not only filters noise but it also eliminates actual image information, particularly, the high-frequency information [2].

In Adaptive method of filtering the local properties of the image are considered. Gamma MAP, Lee, Frost, Kuan and their modified versions are example of adaptive filters in which filtering operation makes use of the statistical properties of the image. Median filter is an example of non adaptive filter and they do not make use of any statistical properties of the image [6, 7].

3.1 Bayes Soft Thresholding

The Bayes Shrink method is an adaptive method in which different thresholds are set for every sub band. These sub-bands are frequency bands which are different from each other in level of decomposition and also direction [8–11]. Bayes Shrink uses soft Thresholding. Bayes Shrink method approximates a threshold value which aims at minimizing the Bayesian risk by assuming Generalized Gaussian Distribution (GGD) prior [12]. The optimal Bayes threshold value is given as [7]. In Bayes Thresholding for each sub band is determined assuming Generalized Gaussian Distribution (GCD) [13].

The observation model is given by

$$Y = X + V \tag{3}$$

where Y is obtained by applying wavelet transform to the degraded image, X is obtained by applying the wavelet transform to the original image or uncorrupted image, and V denotes the wavelet transform of the noise components.

X and V are mutually independent therefore the variances σ_y^2, σ_x^2 and σ_v^2 of y, x and v are given

$$\sigma_y^2 = \sigma_x^2 + \sigma_v^2 \tag{4}$$

The sub-band of wavelet decomposition of level 1 is used for estimation of noise variance which

$$\sigma_v^2 = \left[\frac{median(|HH_1|)}{0.6745}\right]^2 \tag{5}$$

The variance for each sub-band of degraded image can be estimated as:

$$\sigma_y^2 = \frac{1}{M}\sum_{n=1}^{M} A_m^2 \tag{6}$$

where A_m is the coefficients of sub-band, M is the total number of wavelet coefficient in that sub-band.

The variance of signal is computed by

$$\sigma_x = \sqrt{\max(\sigma_y^2 - \sigma_v^2} \tag{7}$$

The optimal Bayes threshold value is given as [7]

$$T_b = \begin{cases} \frac{\sigma_v^2}{\sigma_x^2}, if\, \sigma_v^2 < \sigma_y^2 \\ 0, otherwise \end{cases} \tag{8}$$

where σ_v^2 is noise variance

σ_x^2 is signal variance without noise.

3.2 Frost Filter

In order to achieve better results several adaptation methods has been proposed and also varying window size is used and it is also important to preserve the features like edges [2]. One such adaptive filter is Frost filter which was Invented by Frost in 1982 it is a linear and Convolutional filter used to remove the multiplicative noise from images. Frost filter is adaptive in nature unlike mean and median filters with exponentially-weighted averaging filter. Frost filter computes the variation coefficient which is given by the ratio of local standard deviation to the local mean of the corrupted image. A kernel size of n-by-n is selected and the centre pixel value is changed by computing the weighted sum of values of the neighborhood in kernel. The weighting factor decrease as we go away from interested pixel and increase with variance [2]. It assumes multiplicative noise. Frost filter follows formula given by

$$I_D = \sum_{n*n} K\alpha e^{-\alpha|t|} \tag{9}$$

where α is given by

$$\alpha = \left(\frac{4}{n * \overline{\sigma^2}}\right) * \left(\frac{\sigma^2}{\overline{I^2}}\right) \tag{10}$$

K Normalized constant
$\overline{I^2}$ Local Mean
σ Local variance
$\overline{\sigma}$ Image coefficient of variation value
$|t|$ $|X - X_0| + |Y - Y_0|$
n moving kernel size.

3.3 Measuring Parameters

In this work, the assessment parameters that are used to evaluate the performance of speckle reduction are Noise Variance, Mean Square Error (MSE) and Signal to Noise Ratio (SNR). MSE, SNR for given a variance on different images are been calculated.

3.3.1 MSE (Mean Square Error)

MSE is mean error of the pixels of whole image. In our work, a definition of a greater value of Mean square error refers to a large difference between speckled image and despeckled image. This shows a significant reduction of speckle noise. The formula for the MSE calculation is given

$$MSE = \frac{1}{N}\sum_{j=0}^{N-1}\left(X_j - \bar{X}_j\right)^2 \tag{11}$$

where X_j—Speckled Image $\overline{X_j}$—Denoised Image.

3.3.2 PSNR (Peak Signal to Noise Ratio)

SNR is a ratio of Signal to Noise, higher SNR ratio indicates more Signal is present i.e. more speckle is reduced. The formula for SNR is given by

$$PSNR = 20\log_{10}\left(\frac{max_I}{\sqrt{MSE}}\right) \tag{12}$$

Table 1 Comparison of PSNR of different methods

σ^2	0.01	0.05	0.07	0.10	0.20	0.80	2.0	4.0
Soft threshold	0.0414	0.0527	0.0557	0.0607	0.0745	0.1194	0.1422	0.1584
Hard threshhold	0.0371	0.0508	0.0549	0.0602	0.0738	0.1187	0.1419	0.1586
Bayes soft threshold	0.0311	0.0535	0.0599	0.0681	0.0820	0.1211	0.1404	0.1568
Frost filter	0.0319	0.0381	0.0413	0.0456	0.0598	0.1120	0.1420	0.1621
Proposed (hybrid)	**0.0321**	**0.0380**	**0.0410**	**0.0456**	**0.0596**	**0.1107**	**0.1368**	**0.1544**

where $\max_I$ the value of the pixel in the image with possible maximum value. The maximum value of pixels which are represented using 8 bits per sample is 255.

4 Results and Discussions

The hybrid method which consists of frost filtering method followed by bayes soft Thresholding. To the speckled image Frost filtering is applied which is an adaptive method of filtering where the edge information is preserved. The bayes soft Thresholding is applied to the image after filtering with Frost filter in which different thresholds are set for every sub band.

In this paper a different standard images like lena, house, mandrill are taken for study and for the simulation lena image is taken as original image and speckle noise with different variance is added to the original image and different denoising methods like Soft Thresholding, Hard Thresholding, Bayes soft Thresholding, frost filter method of Thresholding are implemented and the results are compared with the hybrid method where the evaluation parameter are better than the other method and the same are shown in Tables 1 and 2, simulation results in Figs. 1, 2, and 3.

5 Conclusion

With the obtained results it is observed that high frequency noise can be better removed by using scalar filters but fails to preserve the edge details while Adaptive filter methods are more successful than filtering since it preserves the details. More computation time is required for adaptive filter method and this drawback can be overcome by proper selection of weighting function. Frost filtering and Bayes soft Thresholding techniques give optimal threshold value. The hybrid method has resulted better qualitative measures such as PSNR and MSE than individual technique.

Table 2 Comparison of MSE of different methods

σ^2	0.01	0.05	0.07	0.10	0.20	0.80	2.0	4.0
Soft threshold	37.5968	34.1844	33.4638	32.3755	29.9394	25.0878	23.4107	23.3735
Hard threshhold	39.4624	34.7596	33.7100	32.4624	30.0838	25.1405	23.4171	22.3840
Bayes soft threshold	41.6982	35.6432	34.2802	32.8548	30.1429	25.1700	23.5249	22.5201
Frost filter	39.2326	36.3172	35.2314	34.0083	31.0901	25.4227	23.4638	22.3576
Proposed (hybrid)	**39.1688**	**36.3491**	**35.3115**	**34.0131**	**31.0878**	**25.4219**	**23.6098**	**22.5921**

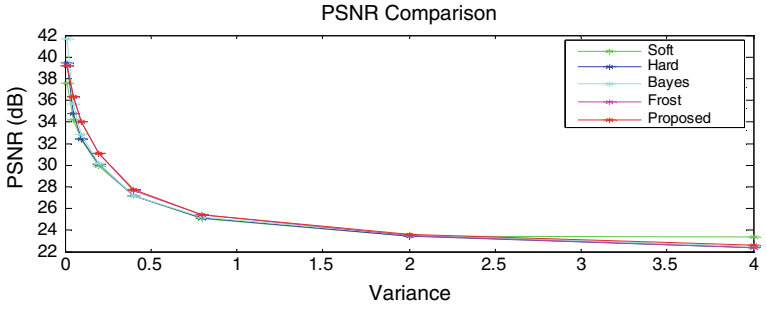

Fig. 1 Matlab result for PSNR for different methods and proposed method

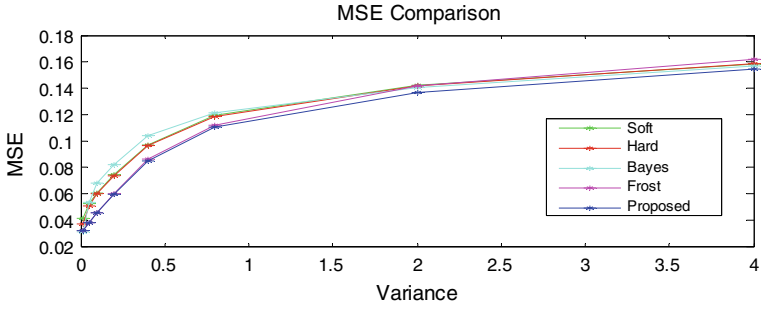

Fig. 2 Matlab result for Variance for different methods and proposed method

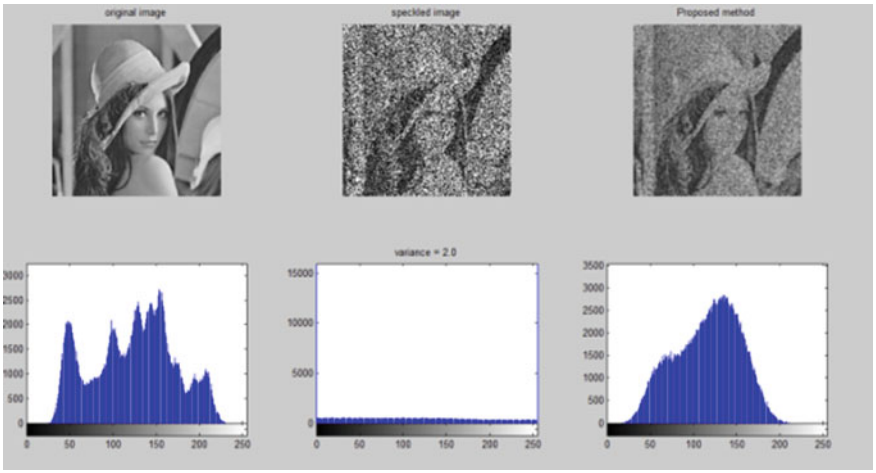

Fig. 3 Denoised image and its histogram with noise variance of 2.0

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Fault Detection and Classification in Automobile Engine Based on Its Audio Signature Using Support Vector Machine

Jitnedra Kumar, Swati Sharma, and Anuj Kumar Bharti

Abstract Numerous attempts have been made in recent years for detecting various faults in an automobile engine. The aim of developing this technique is to detecting the faulty engine more accurately and reducing the cost of risk for an automobile industry. These developed techniques have potential to detect and classify the type of fault automatically. Some of reported and developed techniques are unsupervised and some work on supervised learning. Previously reported techniques are able to produce good results with complex algorithms. In the present paper, we have developed a simple algorithm for classifying the healthy and faulty engines and detecting the type of fault if there is any. Input signal is an acoustic signal from faulty/healthy automobile engine for a duration of 11 s. Total eleven statistical features of the audio signature has been extracted and fed to the classifier. Classification and detection algorithm is made by sequential channel of support vector machine (SVM). Total four number faults have been tested on a real time collected data. Various combination of the SVM (with different types of kernel functions), artificial neural network and logistic regression have been tested and a maximum accuracy up to 99.26% is obtained, which is greater than all the previously reported algorithms on the same data. The novelty of the algorithm is its less complexity, computed features and ability to produce better results.

Keywords Support vector machine · Machine learning · Fault detection · IC engine

Author's Note

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1 Introduction

Fault detection in automobile manufacturing industry an important process. A fault in an engine is any kind of malfunction which affects the overall performance of the engine. It can create any unacceptable change in the system which can cause any short or long term effect. In today's world, automobile industry are very serious about the monitoring of engine before launching it into the market since it can increase the risk of the product's popularity, benefit and firm's reputation. Manual classification of the healthy and faulty engine always has a chance of error. So, many research groups have made an attempt to develop an automatic method of monitoring the health of the engine. Reports in the literature show that almost every mechanical fault is noticeable in the acoustic signal of the engine [1]. Therefore, many algorithms came into existence for predicting the health of the engine based on its audio signature. Acoustic and vibration signals are generally used for fault classification. These signals are emanated from mechanical parts of engine. Many studies have employed to analyses of acoustic and vibration signal in internal combustion engine for condition monitoring. Acoustic signals are affected by operating environment conditions. If operating environment is noisy then the acoustic signals are usually very weak. Thus signal discrimination can be difficult. Yet acoustic signals have some significant advantages like high sensitivity, real time, localization of failure zone by time arrival of measurement etc. Acoustic signals provide direct measure of failure mechanism.

Iserman had presented a review of developed automatic classification models of faults in mechanical systems [2]. He had put a light on various classification methods based on geometric, statistical or probabilistic approach. Before that Guo et al. reported their algorithm producing accuracy of 95% based on wavelet transform for feature extraction and fuzzy clustering for classification [3]. Jack et al. examines the problems in Artificial Neural Network (ANN) and Support Vector Machine (SVM) and developed an integration of Genetic Algorithm (GA) for both the classifiers and increase the performance up to 100% in some cases [4]. From the literature, it can be concluded that SVM is proved a potential classifier for classification of audio signal of the mechanical systems. More recently Zanaty has proposed new kernels for SVM and compared with Multilayer perceptron (MLP) and presented significantly greater accuracy with SVM. Maximum mean accuracy presented was 95% with SVM while MLP has produced 85% only [5]. Later, Santos et al. provided a solution for similar problem of detecting fault in wind turbines based on vibration analysis. For classification they used SVM with a variety of kernel and ANN. They have presented maximum accuracy of 98.26% with SVM while with ANN using different number of neurons they achieved maximum accuracy of 97.85% [6]. Heng et al. presented their algorithm by combing a set of binary SVM classifiers for classifying the healthy or faulty aircraft engine [7]. Kishore et al. have reported fault detection in centrifugal pump with a hybrid algorithm of SVM and GA. However, they succeeded to reduce the error rate [8]. Huge portion of literature shows the superiority of SVM on other classifiers. However, almost every research group has

used different feature set and a different classifier. Selection of feature set is heavily dependent on which type of fault is classified. In the present study, the method is developed on the basis of "Support Vector Machine" (SVM) technique. SVM is an algorithm of machine learning based technique which is able to do classification into binary or multiple classes called as One–class or Multi-class, depending on application [9]. Artificial Neural Network follows empirical risk minimization which means it is difficult to optimize the size of hidden layers and accurate learning rate. Support vector machine, on the other hand is free from above issues. SVM has two advantages compared to ANNs that are a simple interpretation and sparse solution.

The difference in RM leads to better generalization performance for SVMs than ANNs [10]. Support vector machine is considered often better when compared to ANN because, SVM optimally deals with the problem of overfitting. The main difference in ANN and SVM is that ANNs is having multiple local minima points. SVM, on the other hand uses global minima as the solution. Since SVM needs to work only on creating boundary, therefore size of the does not and an effect on complexity in SVM. In the method section, support vector machine algorithm is described in detail. SVM supports both linear and nonlinear technique. It is effective algorithm, used for classifying of all kinds of datasets. Fault detection can be consider as a special class of classification problem involved in model based method and data based method whose aim is to recognize faulty condition timely. SVM is used for fault classification and fault detection due its high generalization ability and nonlinear classification ability. SVM works on the basis of different kernel function. Choosing different kernel function, SVM produces result of different performances. SVM creates hyper planes for classifying he data which is expected to be linear in nature. The samples which are not linearly separable, SVM transforms them into another space using kernel methods, so that they could be linearly classified. In this simulation, original dataset is handled using SVM algorithm and we got satisfactory fault detection result and get higher accuracy than previous applied method. The better results of SVM make it useful for fault detection in recent years [11, 12].

In the present paper, four types of faults in automobile engine are chosen for classification. Proposed algorithm is also able to discriminate the faulty engine with the healthy engine first. The four types of faults are following:

i. Cam chain noise: Timing chain is a part of IC engines that synchronies the rotation of the crank shaft and the cam shaft. This synchronization makes the engine valve open and close at the at perfect times during its intake and exhaust strokes. When the timing chain is loose or tight then it produces Cam chain noise.
ii. Cylinder head noise: Apart from tappet clearance, any noise happening from cylinder head is termed as cylinder head noise.
iii. Primary Gear Damage: The gear assembly is and crucial component of the IC engine. It is having a set of drive gear and driven gears assembly. Drive gear is also called primary gear. Noise produced due to any irregularity in primary is termed as primary gear damage noise.

iv. Tappet: Tappet is only a component of a rocker arm in the IC engine. It makes a contact with the valve stem in the cylinder head of the engine. During the rotation of the cam, this sound occurs when the tappet make contact during intake and exhaust.

Detection and classification of faults in an automobile engine based on its audio sample is done broadly in three steps:

1. Preprocessing (if required)
2. Feature extraction
3. Classification.

2 Materials and Method

Data

The data for the proposed algorithm was collected by Yadav et al. and also used for the fault classification [14, 15]. They achieved a maximum accuracy of 95% and Later Chopra et al. proposed an algorithm based on deep learning and applied on the same data. They managed to upgrade total classification accuracy to 98% [16]. Detail description of the experimental setup has been is given by Yadav et al. [15].

Total 243 signals has been taken and the break-up of the signal type is given below (Table 1).

Each audio signal is collected for first 11 s from every engine. Every single signal contains 1,100,001 discreet values which represent the sound generated by the engine.

Method

Proposed method for detection and classification of faults is shown in Fig. 1.

Feature Extraction

In proposed method features are extracted in frequency domain. To extract the features in frequency domain first of all take Hilbert transform of signal and from Hilbert transformed signal got instantaneous frequency and instantaneous amplitude. The Hilbert transform $H[g(t)]$ of a signal g(t) is defined as

Table 1 Break-up of the type of engines used for testing the algorithm

S. No.	Type of engine	No. of engine
1	Healthy	40
2	Fault 1 (CCN)	70
3	Fault 2 (CHN)	38
4	Fault 3 (PGD)	34
5	Fault 4 (Tappet)	61

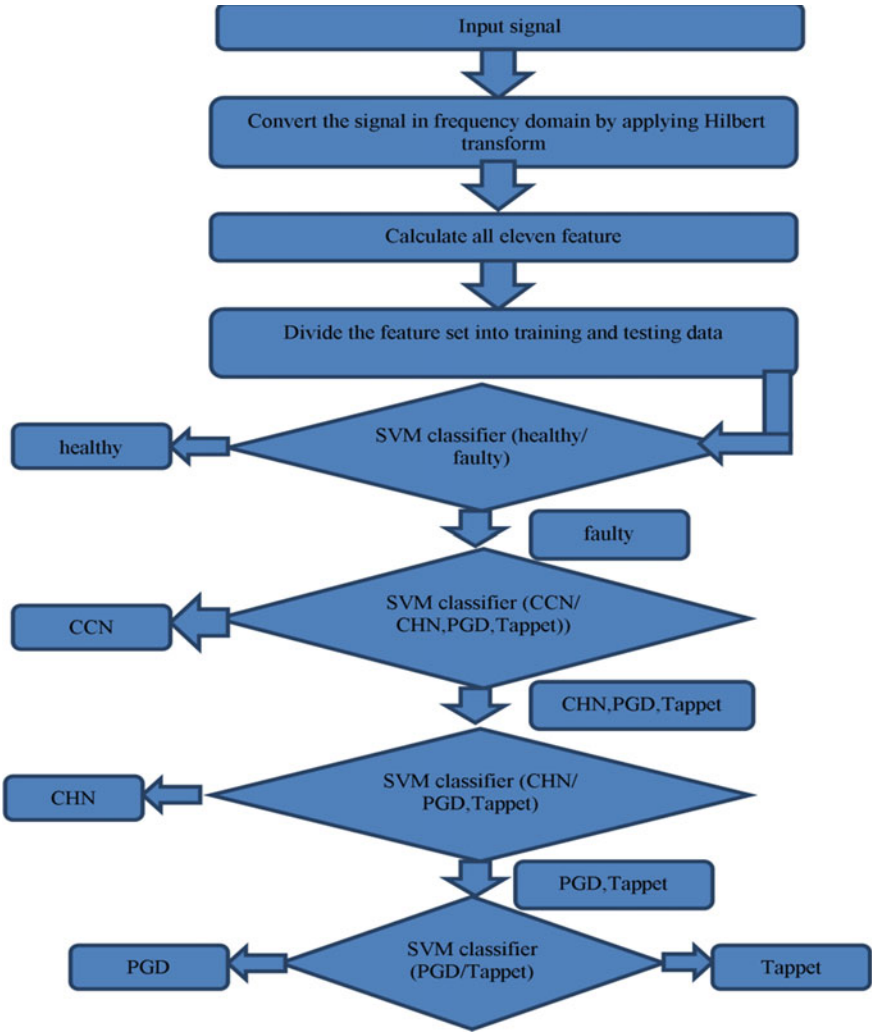

Fig.1 Flow chart of the proposed method

$$H[g(t)] = g(t) * \frac{1}{\pi t} = \frac{1}{\pi} \int_{-\infty}^{\infty} \frac{g(\tau)}{t-\tau} \mathrm{d}\tau = \frac{1}{\pi} \int_{-\infty}^{\infty} \frac{g(t-\tau)}{\tau} \mathrm{d}\tau.$$

In this paper eleven features are extracted individually from instantaneous frequency and instantaneous amplitude. Total twenty two features by combining the eleven features of instantaneous frequency and instantaneous amplitude are used for the classification purpose. Features used in this method are illustrated in Table 2.

Instantaneous frequency is defined as temporal derivative of the oscillation Phase θ.

Table 2 Description of the extracted features

S. No.	Name of feature	Formulae
I	Mean	$\frac{\sum x}{n}$
II	Variance	$\frac{1}{N-1}\sum_{i=1}^{n}(x_i-\overline{x})^2$
III	Energy	$T\sum_{n=0}^{N-1}[x(n)]^2$
IV	Root mean square value	$\sqrt{\frac{1}{n}(x_1^2+x_2^2\ldots x_n^2)}$
V	Peak to peak amplitude	Maximum–to–minimum difference
VI	Power	$\frac{1}{N}\sum_{n=0}^{N-1}[x(n)]^2$
VII	Entropy	$-\sum_{i=1}^{N}p(x_i)\log_{10}p(x_i)$
VIII	Median	Middlemost number in the dataset
IX	Crest factor	$\frac{\lvert X\rvert_{peak}}{X_{max}}$
X	Root sum of squares value	$\sqrt{\sum_{n=1}^{N}\lvert X_n\rvert^2}$
XI	Standard deviation	$\sqrt{\frac{1}{N-1}\sum_{i=1}^{n}(x_i-\overline{x})^2}$

$$\mathrm{V(t)} = \frac{1}{2n}\frac{\mathrm{d}\theta}{\mathrm{d}t}$$

In contrast to a Fourier frequency, the instantaneous frequency is generally a *time-dependent frequency.* Instantaneous amplitude is defined as absolute value of Hilbert transformed signal.

Support Vector Machine (SVM)

As we have discussed above in introduction, proposed method is based on Support Vector Machine algorithm. In this method our aim is to find the hyper plane which is called decision boundary. Margin plays an important role in classification of data. Margin gives intuitions and confidence about our predictions [13, 17–19]. The distance between closest points on both left side and right side (called support vectors) is called as margin. Large number of support vectors increase complexity of the problem. Linear classifier is shown in Fig. 1. SVM uses kernels. These kernels provide efficient way to apply SVM in very high dimensional features space. Kernel is a function that divides data linearly. If dataset is inseparable linearly, kernel maps

nonlinear input data to a high dimensional space and problem is solved. Kernel functions can be linear or nonlinear.

In this work binary classifier is used with data set and the corresponding labels. Here training data set contains two classes which is given by matrix X with the form of $m \times n$. m represents row wise variable signals and n represent column wise features of variable signals.

Linear classifier is given as:

$$f(x) = w^T \cdot \mathrm{x} + b$$

b bias.
w weight vector.

$$w^T \cdot \mathrm{x} + b = 0; \text{ decision boundary.}$$

$$w^T \cdot \mathrm{x} + b \geq 1; \quad w \text{ has positive sample.} \tag{1}$$

$$w^T \cdot \mathrm{x} + b \leq 1; \quad w \text{ has negative sample.} \tag{2}$$

On multiplying y_i with Eqs. (1) and (2) then equations become such that
$y_i = +1$ for positive sample.
$y_i = -1$ for negative sample.
So

$$y_i\left(w^T \cdot \mathrm{x} + b\right) \geq 1;$$
$$y_i\left(w^T \cdot \mathrm{x} + b\right) \leq 1;$$

Here we have taken x_+ for positive sample and x_- for negative sample.

$$y_i\left(w^T \cdot x_+ + b\right) \geq 1;$$
$$y_i\left(w^T \cdot \mathrm{x}_- + b\right) \leq 1;$$

$$\text{if } \; y_i = 1, \quad w^T.x_+ = 1 - b;$$
$$\text{if } \; y_i = -1, \quad w^T.x_- = 1 - b;$$

$$\text{Width} = (x_+ - x_-) \cdot \frac{w}{\|w\|} = (x_+ - x_-) \cdot \frac{w^T}{\|w\|};$$

$$\text{Width} = \frac{1 - b + 1 + b}{\|w\|} = \frac{2}{\|w\|};$$

This width is also called margin. The maximum margin classifier is obtaining by maximizing the $\frac{2}{\|w\|}$ which is equivalent to minimize $\|w\|$.

Minimization $\|w\|$ is approximately equal to $\frac{1}{2}\|w\|^2$.
To maximize margin or $\frac{2}{\|w\|}$, Lagrange function (L) is used.
Lagrange function is given as

$$L = P(x) + \sum_{i=1}^{n} \alpha_i g_i(x); \tag{3}$$

Where
Subjected to $1 - y_i\left(w^T \cdot x_i + b\right) \leq 0$;
$P(x) = \frac{1}{2}\|w\|^2$, α_i = Lagrange multiplier, $g_i(x) = 1 - y_i(w^T \cdot x_i + b)$; $\|w\|^2 = w^T w$, &x_i = decision vector.
Taking gradient of L w.r.t w and b to zero, we have

$$L = \frac{1}{2}\|w\|^2 + \sum_{i=1}^{n} \alpha_i [1 - y_i(w^T \cdot x_i + b)]; \tag{4}$$

$$\frac{\partial L}{\partial w} = w - \sum_{i=1}^{n} \alpha_i \ y_i x_i;$$

$$\frac{\partial L}{\partial w} = 0;$$

$$w = \sum_{i=1}^{n} \alpha_i \ y_i x_i; \tag{5}$$

$$\frac{\partial L}{\partial b} = -\sum_{i=1}^{n} \alpha_i y_i;$$

$$\frac{\partial L}{\partial b} = 0;$$

$$\sum_{i=1}^{n} \alpha_i \ y_i = 0; \tag{6}$$

Putting the value of w in Eq. (4), we have

$$L = \frac{1}{2}\sum_{i=1}^{n} \alpha_i \ y_i x_i^T \sum_{j=1}^{n} \alpha_j \ y_j x_j + \sum_{i=1}^{n} \alpha_i [1 - y_i (\sum_{j=1}^{n} \alpha_j \ y_j x_j^T \cdot x_i + b)];$$

$$L = \frac{1}{2}\sum_{i=1}^{n} \alpha_i \ y_i x_i^T \sum_{j=1}^{n} \alpha_j \ y_j x_j + \sum_{i=1}^{n} \alpha_i$$

$$-\sum_{i=1}^{n}\alpha_i\ y_i\sum_{j=1}^{n}\alpha_j\ y_j(x_j^T\cdot x_i)-\sum_{i=1}^{n}\alpha_i\ y_i b;$$

$$b=\text{constant}\ \&\ \sum_{i=1}^{n}\alpha_i\ y_i=0;$$

$$L=\sum_{i=1}^{n}\alpha_i-\frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n}\alpha_j\ \alpha_i\ y_i y_j x_i^T\cdot x_i;$$

From Eq. (6) $\sum_{i=1}^{n}\alpha_i\ y_i=0;$

Hence this is a function of only α_i and it is represented by $L(\alpha)$.

Now we have new function to maximize $L(\alpha)$.

$$L(\alpha)=\sum_{i=1}^{n}\alpha_i-\frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n}\alpha_j\ \alpha_i\ y_i y_j x_i^T\cdot x_i;$$

$L(\alpha)$ will be maximum if giving below condition is satisfied.

$$\alpha_i\geq 0;$$
$$\sum_{i=1}^{n}\alpha_i y_i=0;$$

This is called as quadratic programing problem.

We get optimal value of w by putting α_i in Eq. (5)

x_i with non-zero value of α_i are called support vectors. To test new data R then we will have to compute

$$D(R)=w^T.R+b=\sum_{i=1}^{n}\alpha_i y_i(x_i^T\cdot R)+b;$$

$D(R)$ is decision rule, there is no matter what Value of R, only sign is important.

If result is positive from above, R classify as class one and if result is negative, R classify as class two.

3 Result

Training and testing data is divided in the ration of 85 and 15% for all type of conditions (i.e. faults). According to testing data proposed method is capable of producing better results with the existing data. This dataset is previously tested by

Table 3 Comparison of results with multi-class SVM

Method	Accuracy (%)
Proposed method	99.26
Multi class SVM	95.83

Table 4 Comparison of results with other established methods

S. No.	Method	Accuracy (%)
1	ANN	94.2
2	Logistic regression	96.2
3	Proposed method	99.26

Table 5 Comparison of results with previous reported results on the same data

S. No.	Author(s)	Year	Accuracy (%)
1	Yadav et al. [15]	2010	95
2	Chopra et al. [16]	2015	98
3	Proposed method	2017	99.26

Yadav et al. [15] and chopra et al. [16] with different approach and presented an accuracy of 95, and 98% respectively. Proposed method is a sequential chain of SVM binary classifier and produces better results than multi class SVM. These results are compared with well-established existing methods such as ANN and logistic regression and even different kernels of SVM (Table 3).

It is expected the pairwise classification would be slower than the multiclass classification by SVM but produces better accuracy. However, in such problems accuracy is the priority.

Apart from multi class SVM, proposed method is also compared with ANN and logistic regression with the similar feature set and results are following (Table 4).

Producing accuracy of 99.26% indicates that this algorithm is capable enough to judge the health of the engine based on its generated audio. This result also shows the significance of the audio signature of the engine.

Proposed method is also compared with previously published reports on the same dataset and results are following (Table 5).

We have reviewed previous literature and presented results are a way better than published results. Although, many research groups have used advance yet complex algorithm.

4 Conclusion

Proposed method reduces the rate of false positives and this is crucial for industries. Previous methods were giving larger false positives, which is generally not a good idea for such problems.

This method is also less complex which reduces the cost of computation at a larger scale. Another merit of the algorithm is the features calculated. These features have made the difference with other algorithms. Without being transformed signal was not able to produce better results.

Although proposed method has given a significantly better accuracy but including more types of faults (variance in samples) may improve the usability of the algorithm. However, algorithm is also needed to test in a real time environment.

Automobile industry is continuously facing this problem even now a days, a reputed company has faced a huge loss due to an unattended unidentified fault in the engine. So, proposed algorithm may help in such cases and reduces the cost of monitoring the health of the engine.

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Smart Farming Using Internet of Things (IoT) Technologies

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Abstract Smart developing is perhaps the most mainstream employments of Internet of Things (IoT) in the rustic territory and different affiliations are using this procedure around the planet. Reap Metrics is a sharp developing affiliation focused in on overly present day agronomic game plans while acquiring useful involvement with the organization of exactness water framework. Enormous landowners and little farmers should fathom the ability of IoT market for agribusiness by acquainting splendid advances with fabricate force and acceptability in their manifestations. Shrewd Farming is an arising idea that alludes to overseeing ranches utilizing current Information and Communication Technologies to expand the amount and nature of items while streamlining the human work required. Shrewd cultivating uses current data and correspondence advancements, similar to Internet of Things (IoT) enabled sensors or drones, to monitor the condition of agriculture as well as critical environmental factors, like moisture levels. Smart agriculture applications boast improved operational efficiency and allow farmers to quickly respond to if conditions threaten their yield. Smart farming can include conditions like hotness, moisture, precipitation, and soil quality. In this paper we describe the challenges and applications of smart farming for agriculture growth.

Keywords IoT applications · Smooth agriculture · Precision farming

1 Introduction

For the monetary advancement of any country farming play a significant segment. Various work chances are created for the people. By using Internet of things (IoT) farmers can use real-time IoT information to improve enhance surroundings for their grounds, respond to environmentally friendly modifications, and rapidly recognize

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pests or disease before it can damage their harvest. Farmers can use available Web of things (IoT) innovation and can utilize sensors for soil, water, light, mugginess, temperature the board and programming for that target explicit homestead types or use case freethinker stages [1, 2]. For network ranchers can utilize cell, Lora and for area they can utilize GPS, Satellite.

Internet of Things (IoT) formed isolated recognizing consumes devices located alongside the farms like climate locations for assembly statistics which is communicated to systematic device for examination. Sensors are policies complex to abnormalities. Agriculturalists can display the harvests from systematic control panel and takings action based on perceptions [3, 4]. Agriculture implements Internet of Things (IoT) finished use of automatons, drones, sensors and processer imaging combined with logical implements for receiving perceptions and observer the farmsteads. For monitoring crop (Fig. 1) using sensors, sensors positioned beside the farmsteads observer the harvests for modifications in bright, moisture, hotness, form and scope. Any incongruity is noticed by the devices is examined and agriculturalist is informed. Therefore, isolated recognizing can benefit prevent the extent of illnesses and retain a judgement on the development of harvests. IoT founded Shrewd Agriculture improves the complete Cultivation outline by perceiving the ground progressively [5]. With the help of sensors and interconnectivity, the Internet of Things in Agriculture has saved the hour of the farmers just as diminished the rich usage of resources, for instance, Water and Electricity. It keeps various parts like dampness, temperature, soil, etc. under check and gives a totally clear continuous insight. Exactness Farming makes farmers make data with the help of sensors and dismember that information to take insightful and quick decisions. There are different precision developing techniques like water framework the heads, creatures the board, vehicle following and much more which accept a crucial part in extending the capability and adequacy. With the assistance of Precision cultivating, you can dissect soil conditions

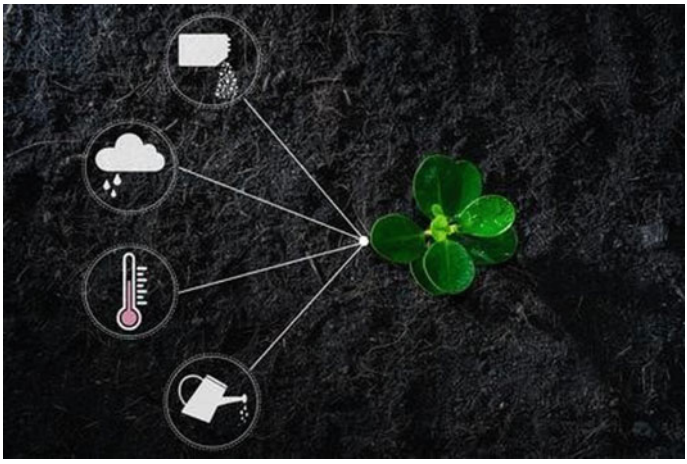

Fig. 1 Monitoring of crop using internet of things

and other related boundaries to expand the operational productivity. Not simply this you can similarly distinguish the ceaseless working conditions of the related devices to perceive water and supplement level. Keen Farming is a welcome tech and fruitful plan of doing agribusiness and creating food in an efficient way. It is a utilization of realizing related contraptions and imaginative headways together into cultivating. Clever Farming fundamentally depends upon IoT in this manner discarding the need of genuine work of farmers and cultivators and thusly extending the proficiency in each possible way [6, 7]. With the continuous cultivating designs subject to agribusiness, Internet of Things has brought colossal focal points like powerful use of water, progression of information sources and some more. What made differentiation were the titanic favorable circumstances and which has gotten an adjusted cultivating in the continuous days.

2 Smart Farming Using IOT

IoT based Smart Farming improves the entire Agriculture structure by noticing the field logically. With the help of sensors and interconnectivity, the Internet of Things in Agriculture has saved the hour of the farmers just as diminished the rich usage of resources, for instance, Water and Electricity [8, 9]. It keeps various segments like moisture, temperature, soil, etc. under check and gives a totally clear progressing discernment. Precision Farming makes farmers make data with the help of sensors and analyze that information to take savvy and quick decisions. There are different precision developing techniques like water framework the chiefs, creatures the board, vehicle following and much more which expect a major part in extending the capability and sufficiency. With the help of precision developing, you can analyze soil conditions and other related limits to grow the operational efficiency. Not simply this you can in like manner distinguish the ceaseless working conditions of the related devices to perceive water and supplement level. Clever Farming is a welcome tech and effective course of action of doing agribusiness and creating food in a conservative way. It is a utilization of completing related devices and creative progressions together into cultivating. Astute Farming fundamentally depends upon IoT in this manner discarding the need of real work of farmers and cultivators and thusly growing the productivity in each possible manner. With the continuous cultivating designs subject to agribusiness, Internet of Things has brought tremendous preferences like successful usage of water, headway of information sources and some more. What made differentiation were the monster preferences and which has gotten a changed cultivating in the progressing days [10, 11] (Fig. 2).

IoT sensors introduced on a specific good way from one another permit ranchers to screen everything from crops development to cows reproducing [12, 13]. It assists ranchers with improving horticultural cycles and do their business all the more productively. Mammoth proprietors and slight landowner's necessity understand the competence of Internet of Things (IoT) market for cultivation by familiarizing savvy

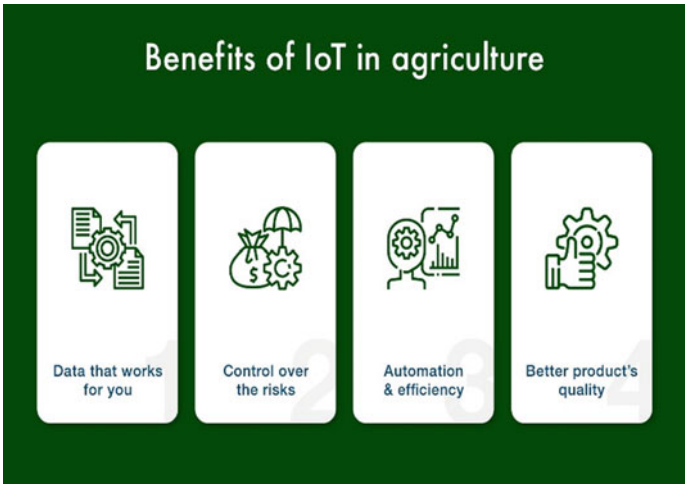

Fig. 2 Benefits of IoT in agriculture

advancements to build seriousness and supportability in their formations. Brilliant cultivating innovation can help:

1. Easy assortment and the executives of information from your IoT gadgets to screen shifted parts of cultivating, for example, dampness levels, climate conditions, crop development qualities, and so forth.
2. Precise experiences and proposals that empower ranchers to envision information and screen their homesteads progressively, settling on more educated choices.
3. Comprehensive enormous information bits of knowledge, examination and customized proposals help in better dynamic for brilliant agribusiness and keen cultivating [14].

Farmers have quite recently begun using some imaginative developing systems and advances to improve the capability of their ordinary work. For example, sensors set in fields grant farmers to get point by point aides of both the geology and resources in the zone, similarly as elements, for instance, acridity and temperature of the soil. Farmers can use their PDAs to remotely screen their stuff, yields, and trained animals, similarly as get subtleties on their animals dealing with and produce [15, 16]. They can even use this advancement to run quantifiable figures for their harvests and creatures. Horticulture actualizes IoT through utilization of robots, robots, sensors and PC imaging incorporated with explanatory instruments for getting experiences and screen the ranches. Situation of actual hardware on the ranches screens and records information which is utilized to get experiences. Savvy Farming is centered around the utilization of information obtained through different sources (recorded, geological and instrumental) in the administration of homestead exercises. Innovatively progressed doesn't basically imply that it is a savvy framework. Shrewd frameworks

separate themselves through their capacity to record the information and bode well out of it. Brilliant Farming spotlights on use of obtained information and consolidating it from different information sources to show the master plan to deal with all the exercises of the homestead. Keen cultivating is a major jump from conventional cultivating as it carries sureness and consistency to table [17, 18].

3 Farming Management Using IOT

Since agriculture is the backbone of any country, it is necessary to ensure its sustainable growth over the years. Shrewd Undeveloped is an impression of agricultural organization consuming contemporary Info and Announcement Expertise to upsurge the number and superiority of goods. The perception of associated shrewd machineries and instruments incorporated on farmhouses to variety unindustrialized developments data-driven and data-permitted [19]. Amongst the machineries existing for contemporary agriculturalists there are

1. Sensing advancements, including soil checking, water, light, dampness, temperature the executives.
2. Software applications—particular programming arrangements that target explicit ranch types.
3. Communication innovations, for example, cell Correspondence.
4. Positioning innovations, including GPS.
5. Equipment and programming frameworks that empower Internet of Things-Based arrangements, mechanical technology and computerization; and Data examination that underlies the dynamic and forecast measures [20].

4 IOT Technologies for Smart Farming

Adroit developing subject to Internet of Things (IoT) progressions engages cultivators and farmers to decrease waste and overhaul productivity going from the measure of manure used to the amount of trips the property vehicles have made, and enabling capable utilization of resources, for instance, water, power, etc. Internet of Things sharp developing plans is a structure that is worked for checking the yield field with the help of sensors (light, tenacity, temperature, soil clamminess, crop prosperity, etc.) and automating the water framework system. The farmers can screen the field conditions from wherever. They can moreover pick among manual and automated options for taking essential actions reliant on this data. In this procedure of property the heads, a key part are sensors, control systems, progressed mechanics, self-administering vehicles, motorized hardware, variable rate development, development finders, button camera, and wearable gadgets [21, 22]. This data can be used to follow the state of the business when in doubt similarly as staff execution, equipment efficiency. The capacity to anticipate the yield of creation permits to get

Table 1 Agricultural smartphone tools

Smartphone tool	Smart farming applications
Camera	Gives pictures of leaf wellbeing, lighting brilliance, chlorophyll estimation, and readiness level. Likewise utilized for estimating Leaf Area Index (LAI) and estimating soil natural and carbon cosmetics
Microphone	Helps with predictive maintenance of machinery
GPS	Delivers position for harvest planning, sickness/pest location
	alerts, solar radiation predictions, and fertilizing
Accelerometer	Supports regulate Sheet Approach Guide. Also used as an equipment rollover alarm
Gyroscope	Detects equipment rollover

ready for better item circulation. Various detecting innovations are utilized in accuracy horticulture, giving information that assists ranchers with observing and enhance crops, just as adjust to changing natural elements including. In this paper, we propose a proficient answer for various information assortment undertakings exploiting edge computing-enabled wireless sensor networks in smart agriculture [23] (Table 1).

Numerous cell phone applications have started to fuse Internet of Things (IoT) standards, information collection, furthermore, convenient getting ready to raise to-date, huge information to little farmers regarding developing, weeding, treating, and watering. These applications gather data from handheld sensors, far off sensors, and atmosphere stations, making all around assessments and critical recommendations [24, 25]. A couple of uses have been developed unequivocally centering for the little extension farmer:

1. Illness Detection and Diagnosis: Photos taken of suspect plants can be shipped off experts for assessment.
2. Fertilizer Calculator: Dust devices and greenery quality canister numeral obtainable come again complements are compulsory.
3. Soil Study: Capturing soil pictures, similarly as pH and substance data from sensors, licenses farmers to screen and adapt to changing soil conditions.
4. Water Study: Determining Leaf Area Index from photos and wonder logging can help farmers with choosing water needs [26].
5. Crop Harvest Readiness: Camera photographs with UV and white lights precisely foresee readiness [27, 28].

5 Conclusion

This paper describes the challenges and applications of smart farming for agriculture growth. The improvement of new strategies for improving harvest yield and dealing with, one can promptly see as of now: novelty discouraged, imaginative more youthful individuals getting humanizing as a vocation, agriculture as a approaches

for autonomy from non-renewable liveliness foundations, following the crop growth, safety and nourishment pattern, organizations among growers, benefactors, and vendors and customers. This paper thought about every one of these perspectives and featured the part of different advancements, particularly Internet of Things, to make the horticulture more brilliant and more productive to meet future assumptions. This paper has assisted to bung up available the opening in among production, quality and quantity. Data Ingested by collecting & importing the information from numerous sensors for physical spell use.

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Real-Time Integration of Industrial Robot with MATLAB

Megha G. Krishnan, Abhilash T. Vijayan, and S. Ashok

Abstract The prevalence of robots in manufacturing industries is growing due to the increasingly automated industrial operations. The research in robotics and automation is well supported by simulation platforms like MATLAB, which provides a scientific tool with an algebraic base and various toolboxes. Dedicated systems can be built after testing the innovative algorithms developed. The growth of robotic solutions becomes sluggish at the system interface phase, which is critical and challenging. This paper discusses a simple and cost-effective way of interfacing MATLAB with an industrial robot, ABB IRB 1200 in real-time by establishing file transfer protocol (FTP) client–server communication using Transmission Control Protocol/Internet Protocol (TCP/IP). The method benefits researchers to understand and explore the possibilities of robot communication for validating any modern control. A positioning experiment is conducted to demonstrate how the robotic system is communicated with the MATLAB.

Keywords Real-time integration · Industrial robot · ABB IRB 1200 robot · MATLAB interface

1 Introduction

Industries benefit from intelligent or decision-making robots in production lines and applications rather than collaborative robots. Numerous research has been carried out to develop smart robots to reproduce human senses by gathering information about the environment and making decisions for themselves. When the results are to

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be implemented in real-time systems, the interface options become critical in determining the system's performance. Since most of the software solutions of robots are proprietary in nature, addition or integration of any third-party software or hardware is not stress-free. In this paper, an effective communication between the control system and the ABB robot is established for the validation of a suggested strategy in a real-time system. Both modelling and simulation are possible for ABB robots with various toolbox developed for MATLAB. The programs can be translated into the corresponding RAPID code using inbuilt functions and the IRC5 controller can receive the RAPID file using a primary FTP client or through RobotStudio for experimental evaluation. The ABB robot controllers are capable of reading external information from sensors through customer I/O devices and influence the program structure in RAPID. Section 3 explains the stepwise procedure for the interface of ABB robot with MATLAB through simple programming.

2 Literature Survey

Numerous platforms are available for the simulation studies of robotic systems, some of which can be extended to hardware-in-loop applications. MATLAB, a widely used software platform for research and teaching purposes in robotics and automation, mainly because of the availability of a collection of toolboxes and specific third-party solution packages [1]. Different manufacturers have dedicated robot controllers and proprietary robot languages; most of them have similar structures. It would require either the knowledge of additional software or paid add-on installations or both for effective communication between the robot controller and the computation software [2]. Effective integration of the robotic system with research software platforms is necessary to implement innovative algorithms developed but presents significant challenges [3]. One of the most common application development frameworks for robots is the Robot Operating System (ROS) [4]. Robotics systems toolbox from Mathworks allows the connection of ROS with MATLAB/Simulink [5, 6]. Various toolboxes/software like Advanced Robotics Control and Operations Software (ARCOS) [7], Interfacing Toolbox for Robotic Arms (ITRA) [2], Mobile robot toolbox [8] etc., were developed to communicate between MATLAB and the pioneer family of robots. A client–server communication using TCP/IP protocol is developed in C/C++ for MATLAB compatible motion control units on the remote side [9], which is not used for industrial robots. The R&A equipment, including industrial robots are accessed from the MATLAB shell based on distributed software architecture [10]. This paper demonstrates a simple and efficient way of integrating an industrial robot with MATLAB in the server computer. This method requires only the basic knowledge of MATLAB, where most of the techniques discussed in the literature require knowledge of software programming languages like C, C++, and Java. Most of the researchers face difficulty while testing and implementing the developed algorithm in a real-time system. This method is advantageous for testing

the algorithms in a real-time environment without procuring and mastering add-on packages or supplementary software platforms.

3 Robot MATLAB Communication

The robot system under study includes 6 DOF ABB IRB 1200 robot manipulator with 7 kg payload and 703 mm reach and IRC5 controller [11]. RobotWare is the robot controller software that communicates RAPID, a flexible high-level programming language [12]. The robot manipulator can be positioned by running the MATLAB programs in the personal computer (PC) and RAPID program in the FlexPendant (ABB's Human Machine Interface) in parallel. The controller has numerous Ethernet channels, which can be used at 10 Mbit/s or 100 Mbit/s. The speed of communication is set automatically. The programmer can send or receive data/information between the PC and the robot by establishing TCP/IP communication with network file system access using FTP client and server (see Fig. 1).

To establish secure communication between robot and PC, connect the robot controller and PC through a permanent Ethernet port. Then log on to the controller

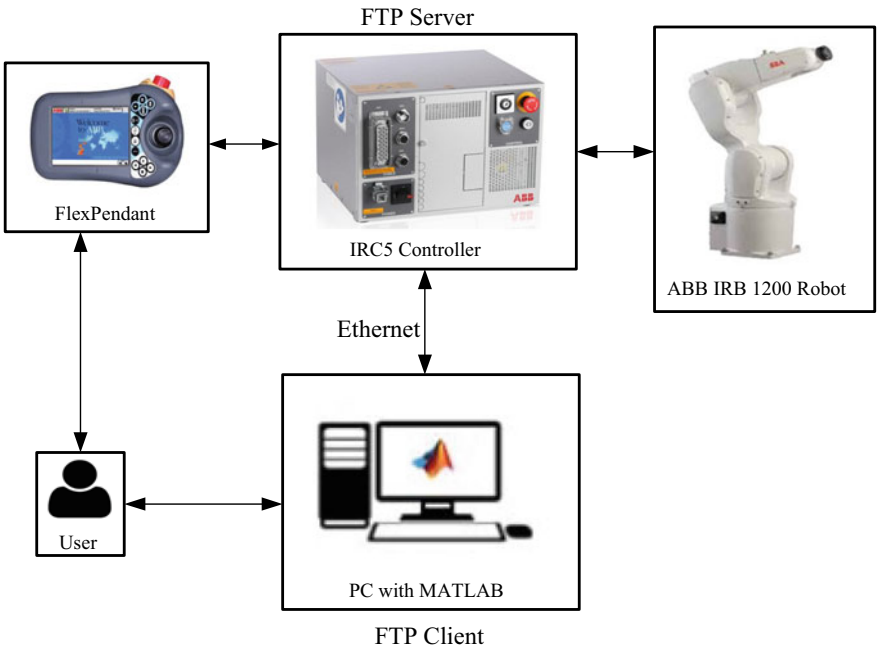

Fig. 1 System framework

using the user authorization system (UAS) in the FlexPendant. UAS can limit available functions to the users. Configure the PC to use Dynamic Host Configuration Protocol (DHCP) to obtain an automatic Internet Protocol (IP) address and open the command prompt window in the PC and renew the IP configuration by executing ipconfig/renew command. Command prompt window displays the current TCP/IP network configuration of the PC. The FTP server on the IRC5 controller will assign an IP configuration for the client PC. As the connection is established, the files with data/information are transferred between the client and the server.

3.1 Creating FTP Object and Files for Data Transfer in MATLAB

MATLAB can be connected to the FTP server by calling ftp function as

```
robotftp = ftp('192.168.125.1','username','password');
```

The username and password are to access a particular FTP account on the server, which corresponds to that for logging on the controller. Open files for the position, orientation and configuration data using `fopen` function and keep them in the MATLAB directory for data transfer. Upload these files to the robot controller using `mput` function and then close and delete them from the MATLAB directory using `fclose` and `delete` functions to prevent duplication and replacement of intended data.

3.2 Write and Send Current Pose Data in RAPID

Meanwhile, the robot controller is ready to receive the files uploaded by the PC. The RAPID program code written on the FlexPendant should be running and waiting for these files. The text files for the position, orientation and configuration data are declared as string variables `string1, string2` and `string3` in the `MainModule`. The program code to be executed is written in the procedure called `main`. There can be several procedures and a procedure is declared in the program with `PROC`. Then the existence of file is checked using the following code snippet and the maximum wait time for the robot is set as 240 s.

```
IF object THEN
object:=FALSE;
ELSE
WaitUntil IsFile(string1)\MaxTime:=240;
obect:=FALSE;
ENDIF
```

Table 1 `robtarget` components

S. No.	Reference	Data	Data type	Description
1	Translation	[x, y, z]	pos	Position of the tool in mm
2	Rotation	[q1, q2, q3, q4]	orient	Orientation of the tool in quaternions
3	Robot configuration	[cf1, cf4, cf6, cfx]	confdata	Axis configuration of the robot
4	External axes	[eax_a, eax_b, eax_c, eax_d, eax_e, eax_f]	extjoint	Position of the external axes

Once the files are received at the controller, the current pose of the robot has to be written and send back to the PC for further movement. The pose data in RAPID [1] is defined using a data type `robtarget`, which can be expressed as,

```
CONST robtarget pos1:=[[x, y, z],[q1, q2, q3, q4],[cf1, cf4, cf6,
cfx],[eax_a,eax_b,eax_c,eax_d,eax_e,eax_f]]
```

The robtarget consists of four components and each one is explained in Table 1. The current position of the robot can be read using `CRobT` function, which returns a robtarget value with position, orientation, axes configuration, and external axes position. Open a file from `diskhome` for writing using the open function and set the file pointer to the beginning of the file using `Rewind` instruction. The following code snippet shows how the current position is written on file and keep ready for sending to the PC.

```
Open diskhome\File:=string6, selfposedata\Write;
Rewind selfposedata;
posnow := cur_pose.trans;
Write selfposedata, ""\Pos:=posnow;
Close selfposedata;
```

For convenience, the configuration data `cf1`, `cf4`, `cf6` and `cfx` are initially transferred to registers and then write to the configuration data file. When the data file is moved to the MATLAB directory, the robot can either wait for the next instruction or end the procedure depending on the program needs.

3.3 Read Current Pose Data in MATLAB

Once the files uploaded to the controller is written with the current pose of the robot, download those files using `mget` function and load data into an array using `importdata` function. The orientation data in quaternion format is converted into rotational matrix using `quat2rotm` function in Corke's Robotics Toolbox (RTB) [14]. The next pose for robot positioning can be obtained using the programmer's control law written in MATLAB and can be sent to the controller for robot manipulation.

3.4 Send New Pose in MATLAB

The new pose data has to be converted in to `robtarget` format for uploading to the robot controller. Open new text files using `fopen` function and write new position, orientation and configuration data using `fprintf` function. Then upload the data files to the FTP server using `mput` function.

3.5 Read New Pose Data and Move the Robot

The file checking code is run in the RAPID editor to check whether the new files with updated pose data are reached the controller or not. Once the files are received, open the files from `diskhome` in read mode and read the string from the file using `ReadStr` function. Hence the updated data are stored `in text_pos, text_orient,` and `text_config` files as string, which can be converted to values using `StrToVal` function as follows.

```
FUNC robtarget robo_target (string postext1,string orient-
text,string robconfigtext);
bool1 := StrToVal(postext1,temptarget.trans);
bool2 := StrToVal(orienttext,temptarget.rot);
bool3 := StrToVal(robconfigtext,temptarget.robconf);
ENDFUNC.
```

Finally, the updated pose is extracted using `robo_target` function and the robot is moved linearly to the new position using `MoveL` instruction. `v150` specifies the speed of the robot (150 mm/s). `z100` defines the corner zone defined by the datatype `zonedata`. `GRIPPER` defines the tip of the tool attached that should move to the position specified.

```
Posenew := robo_target(text_pos,text_orient,text_config);
MoveL Posenew, v150, z100, GRIPPER;
```

With these basic operations, Sect. 4 demonstrates a positioning application on an industrial robot.

4 Positioning Experiment

To show the performance of the client–server communication strategy developed, a positioning experiment is conducted to move the robot based on the MATLAB commands. The experiment setup for positioning application is shown in Fig. 2 [13]. The robot controller, IRC5 compact is connected to PC using the Ethernet cable. The procedure explained in Sect. 3 is followed for establishing connection. The robot controller send the current pose to the PC as files. Hence the initial pose `(Ti)`

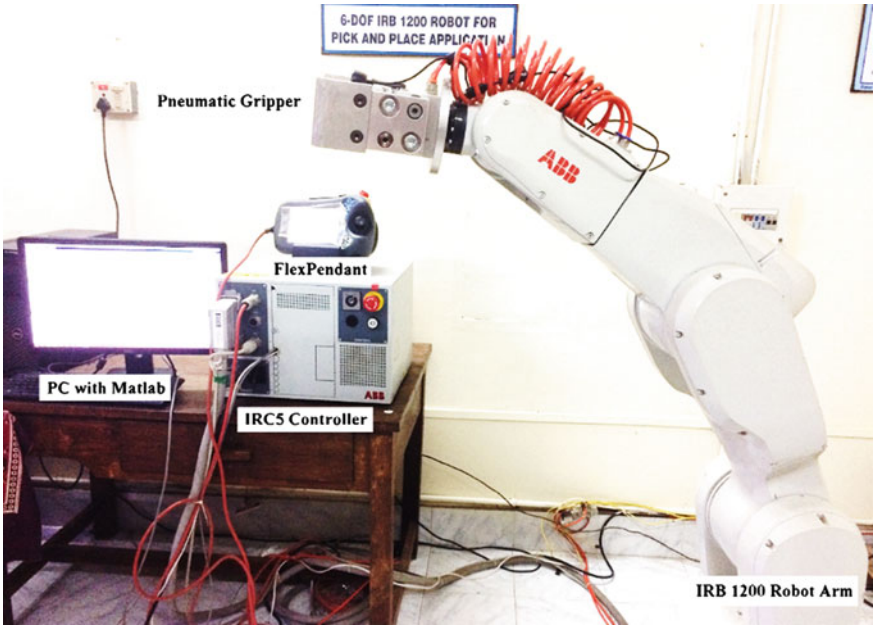

Fig. 2 Experiment setup

of robot tool center point (TCP) is obtained from the robot controller. MATLAB generates a Cartesian trajectory from pose `Ti` to `Tf` with 35 points using `ctraj` command from RTB [14]. The pose of the generated trajectory is sent to the robot controller one after another as files and the robot moves accordingly. The elapsed time to get a current pose from the controller is about 2–3 s. Thus, the robot manipulator successfully communicates with the robot controller for positioning experiment. The position (meters) and orientation (quaternion) obtained during the robot movement is plotted in MATLAB (see Fig. 3).

5 Conclusion

Various software tools are existing in the robotics and automation field of research for simulating the innovations, ideas and algorithms developed. The implementation in real-time is highly inevitable to validate the effectiveness of algorithms developed. It requires a solid interface between the software and hardware platforms, which often creates a hurdle with an incompatible system or add-on paid packages. Once secure communication between the robot and the software platform is established, dedicated systems can be structured for any applications like tracking, pick and place, gesture following, visual servoing, etc. This paper provides a simple and cost-effective method for interfacing an ABB robot with the widespread technical software

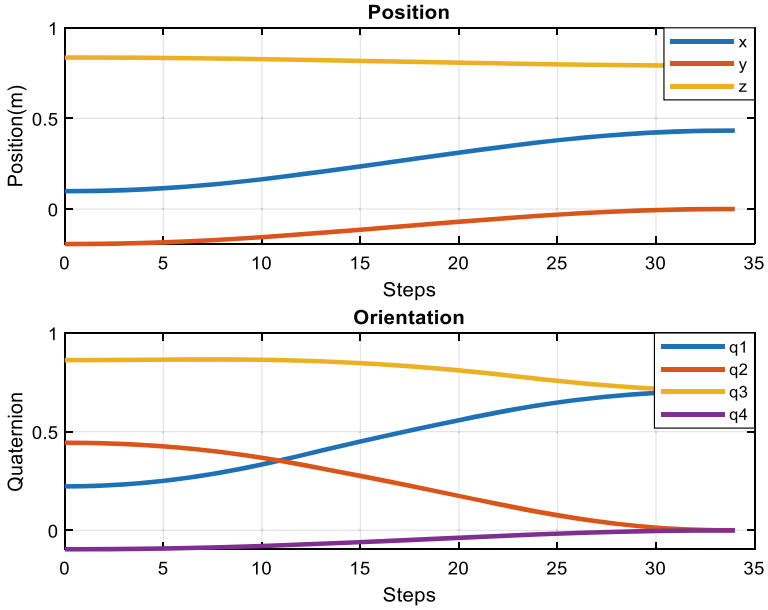

Fig. 3 Position and orientation of TCP

MATLAB and its real-time experimental validation. Even though the system seems to be a little sluggish in response, the overall performance of the system is inspiring with the scope of testing any proven algorithm in a real robot.

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Enhanced Scientific Workflow Scheduling in Cloud System

Ramandeep Sandhu and Kamlesh Lakhwani

Abstract In today's technological world, cloud has taken a long stride towards success for providing maximum throughput as well as high qualitative services to its consumers. Yet, approaches for maximizing the utilization of cloud resources is at peak demand. In the world of 'pay-as-per-need' and 'pay-as-per-use', consumer's satisfaction depends on several factors. Each cloud service provider focuses on maximum utilization with minimum consumption of cloud resources. In this paper, a framework has been proposed which is using a better approach for scheduling a workflow in cloud system. In complete process, while scheduling workflow tasks, deadline constraint is important parameter. Also total execution time, total execution cost and response time are important parameters which require to be minimized.

Keywords Cloud computing · Cloud consumers · Cloud services · VMs · Task mapping

1 Introduction

Cloud is a new trend with myriad satisfactory features for consumer as well as for provider [1–3]. Cloud computing is used factually everywhere in the world like big data analysis, file storage, backup, development of projects, testing etc. Effective resource utilization makes it a prior requirement in industrial world. In cloud Environment, optimization of workflow scheduling is an active and challenging research area. Providing an optimum scheduling for better performance requires consideration of various parameters like time, cost, response time, energy consumption and others.

Researchers have also given a lot of openings that the cloud has brought in, such as higher consumption of resources, improved responsiveness thereby improving user

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practice, enabling a generation of collaborative scientific workflows and reducing the cost in challenges and opportunities in running scientific workflows on cloud [4]. Still, the challenges faced by the cloud applications are architectural challenges, service challenges for integration tools, high-end computing support language-conversion challenge, challenge in compute intensive applications, and challenge for data management, service management challenge [5–7].

2 Related Work

Pandey et al. [8] have worked on reducing the computing cost. In their research, particle swarm optimization (PSO) algorithm has been used which is basically a meta-heuristic algorithm and it is used for better optimal scheduling in cloud systems. In it, the total cost calculated is the cost of execution and the transfer cost of data. This algorithm helps to schedule the tasks on resources and optimal mapping. In [9], the differences between the actual scope field of cloud and the requirements of scientific applications are discussed. Researchers in [10, 11] have discussed dependency of cost on execution models in this work. In this work, the cost is calculated as a function of number of processors.

Alkhanak et al. [12] proposed a better cost optimization approach. They selected scientific workflows as input and worked for better scheduling in cloud computing. The proposed approach employs the four meta-heuristic algorithms which are based on the population. The approach helps in reducing cost and time of the service providers. The execution cost and time are reduced as compared to other existing approaches. Rimal et al. [13] chains the Multi-tenancy characteristic and provides the scalability and other benefits to the other users. Resource grouping is an important task in the multi-tenant cloud computing which is done by using the scheduling process. Casas et al. [14] focused on Parallelization. Therefore, they proposed a scheduling approach called Balanced and file Reuse-Replication scheduling. It splits the workflows into sub-workflows which help in proper utilization via parallelization process. The work in [15] reduced time and cost and introduced a gravitational search algorithm for workflow scheduling in the cloud environment. The optimizations in workflow reduce the cost and makespan. Two algorithms are hybridized GSA and HEFT for workflow scheduling. The performance evaluation is done on the basis of two metrics that are monetary cost ratio and schedule length ratio. In same field, scheduling based on energy-saving criteria for virtual machines in [16] provided fixed interval constraints. This approach has lessened down the busy time and total energy consumption by the resources. The experiment is performed on the parallel workload models. Ghose et al. [17] have specified the energy efficient scheduling approach which is also useful in cloud environment. Liu et al. [18] proposed the genetic algorithm for workflow scheduling in cloud computing with deadline-constrained Both TET (Total Evaluation Time) and TEC (Total Evaluation Cost) were evaluated in user's defined deadline constraints. Anubhav et al. [19] introduced a gravitational

search algorithm for workflow scheduling in the cloud environment. This optimization is helpful in workflow scheduling as it reduces the cost and makespan. In this process, two algorithms are hybridized GSA and HEFT for workflow scheduling. The performance evaluation is done on the basis of two metrics that are monetary cost ratio and schedule length ratio. Garg et al. [20] formulated the scheduling problem in cloud by using the Genetic Algorithm. Bölöni et al. [21] proposed the concept of computation scheduling which is used for prediction of computation cost and financial cost. Sagnika et al. [22] proposed BAT algorithm for workflow scheduling which helps to hold the large scale of data. Vinothina et al. [23] studied Ant Colony Optimization (ACO) algorithm for workflow scheduling for heterogeneous distributed systems. Alkhanak et al. [24] have considered both cloud and Grid systems and provided cost optimization of Scientific Workflow Scheduling (SWFS). PSO and HEFT scheduling is used in [25] to make it better in case of time.

3 The Proposed Approach

In today's advance world of technology, cloud and its applications have provided various techniques. While the literature survey, many papers have been studied related to workflow scheduling in cloud environment depends on the static configuration of virtual machine, which is not a real condition. Rather than only work for managing cloud resources, it has been formulated that betterment in terms of cost and time saving must be important parameters. For all this system, if distribution of tasks should not be randomly then improvement can be high. Random distribution of task has been done in existing works [26]. Also, optimize the task depend on single objective, which is sometimes conflict like time and cost. Furthermore, only workflow dependency is main aspect on which deadlines are totally dependent [27]. Also, in existing approaches, optimization use local VM or global Data center.

Phases of Proposed Methodology: The complete framework is divided into two phased.

Phase 1 is to find out rank value of each task of input workflow. This phase basically used the concept of correlation between input heuristics parameters time, budget and deadline. Correlation can have a value in range from -1 to $+1$. It is a relation between two parameters to express that how strong two parameters have relation with each other. At the end, the task with high correlation is given maximum rank and task with least correlation is given minimum rank. Now these ranked tasks are provided to phase 2 for further mapping on cloud resources.

Phase 2 is to schedule the ranked tasks and then to perform task migration in case underutilized machines are in the system which can support in energy consumption. During this process, an advance optimization approach has been used which is based on Tabu and whale optimization approach. Tabu optimization helps to find out underutilized resources and then whale optimization helps in migration of tasks from underutilized machines to other ones but without increase in time, cost and response time.

Afterwards, performance evaluation and Analysis is also main objective covered in this study. After performing VM migration in optimized manner, Makespan, Cost, energy and response time of Workflow Execution is calculated. So, these four parameters will help to analyze performance of proposed framework. In whole system, utilization of resources will be increased.

Proposed framework representation (Fig. 1).

In Algorithm 1, tabu optimization concept used in our proposed methodology is explained.

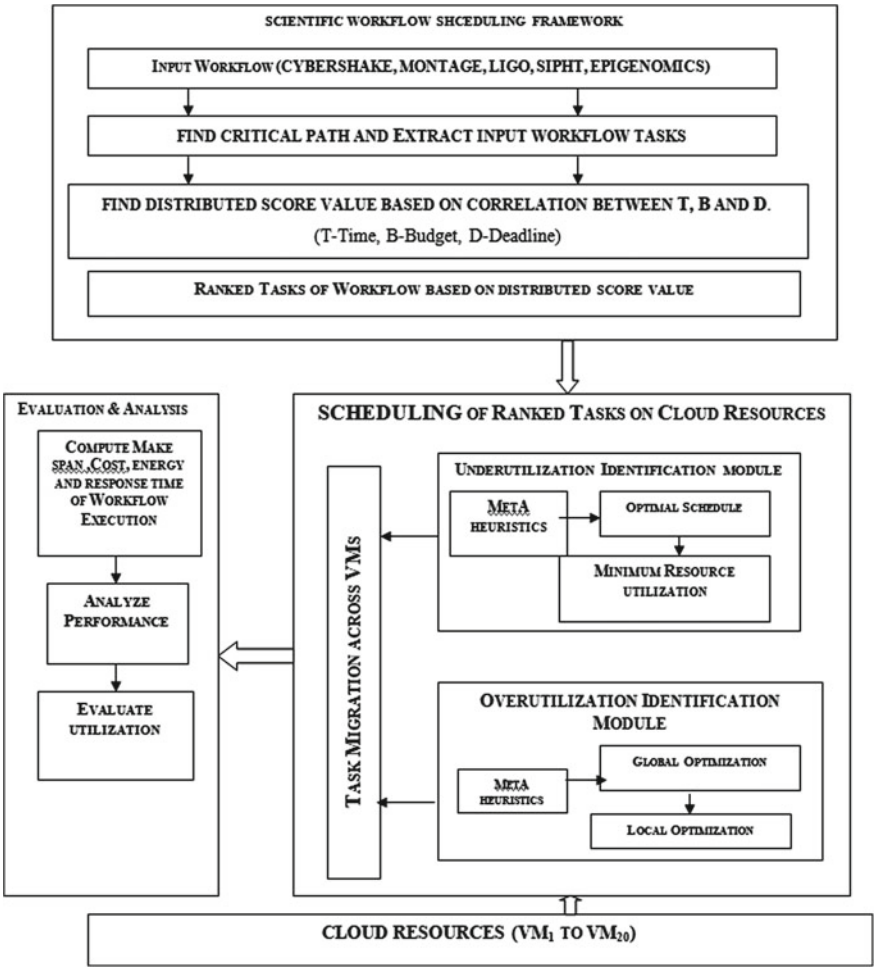

Fig. 1 Flow diagram of proposed methodology

Algorithm 1 **TABU (task, rank)**

BEGIN

Set T=task and Iteration = N

Search neighbour VM based on mapped tasks (T, T_m)

Add such VM in tabu list where less tasks than its previous neighbour

if (D (N_m) > D (N)) until $D\ (N_m)_{max}$)

update Tabu_list (T, T_m)

if $VM_s \leftarrow Tabulist\ (T, T_m)$

Return VM_s

END

Tabu optimization as shown in Algorithm 1 has provided a list of those VMS which can be targeted as underutilized resources and for better performance, its tasks can be migrated on other VMS.

4 Conclusion

Cloud system has provided myriad features for better management and optimization. The proposed framework is an efficient framework for time, cost as well as energy saving. Apart from this, response time is also main aspect in this study. By using ranking method for input tasks, it is better to schedule tasks in an optimize matter rather than simply map the tasks on cloud VMs. Also use of tabu and whale optimization has enhanced the performance of our proposed research as underutilized resources are freed from the system within time and cost constraints. In our future study, we will implement the framework using advance optimization techniques in cloud environment so that better resource utilization with minimum time and cost can be provided.

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Automatic Recommendations Over the Places Using Built-In Service Google Maps

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Abstract Nowadays, everywhere traffic takes place at the public places. Also, the public clustering's to be monitored. The facility to be added to the maps is automatic recommendations in order to recommend the list of options by alerting the concerned users. In the case of traffic, alerting the recommendations to the concerned authority about the traffic load daily so that action plans are implemented in advance than the users raise the discomfort. In the case of people load at particular places, recommendations are made about future predictions. Whenever the user selects the place over a map, the recommendations are listed in another approach. The proposed approach notifies the recommendations through dynamic and repeated structures at certain places. These recommendations are much helpful in implementing the services to the people without expecting the raise of voice from them. The governance and private governance will make more revenue by taking the advance decisions about certain places. The benefits achieved are in advance user satisfaction and better service orientation to be provided. The maps add the facility that monitors structures and clusters and intimates that to the concerned through automatic recommendations.

Keywords Google maps · Recommendation feature · Monitoring process · Scheduling · Messaging · Tracking

1 Introduction

Over time, the scenarios to analyze and assess are varying on any application. The recommendations are very crucial aspect after analyzing the application. Consider a scenario where most of the traffic is found over the long bridge at the entering of the Vijayawada. In this case, most of the times traffic became a headache and that cause inconvenience to the people if they reach in expected time. In such a case, recommendation will be given as alert to the concerned authority that needs to take action. If these recommendations will require reply, if it is positive reply

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and action taken over that recommendation means well and good. Otherwise, The same alert will go to the head office about the initiation to take place over that place. The recommendations vary depending on the context of place and people. In manual approach, how to identify the improvement areas will be required dynamic employees and needs review forms to be filled by the users either manually or digitally. After collecting the reviews, need to analyze and takes more time for manual method where as somehow less time for digitally accepted reviews. After this analyzation, the report prepared is to be sent to concerned higher level as well as regional office in order to point the area to be developed. The tracking is also very difficult to know in the case of traditional or manual approach. Hence, the methodology is to be changed and should be dynamic as well as instant update of the status in the app. If the area in the city is to be studied, it requires little effort to complete the process and will post the details to the concerned departments and authorities. he drawback of traditional approach are time consuming, unknown conditions of the new place, requires dependent on local people of the new area, survey and study about the new place requires to stay far from the family. There were recommendations and other relevant approaches are defined for various applications such as reducing the traffic by proposing certain policies as well as reduce pollution using certain policies about a specific city, proposing the establishment of hotels at certain places in a city, proposing the establishment of shopping malls at certain places of a city, and many other kind of application oriented tasks. Among all these applications, the recommendations are given based on certain methods as well as traditional approaches. These approaches are time consuming, and are not automated propagation of recommendations. The methods whatever are available are to be discussed in the literature review chapter. There those methods limitations as well as their unfitted features that might delay the process of resulting the desired outputs.

2 Literature Review

There are certain studies over the analyzation of certain places and their process of recommendations are different according to scenarios. According to [1] study, the certain policies and set of rules are proposed in order to reduce traffic congestion control as well as pollution. The result obtained here is road network is increased in space, and also greenery levels are improved through plants. In [2] study, there were 10 ways to reduce traffic congestion in UK based city, and the recommendations are also listed and are described for their implementation. In [3–5] works, where first study demonstrates about various factors that influence hotel selection and its business in which travelers might consider certain factors in choosing the hotel, the second work where price of food items as well as rooms depend on the place located in city or outside of the city or remote areas, hence location might influence the hotel business, and third work describes about top 10 strategies in order to make business a more profitable. In [6–8] studies, where first study demonstrates that price comparison services about certain products over few online shopping sites, second

study describes about recommendations based on social as well as economic aspects that cope with needs of actor and provides services, and third study demonstrates about providing the assistance to the customers in choosing the goods at stores through a recommendation model called Restore.

According to [9], the study is focused on spatio-temporal colored feature net that reduces of dropouts in the last layers of neural network, and achieves the goal in less number of iterations. This approach estimate joint motions n 3D sign data accurately. In [10] study, the work is focused on designing the AIRAVAT where accurately predicts ionospheric space weather over a map using Kalman filter to get updated and forecasted steps. In the [11], the study is focused on designing anti-obesity drugs and certain components are combined and obtained potential hits over the given receptors. In work [12], the details focused are local guides to certain cities and there is no keeping track of recommendations are resolved or not and also it is static on certain thing but not dynamic. In [13] study, the details are about recommending nearby restaurants that are good for eatables and this feature is restricted to only specific category. This may leads to getting only specific details and its updates while travelling from one place to other place as you are new to such environment. In traffic observed in [14], the details focused are changes that need to be initiated in order to communicate efficiently from gateway to vehicle and also from vehicle to the gateway respectively. In cloud traffic mentioned in [15], there are certain adjustments in the load that could be done in order to recreate better load adjustments using round robin style of methods. In [16], the traffic incurred includes differentiating the DDOS traffic flows and benevolent traffic flows. The novel method used is guaranteeing the robustness of the model using statistical metrics.

In packets traffic [17], the details observed are packet loss as well as packet delivery with little delay is reduced to the extent possible in order to transmit the voice over a MANET. In [18], the traffic imposed by ITS is monitored by bid data proliferation tool called Kafka tool in order to produce the free hard lane in the microscopic traffic simulation. In traffic found in [19], the traffic lights are dynamically responded for controlling the vehicle traffic present in the roads using machine learning scheme like reinforcement learning in order to minimize the traffic load. In traffic found in two way and intermediate lane roads, LDF and DDF are developed in order do calculations for load on urban and rural highways. In traffics mentioned in [20], the quickening moving walkway frameworks are designed in order to recommend highways in the identified congested traffic areas. In the regard of information mentioned in [21], the present pandemic is to be restricted using the digital mask that reports the virus in the environment that the user is currently staying. The mask designed will provide statistics about the objects in the present environment. With respect to source specified in [22], the IoT is used in detecting the location and automatically takes its currency and converts that into the user's currency. This user flexibility is provided in this context.

As per the study mentioned in [23], the IOT is used in the power banks and portable devices in order to exchange charging power in the user-friendly atmosphere. The customized way of charging is done through the designed app and IOT technology. With respect to the description given in [24], the IOT is used in communicating the

weighted objects falling to the other devices in order to catch it and send it gently to the ground using automated net.

As the information of [25], the IOT is used in the industries where level of gas is monitored and detects the leakage if any such is identified during the passage of gas over the pipes that are placed from the source to destination. This detection avoids harmful incidents over the people.

With respect to the source specified in [26], the IOT is useful over the users in such a way that users health bulletin to be monitored and provides a guide to maintain the fitness based on food diet. With the view of source mentioned in [27], the IOT and GSM are used in determining the popular places when a user wants to make a trip in the world. The guidance is to be provided about the top places and ranked places in those cities along with route map.

As per the source demonstrated in [28], the GSM and IOT are used to monitor the garbage bins and alert the nearest the municipal office in order to clear it which avoids wastage of visiting many times of that bin. In the regard of [29], any intrusion is detected in the IOT based internet environment in the homes, which should be alerted and avoids future inconveniences. In the aspect description given in [30], the detection of premature bosom irregularity in the images related to especially personal healthcare systems is discussed and the role modality is explored in processing the system. As per [31], the growth of the baby is studied using modern technologies such as IoT through the image processing where capturing the baby image and detecting the premature delivery.

In all the mentioned studies from [1–21], there a some approach that deals with the situation but that is not right mechanism in order to complete the scenario simply because it requires a lot of interaction of entities and manual follow up procedure is required. These all approaches are time consuming and leads to inefficient results which wont benefit the socially as well as economically. In order to benefit socially and economically, the proposed system consist of satellite monitoring using google maps with added feature 

that when turned on by the private member or by government agency.

The registered member has privilege to provide details for monitoring about specific thing and will be alerted and tracked the recommendation till completion. The advantage of proposed system is bringing the social satisfaction in advance than raising the dis-comfortability from the society.

3 Proposed Approach

In this, there is satellite view of map over the areas and automatic recommendation is alerted once tremendous data is observed than normal level. In proposed approach, an option titled 

is used and is when selected on, it will start analyzing the environment.

Before it starts the analysis, it asks for details that need to be analyzed. After providing the details, steady analysis is done for days till there is no change much in details gathered, it will alert the message using recommendation feature added in the google maps.

The google maps have many inherent features that watch the happenings on the earth through satellite connection. Those happenings need to be activated using recommendation option. The architecture of proposed system is demonstrated as follows (Fig. 1).

In this diagram, there were two modules identified which are processing and displaying. In processing module, the activities such as day by day monitoring of certain details, Count the days about there is no much change in the statistics gathered, Study the related places within the same region, simultaneously study the places with respect to different regions, rank the places according to statistics in the same region, and simultaneously alert recommendations for the first ranked places of different regions about the issue to be resolved. In displaying module, alerting became the output of the incorporated process, also response of the receiver is noted, and tracking of the issue and its progress is done time to time so that how long the issue is taken to be resolved is noted. This all information is to be useful when someone takes to

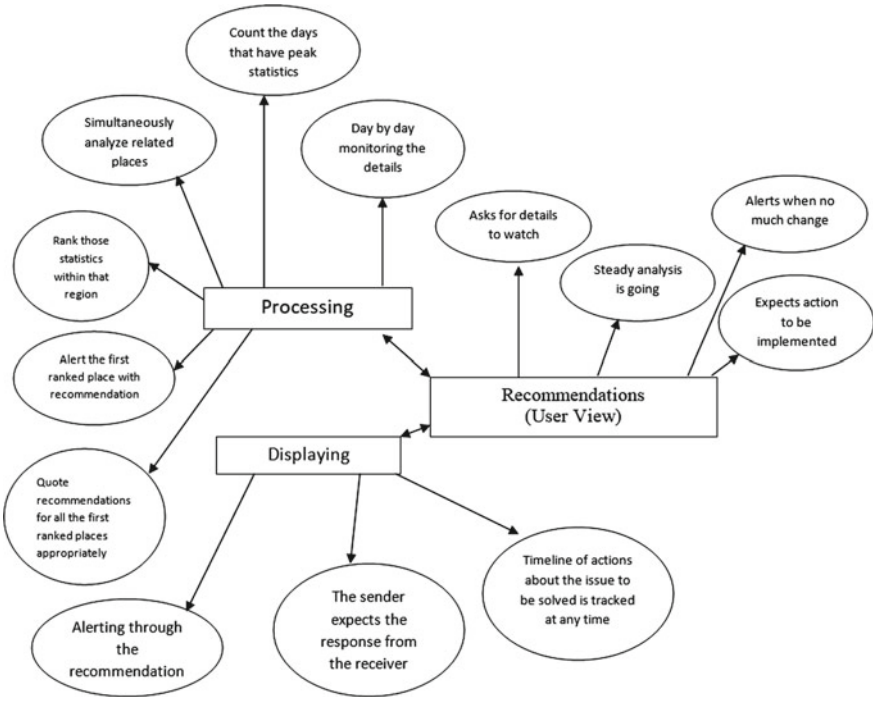


Fig. 1 Architecture of automatic recommendations using google maps over the places

do research over the past scenarios. Such scenarios will be helpful in order to speed up the process.

The pseudo procedure for Recommendations using maps over the places is as follows:

Pseudo_procedure AutomaticRecommendations_using_,maps(string[] details, map):

Input: Details to be given as input such as Hotels, google map is considered for analyzation.

Output: Recommendation as a alert and keeping track of the resolving of the issue.

Step 1: Turn on the  Recommendation, so that what details to be watched are noted in details String array.

Step 2: The details such as category to observer such as places, hotels, shopping malls, Hospitals, streets, Temples, Roads, and etc. in which select one item, select the area such as Nation, State or even specific area if you want peak statistics, and also user can select the how many first number of places where to invest their amounts. Assume Hotels is selected and specific area Vijayawada is selected, and also selects first 3 places.

Step 3: The hotels in that selected region are analyzed and ranks are assigned automatically based on in and out persons from that hotel. Also, in depth analysis is done over the areas of ranked hotels based on day by day.

Step 4: Such statistical analysis of the data is considered, and will alert the registered person through recommendation about the places where establishment of the hotel in the specific area is to be done.

Step 5: The response from the receiver will be expected and is tracked to resolve the recommendation. Also, receiver may ignore the recommendation by choosing to another field of interest in order to invest, Such cases, it may be made deactivated by the authorized person which cause increasing the performance of the map.

Step 6: If step2 is not specific area, suppose it should be broader area like state. In such a case, third option called how much first number of places to show for the investment is asked. Accordingly, the proposed system would popup the recommendations to the authorized person. Now, the receiver will respond where to invest must be chosen by check boxes. This Process is repeated from Step3 to Step5 till recommendation option is deactivated or initiated and resolved by the receiver.

If the study is about the places but not the hotels, then prioritize the places and their traffic and its pollution involvement, then display the first number of places where initiation to be taken and needs to be resolved.

It involves few steps that require the refinement in the above pseudo procedure:

Step 1: Turn on the  Recommendation, so that what details to be watched are noted in details String array.

Step 2: The details such as category to observer such as places, hotels, shopping malls, Hospitals, streets, Temples, Roads, and etc., in which select one item, select the area such as Nation, State or even specific area if you want peak statistics, and also user can select the how many first number of places where to invest their amounts. Assume Hotels is selected and specific area Vijayawada is selected, and also selects first 3 places.

Step 3: The places in that selected region are analyzed and ranks are assigned automatically based on inflow and outflow of the traffic. Also, in depth analysis is done over the traffic explored based on day by day.

Step 4: Such statistical analysis of the data is considered, and will alert the registered person through recommendation about the places where establishment of novel task or initiation of resolving the issue in that specific area is to be done.

Step 5: The response from the receiver will be expected and is tracked to resolve the recommendation. Also, receiver may ignore the recommendation by choosing to another field of interest. In such cases, it may be made deactivated by the authorized person which cause increasing the performance of the map directly.

The flow chart for recommendations using maps over the places is as follows (Fig. 2).

In above diagram, the identified modules are interacted one after the other in order to achieve the intended goal. The modules are listed along with their intended task to be carry out. The pictorial diagram will convey the meaning better than textual content. Hence, flow chart defines flow of modules involved in the proposed methodology.

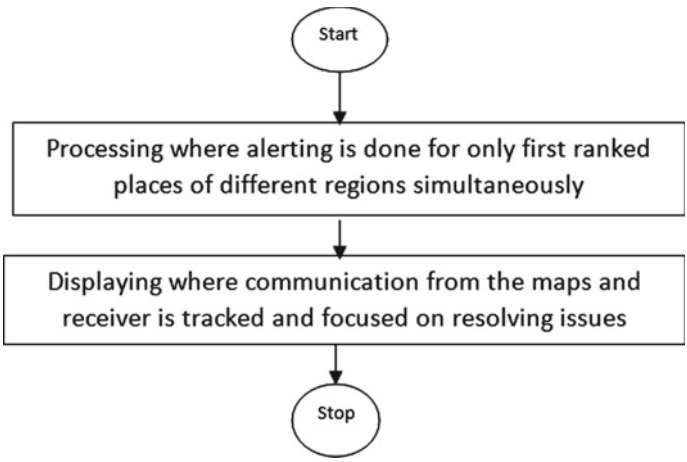


Fig. 2 Flow chart of recommendations using maps over the places

4 Results

In this, the statistics are presented with respect to the proposed system as well as the kind of simulated outputs to be extracted for the variety of scenarios.

The following figures are flow of activities involved in bringing the desired results (Figs. 3 and 4).

In above diagram, Recommendationis included in the features of the google map. When it is selected, then map will immediately ask for details to observe. If the peak statistics are found for certain days, and there is no change much in the data observing, then the feature in the maps will automatically alerts that information to the concerned authority or person.

In above, Category include list of items such as places, mountains, hotels, shopping malls, theatres, parks, rivers, and Miscellaneous asks for other items which are not in the list.

The next window represented in Fig. 5 will output the recommendations about the maximum of 4 places in the Andhra Pradesh where more traffic is observed using maps and are required to take actions to reduce the traffic which directly leads to more pollution.

The next window will be keeping track of responses made from the concerned authority as well as those recommendations are followed according to timeline (Fig. 6).

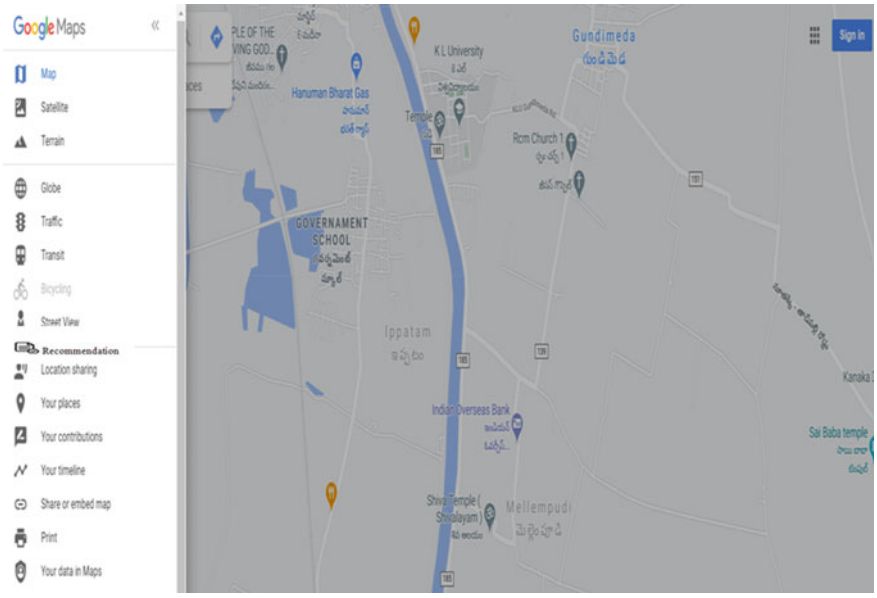


Fig. 3 The feature recommendation is included in the google maps

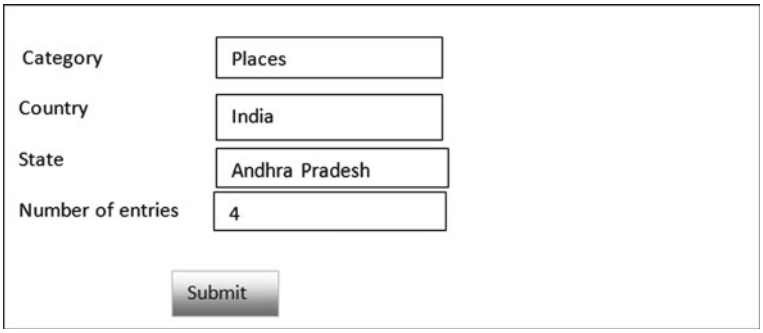


Fig. 4 Details to be asked in order to observe

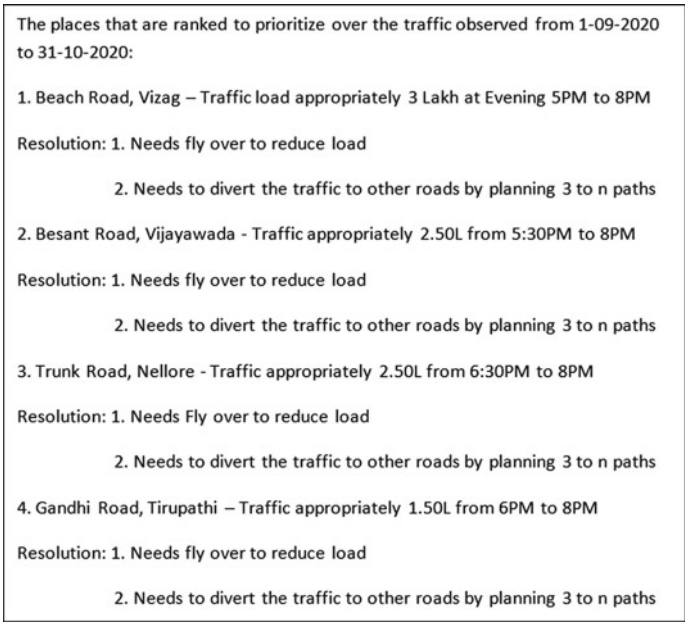


Fig. 5 Recommendations alerted to concerned Authority

Similarly, for 2, 3, 4 recommendations are also accepted by concerned authority in their locations and will be propagated to next level. The timeline of each level is recorded and are tracked till that recommendation is resolved and is closed. Whenever the recommendation is closed, it will enhance the performance of maps directly.

The performance of the defined approach when compared with traditional approach is demonstrated as follows (Figs. 7 and 8).

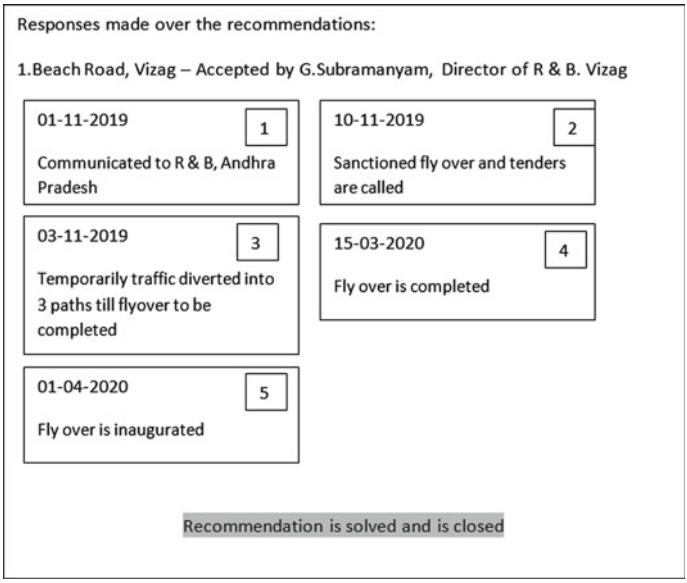
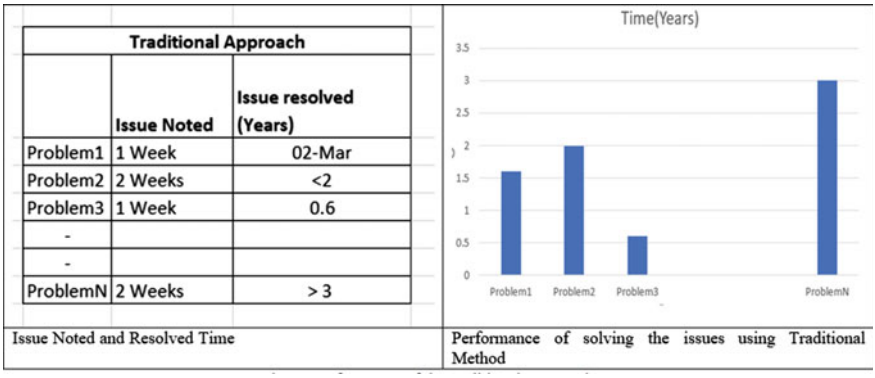


Fig. 6 Time line of first recommendation is resolved and closed



Traditional Approach		
	Issue Noted	Issue resolved (Years)
Problem1	1 Week	02-Mar
Problem2	2 Weeks	<2
Problem3	1 Week	0.6
-		
-		
ProblemN	2 Weeks	> 3

Issue Noted and Resolved Time

Performance of solving the issues using Traditional Method

Fig. 7 Performance of the traditional Approach

In this, issue once manually registered, it may be delayed because of lack of monitoring and automatic up-dation. But the proposed system would take the issue and would be resolved in less time.

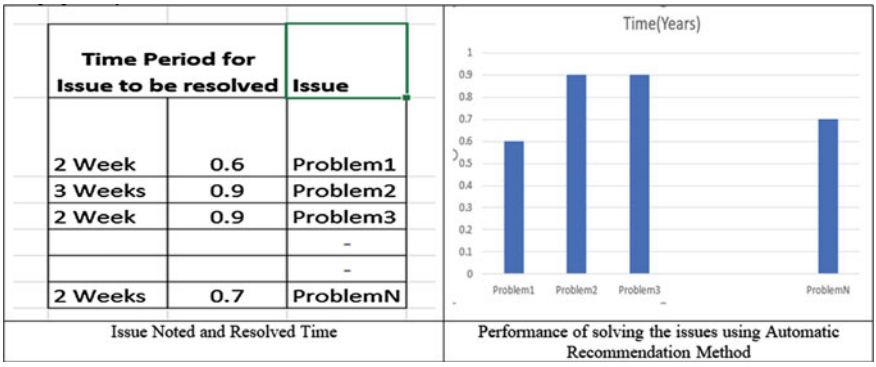


Fig. 8 Performance of the proposed "automatic recommendations and issue renovation"

5 Conclusion

In this, certain areas need to be analyzed by the maps so that appropriate popup recommendations could be alerted to concerned authorities. The recommendation feature is added to the google maps in order to provide the statistical information about certain places to the registered and requested persons. The inherent feature of the google maps is deep analysis and is going to alert through recommendations where issue is addressed and solvable steps also to be listed so that receiver will take further step either to proceed further or change or close the recommendation. This closing of the recommendation could be done in either tracking of recommendation to be resolved in timeline or manual closing of the receiver based on change of field or not possible to invest at that moment that could be considered by post surveys. If the number of recommendations required by the people became numerous, it will become overhead to the maps. Hence, the number of closing of the recommendations will enhance the performance of google maps. The output of alerting recommendation is making aware of the issue or the benefit that will be present in that region, and helps to track of the recommendation till to be closed. The traditional approaches consume more time and are not sophisticated compared to automatic alerting of recommendations and tracking till they are closed.

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POS Tagger Model for South Indian Language Using a Deep Learning Approach

M. Rajani Shree and B. R. Shambhavi

Abstract Computational Linguistics is necessary for understanding the language which brings human being with an insight into thinking and intelligence. It is an inspiring research concept in Natural Language Processing (NLP) domain. Parts of Speech (POS) labeling is a very crucial phase in NLP, since based on this, most of the other tasks like Syntax parsing, Semantic parsing, Sentiment analysis, Sentence level classification etc. are carried out. This paper presents a POS tagger model developed on Kannada texts which is one of the South Indian Languages by employing deep neural network methodology. The deep learning model adopted in this work has a combination of word embedding and Recurrent Neural Network (RNN) along with Long-Short memory (LSTM) techniques. The total size of the dataset used during this implementation is 10,000 annotated Kannada sentences (190,000 Kannada words) comprising of five different domains like Agriculture, Sports, Literature, Tourism and Science and Technology. Most of the sentences from the available dataset are compound and ranged up to 10–11 words. The dataset is taken from Technology Development for Indian Languages (TDIL) website. It has been divided into 8000 Kannada sentences as a training dataset and 2,000 Kannada sentences as a test dataset. The BIS (Bureau of Indian Standards) tagset is adopted for POS tags, in which we considered 27 prime POS tags. An average accuracy of POS tagging on an unseen dataset obtained from the trained POS tagger model is 81%. The results are extended with plotted graphs and shown in this paper.

Keywords Natural language processing · Word embedding · Deep neural network · Recurrent neural network · Parts-of-speech tagger

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1 Introduction

Parts of Speech (POS) tagging is an essential part in Natural Language Processing area, since POS tags are compulsory for other applications like Syntax parsing, Semantic parsing, Information Retrieval, Word sense Disambiguation, Machine Translation and Sentiment Analysis. Parts-of-speech tagging is a beginning process and is a very important task as it is the foundation for further activities. If the accuracy of POS tagging is poor means POS labels are not properly assigned to corresponding words and the same will affect upcoming processes such as syntax and semantic parsing applications and these applications will in turn obtain poor results. In this paper, we propose a Parts-of-speech tagger model on Kannada texts which is built using a deep neural network technique. Deep learning model is a kind of Recurrent Neural Network which has been adopted here to train the system and predict the appropriate POS labels. This technique has been combined with Word embedding algorithm to yield the better results. Word embedding is a method of representing words in the numerical form which bridges the gaps between human understandings of words to that of a machine. It is a distributed representation of text converted to numerical vectors in an n-dimensional space and it is essential for solving most of the NLP problems. The importance of this has increased and more number of researchers started adopting word embedding techniques in NLP applications. One kind of Word Embedding techniques is Word2Vec algorithm and it has been adopted in our proposed model to extract the features from Kannada texts. The main advantage of using word embedding technique is that it captures the meaning of each word compared with their neighboring words. Word2Vec algorithm converts each Kannada word into n-dimensional numerical vectors. Training the model using word2vec algorithm is more suitable in NLP, because different words which are identical in their meaning are close together in the word embedding vector space. We made sure at each stage of execution that none of the UTF-8 characters were misinterpreted or allowed to lose while using Word2Vec algorithm. In our work which is presented in this paper, the kannada words are converted into numerical vectors by adopting Word2Vec technique and the Word2Vec model is trained with hyper parameters such as 10 epochs, context window size as 2, vector dimension size as 100 and minimum count of occurrence of each word as 1. The main benefit of using Word Embedding method is that it relates the different words which have similar meaning in close proximity within word embedding space.

For Example the similar words that can be obtained from Word2Vec model for a Kannada word " "ತುಂಬ(tuMba)" are shown here:

[('ತುಂಬ',1.0), ('ತುಂಬಾ',0.7951), ('ತುಂಬಾನೆ',0.6600), ('ಅತ್ಯಂತ', 0.6127), ('ತೀರಾ', 0.4517), ('ತಪಸ್ಸು', 0.5471, ('ತುಂಬಿ', 0.5239), ('ತುಂಬಿರುತ್ತಾರೆ',0.4467)]

As we can observe that the cosine distances between the input word " ತುಂಬ(tuMba)" and the other words are closer. The actual meaning the word " ತುಂಬ" (tuMba) in English is ***very much*** and this word is used in a sentence to highlight something (Intensifier). The distinct words which give identical meanings are

mentioned in this example. We are able get the above output by invoking a method called **model1.wv.similar_by_vector (model1.wv[' ['ತಂಡ']'])**.

In the next step, sequential deep learning model has been built using Keras framework to train the system for POS tagging. Deep Learning is a recent technique in IT Industry which is an advanced machine learning concept and utilizes neural networks theory. LSTM (Long Short Term Memory) layer has been added to sequential model in order to obtain the effective output. LSTM is an improved version of Recurrent Neural Network (RNN) which makes it easier to memorize the previous data in the storage cells. We have collected the dataset which contains 10,000 annotated Kannada sentences (1,90,000 Kannada words) of 5 different domains from a central government website called Indian Language Technology Proliferation and Deployment Centre or Technology Development for Indian Languages (TDIL) [1]. The tagged texts were cleaned (removed unwanted characters), corrected some of the tags according to the context and made it proper for next tasks. Ministry of Communication and Information Technology (MCIT) had started TDIL programme in 1991 to develop the resources and tools for all major Indian Languages [2]. The main goal of this programme is to ease human-machine interaction without any language barrier. The Indian Government is also having plans to unite them to produce innovative user products and services. This paper mentioned Indian Government's policies towards Indian language improvement and maintenance.

2 Related Work

Many researchers have done significant amount of work in the natural language processing domain using a variety of traditional supervised machine learning approaches like Hidden Markov Model, Conditional Random Field Model, Support Vector Machine Model and Maximum Entropy Model. Some of the research work which focused on POS tagging are discussed in this section.

In our previous work [3], two POS tagger models were built for Kannada language, first using Conditional Random Field (CRF++0.50) which is a traditional supervised machine learning approach and the second using Tensorflow library along with word embedding which is a deep learning approach. We used the same dataset for both the models consisting of 1200 Kannada sentences. We compared Precision, Recall and F1-score of each POS label for both the models. An average tagging accuracy of CRF model obtained was 76% and that of deep learning model was 71%. But the size of dataset used here was very small. In continuation of this work, we increased the dataset size to 10,000 Kannada sentences. Also Keras library is used to build the deep learning model, got an improved accuracy by 10% and the same is presented in this paper. Swaroop et al. [4] in 2019, presented a POS tagger for Kannada language by adopting Conditional Random Fields (CRF) technique. They have extracted the features from training dataset like Sandhi splitting, context, digits, length of the word and Ending characters. Using these features the first model was built and the second model was developed including all these mentioned features in

addition with the word embedding feature. They gained tagging accuracy results of model 1 as 93.42%, 93.11% and 91.61% for General, Tourism, Conversational test dataset and gained accuracy results of model 2 as 95.84%, 94.96% and 93.47% for General, Tourism, and Conversational test dataset correspondingly. This shows from the result that by adopting Word Embedding method can improve the efficiency. In the paper which was published in 2010, Antony and Soman [5], also developed a POS tagger on Kannada texts using Support Vector Machine (SVM) which is a traditional machine learning algorithm. The Authors extracted the dataset from Kannada newspapers and books manually. They had used their own tagset consisting of 30 tags and manually tagged each word in the dataset. The model has been evaluated and obtained considerable performance. Todi et al. [6] explored the significance of using both character and word embeddings together in Kannada POS tagging. Kannada POS taggers were built by adopting two types of approaches, traditional Machine Learning (ML) model and Neural Network model. The CRF and SVM machine learning techniques were used to develop the first kind of model and RNN with LSTM technique was used to develop the second kind of model. The performances of all the models were compared and obtained overall accuracy of CRF model as 92%, SVM model as 91% and that of bidirectional RNN with LSTM as 92%. In the paper [7], Author implemented deep neural network methodology and developed a word-based language model. This model was used to anticipate the probability of the following word in the sequence, depending on the words which were already observed in the sequence. The author has also claimed that usage of LSTM layer can improve the performance of the model and increases the accuracy. The developed language model was applied to speculate and produce a series of words depending on the context of 50 preceding words. The Authors in the paper [8] have mentioned the importance of word embedding, expressed how Word2Vec model can be trained and implemented in deep learning. They have stated that different words which have similar in their meaning are close together in the n-dimensional numerical vector space. It also brings out the implementation details of the skip gram model which is a specific type of word embedding. The challenging issues of word embedding because of out of vocabulary (OOV) words, inflections and homographs in Word2Vec model were discussed in this paper.

Pallavi and Pillai in 2016 [9] experimented with POS tagger using Kannada language by adopting n-gram CRF approach. The dataset consists of 80,000 words, in which 64,000 words considered as train dataset and 16,000 words as test dataset. The tagset consisting of 36 tags was taken from Technology Development for Indian Languages (TDIL) website and used for POS tagging on Kannada words. The maximum accuracy achieved from their model was 92.94%. In the work presented by Shambhavi and Kumar [10] examined two separate probabilistic models (CRF and HMM) for Kannada language taken from the EMILLE corpus. They employed 25 parts-of-speech tags from a standard tagset created by Bharati et al. for the Indian Language Machine Translation Project. They divided the dataset into 95% i.e. 51,269 words as their train data and left 5% i.e. 2932 words as their test data. They did split 95% of their data (51,269 words) for training and the remaining 5% (2932 words) to test their models. They showed that CRF models frequently outperformed HMMs by

gaining 84% accuracy with the former as opposed to 79% with the latter. Siva Reddy et al. in the paper [11], made an attempt to build a cross-language POS tagger for Kannada with the help of Telugu language resources. The POS tag used here itself is encoded with all the morphological information like gender, person, number etc. They aimed to build a Kannada POS tagger using Hidden-Markov Model (HMM). The corpora that they used in their work was taken from Indian Languages Machine Translation (ILMT) consortium The precision, recall and F-measure scores of each POS tag have been discussed in the results.

The Authors in the paper [12] in 2008, compared the different Bayesian estimators for Hidden Markov Model (HMM) POS Taggers with several numbers of hidden states on different size datasets. They explored a variety of samplers for HMMS, found that Gibbs samplers do well with small data sets and Variational Bayes does well on large data sets. English Dataset has been used for getting the experimental results. Another effort has been made by Reddy et al. [13] on POS Tagging and developed an ensemble Parts-of-Speech taggers by adopting Decision Tree approach. They have integrated both Support Vector Machine (SVM) and Conditional Random Field (CRF) based POS taggers which are supervised approaches along with semi-supervised data mining approach that uses context based lists. The semi-supervised context based list POS tagger was suitable to use contextual information for tagging on unseen words while supervised POS taggers performed well for words present in the training model. This integrated ensemble POS tagger approach enhanced the performance of tagging and yielded good results compared to the basic methods. In [14], Samir Amri et al. built POS tagger models on Amazigh Language using Conditional Random Field (CRF), Support Vector Machine (SVM) and Tree Tagger methodologies. Their dataset size is 85000 and adopted 28 tags for Amazigh Language. The Authors have trained the POS taggers, tested and obtained the accuracy results as 90.08%, 89.38% and 92.06% in the CRF, SVM and tree Tagger model respectively. The Authors in the paper [15], proposed a POS tagger model on low resource language—Farsi text and this model was built based on Neural Network concept. They carried out a shallow morphological analysis and got an accuracy of 97.4% as tagging results. The Authors also expressed the problem in tagging because of words which are out of vocabulary (OOV) present in the dataset.

The Author Seunghoon Nac has published a paper in 2015 [16] in which morpheme segmentation and then POS tagging has been done on Korean language based on CRF method. Both atomic and compound morpheme units have been considered and tagged. After POS tagging, post-processing of compound morphemes has been carried out, in which each mixed morpheme is further divided into smallest unit of morphemes based on pre-analyzed structure taken from the tagged corpus. Song and Park [17], expressed the problem in Korean text that word spacing element did not match one-to-one to POS tag and those morphemes must be retrieved during the process of Parts-of-Speech tagging. In order to overcome this, they have developed a Korean Parts-of-speech tagger that contains two steps process. This generates first a sequence of lemmatized and retrieved morphemes which could be mapped one-to-one to a POS tag using encoder-decoder design. In the second step, the POS tag of each morpheme in the generated sequence was identified by a typical labeling

method. The Authors in the paper [18] which was published in 2016, have proposed POS tagging in that both dictionary based and traditional statistical machine learning methods were integrated. An accuracy of POS tagger obtained from the tested dataset was 95.80%. Since both the methods were combined, the POS tagger model can work efficiently on considerably small size dataset. Gopalakrishnan et al. [19], presented a Parts-of-speech tagger model by employing Neural Network method. Very little research has been done on POS tagger using deep learning concept. One such attempt made on POS tagger model is expressed in this paper. They evaluated their model on GENIA dataset which is publicly accessible and gained considerable results. The main focus here was on the biomedical domain present in the available dataset. Murthy and Badugu [20] presented a different approach to tag the words without using any machine learning algorithms or training dataset. The tagging approach they followed was based purely on the internal structure of the words and morphological analysis. The experiment done was on two Indian Languages Kannada and Telugu. They adopted LERC-UoH Tag Set standard for POS tagging to each word in the corpus. They created their own Kannada and Telugu corpus to conduct this experiment and obtained considerable results. In the book, Brownlee [21] described in detail about the RNN architecture extended with Deep Learning model. He has claimed that training the system with massive amount of data through deep learning approaches always yield better results than older machine learning algorithms. He has also explained in his book that keras framework which is written in python is more suitable for implementing deep learning model and described how deep learning models can be developed using Keras.

3 Dataset

The total size of the dataset used in our work is 10,000 Kannada sentences (190,000 words). It includes five different domains like Agriculture, Sports, Literature, Tourism and Science and Technology. The data has been downloaded from Government website TDIL which is freely downloadable. The dataset has followed BIS tagset standard which contain 27 major tags.

An Example of POS tagged sentence which is available from the training dataset is:

ಬಹುತೇಕ-QT_QTF ರೈತರು-N_NN ತಮ್ಮ-PR_PRF ಬೆಳೆಗಳ-N_NN ನಡುವೆ-N_NST ಸೊಪ್ಪು-N_NN ತರಕಾರಿ-N_NN ಬೀಜ-N_NN ಬಿತ್ತಿ-V_VM_VNF ಅದರ-PR_PRP ಫಲ-N_NN ಉಣ್ಣುತ್ತಿದ್ದಾರೆ-V_VM_VF (1)

The same tagged sentence which is shown in (1) is mentioned without their POS tags in (2).

ಬಹುತೇಕ ರೈತರು ತಮ್ಮ ಬೆಳೆಗಳ ನಡುವೆ ಸೊಪ್ಪು ತರಕಾರಿ ಬೀಜ ಬಿತ್ತಿ ಅದರ ಫಲ ಉಣ್ಣುತ್ತಿದ್ದಾರೆ

(2)

(BahuTeka rytharu thamma belegala naduve soppu taraKaari Beeja bitti adara phala uNnuttiddare).

The meaning of the sentence (2) in English is: "**Most of the Farmers are getting rewards by sowing the green leafy vegetable's seeds in between their crops"**.

4 Methodology

In the presented work, we have adopted an advanced machine learning technique called deep neural network architecture i.e. Recurrent Neural Network (RNN) to train the system and predict the POS tags on Kannada words. NLP tasks such as POS tagging, Syntax parsing, Semantic parsing, Sentiment Analysis, Document classification and many more are the applications that come under Artificial Intelligence domain. Since these applications produce an intelligent decision as an output after being trained with sufficient inputs. Artificial Intelligent system incorporates two major concepts known as traditional machine learning and deep learning algorithms. Deep learning techniques are being used nowadays for all kinds of sequential tasks since they try to learn high level features from the huge amount of data in an incremental manner. Also the deep learning classifiers are trained through feature learning and able to identify the patterns or contexts from the trained dataset unlike traditional machine learning techniques which perform only through task-specific algorithms. A research has been done on different neural networks with LSTM (Long Short-Term Memory) like Bidirectional LSTM, CRF, LSTM-CRF and finally Bidirectional LSTM-CRF [22]. They have expressed the advantage of using LSTM network layer that it is able to exploit long range dependencies in the data.

We have adopted Word2Vec algorithm from gensim module and it is one of the word embedding approaches to extract the features from Kannada sentences. Word2Vec algorithm takes only raw sentences (without POS tags) as input and each word is translated into their corresponding numerical vectors in n-dimensional vector space. The model developed from Word2Vec algorithm is trained with the 10 epochs to learn the features from the dataset. This will be given as input for the next step to build the Keras Sequential model. The words and their corresponding labels were trained separately using RNN model. To yield the better accuracy, the sequential model has been added with LSTM network layer and two activation layers such as "relu" and "softmax". At first, feed-forward neural network models were adopted to establish the deep learning approach. Later on Recurrent Neural Networks (RNN) and then networks along with a long-term memory like the Long Short-Term Memory (LSTM) are being used because these models are able to acquire knowledge of

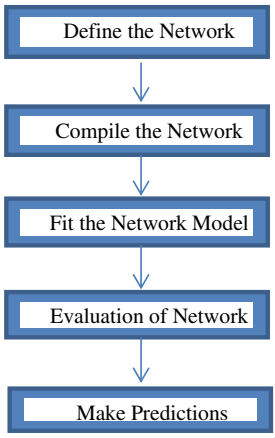

Fig. 1 Keras model life-cycle [21]

the relevant context over lengthy input sequence effectively than the simpler feed-forward networks.

The presented work has been implemented in Python language, since Word2Vec and Keras for deep learning are the libraries available in Python. Keras is a frame work to build the neural network model and it is written in Python which runs over tensorflow at the backend.

The five stage processes in the neural network model of Keras (As shown in Fig. 1) are:

1. Define the Network.
2. Compile the Network.
3. Fit the Network model.
4. Evaluation of Network model.
5. Make Predictions.

The very first step in RNN is to set the sequential neural network model. Neural networks are defined in Keras as a sequence of layers. After defining the Sequential neural network, it must be compiled. Compilation is an efficient step. It converts the sequence of layers into a series of matrix in a format suitable for execution on CPU, based on how Keras is designed. We set the framework for compiling the network which includes Adam optimizer to reduce the error rate, categorical_crossentropy to calculate the loss during training and accuracy as a metric. The compilation of network is followed by training the model. It means fit the network model by assigning the weights on a train dataset [21]. To fit the network, it requires the training data to be mentioned as a matrix of input patterns X_train and y_train which represent words and their corresponding POS tags. Similarly the test dataset includes X_test and y_test. For training the network, we set the number of epochs as 100 and batch size as 64.

After the model is fit, the summary of the performance of model is returned as a history object. This history includes both the loss and any additional metrics specified,

recorded in each epoch. Training the model can take a long time, from minutes to hours and from hours to days depending on the network's dimensions and size of the training dataset. In our work, for 100 epochs the time taken for training the dataset is approximately 5 h. After the network is trained, it can be evaluated. We evaluated the performance of the network model on an unseen dataset i.e. test dataset. This will provide an estimation of the achievement of the network at generating predictions for an unseen or test data in the future. Once the performance of our fit model is fulfilled, we can make use of it to predict the POS tags on new data by calling predict_classes( ) function on X_test dataset.

5 Test Results

The dataset is cleaned, separated labels from all the words through our application and the raw sentences are given as input to Word2Vec algorithm to build the word embedding model. Because word2Vec takes only the raw text for next processing, we need to give untagged sentences. Word2Vec is an algorithm defined in gensim module and is written in Python language. This will convert each word into corresponding numerical vectors. The Word2Vec model is developed with window size as 2, minimum count as 1, number of threads as 4 to increase the speed of execution. Next step is to pre-train the model with total number of sentences as 10,000, total number of words as 108,696 and number of epochs as 10. Since this is necessary to extract the features from Kannada text and this leads to efficiency. Word embedding technique is capable of handling and computing massive amount of data because it converts texts into numerical which becomes easy for computation.

Numerical vectors of words and the labels are converted into numpy arrays separately. Split the total dataset into 80% as trained dataset and 20% as test dataset. The next process is to build the Sequential deep learning model with a LSTM layer and two Dense layers. Before compiling the model relu and softmax activation functions are added, because it is suitable for multi-class categorical type. POS tags are having multiple class categories (27 tags), hence categorical_crossentropy type of loss function is employed. Compile the model, fit the model with batch size of 64, number of epochs as 100 and eventually evaluate the model (correctly assigned POS labels in the test dataset). Finally, we obtained an average accuracy of 81% on POS tagging to each Kannada word as shown in Fig. 2 and the corresponding model loss reduced to 0.5 as shown in Fig. 3.

6 Limitations

The main limitation of our proposed work in this paper is the complicated structure of Kannada sentences which are present in the training dataset. Since Kannada is one of the south Indian languages and is agglutinative in nature, most of the words

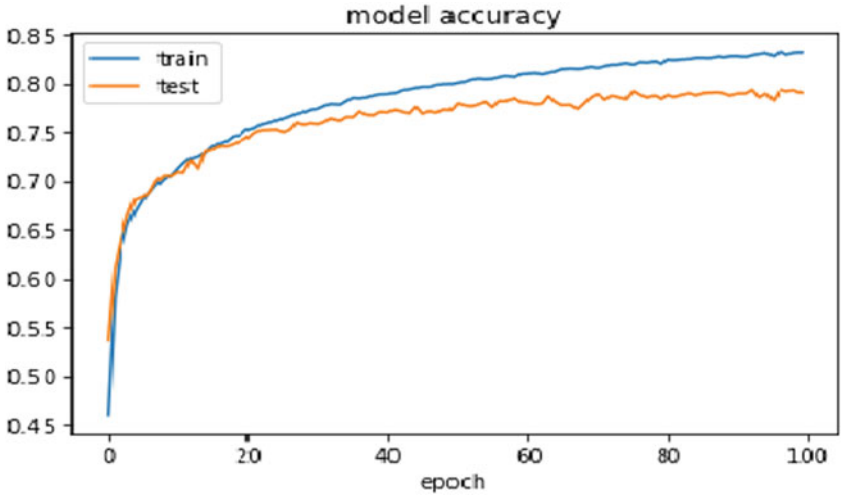

Fig. 2 Accuracy of POS Tagger

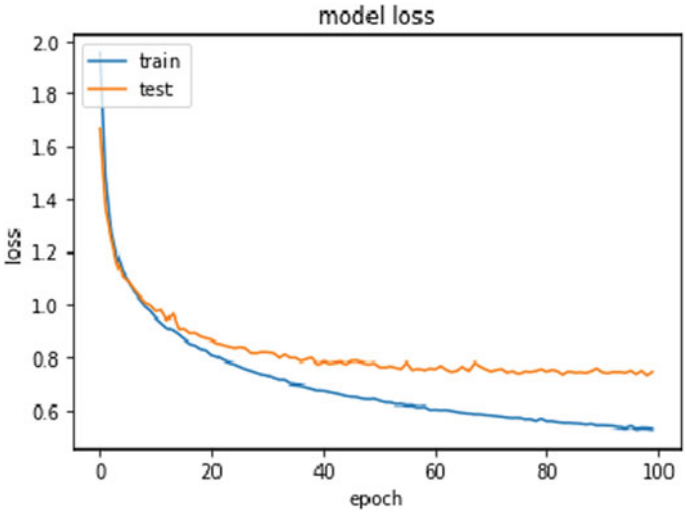

Fig. 3 Loss function on training

each sentence are having inflections. Moreover the dataset used is a mixture of five different domains that leads to contextual differences. Table 1 shows one particular root word and their varieties of inflections which give the different meanings. To train these kinds of words and complex structured sentences, it will be a challenging task to gain 100% accuracy in POS tagging on unseen dataset.

Table 1 Root word and it's inflections

Root word	Inflections for the Root word taken from train dataset	POS tag	Meaning in English
ವಹಿವಾಟು(Transaction)	ವಹಿವಾಟು	N_NN	Transaction
	ವಹಿವಾಟುಗಳು	N_NN	Transactions
	ವಹಿವಾಟಿಗೆ	N_NN	To a transaction
	ವಹಿವಾಟಾಗುತ್ತಿದೆ	V_VM_VF	Transactions are happened
	ವಹಿವಾಟಾಗುತ್ತಿದ್ದು	V_VM_VNF	During transaction
	ವಹಿವಾಟಾಗಿ	V_VM_VNF	After transacting
	ವಹಿವಾಟಿಗಾಗಿ	N_NN	For transaction
	ವಹಿವಾಟಿನಲ್ಲಿಯೂ	N_NN	In a transaction
	ವಹಿವಾಟನ್ನು	N_NN	That transaction
	ವಹಿವಾಟಿನ	N_NN	Transaction's
	ವಹಿವಾಟಾಗುತ್ತಿರುವ	V_VM_VNF	transaction going on

7 Conclusion

We have proposed in this paper the Parts-of-speech tagger model on Kannada texts, implemented with word embedding and RNN technologies. Most of the experiments done so far on POS tagging for Indian languages are only using traditional machine learning techniques and some of them are mentioned in References section in this paper. Hence we made an effort to develop an efficient POS tagger on Kannada texts by adopting the deep learning concept. RNN is a methodology in deep leaning and also it is an enhancement of traditional machine learning techniques. We obtained the encouraging results from the model i.e. 81% accuracy on assigning POS tags on an unseen dataset and it is the major advantage of using advanced deep neural network technique. Most of the Indian Languages are agglutinative languages and it is the major hurdle in achieving precise POS tagging accuracy results. The RNN model yields still better results as the training dataset increases. A similar kind of model that is proposed in this paper can be developed for other Indian Languages also.

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A Secured Healthcare Medical System Using Blockchain Technology

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Abstract In our current healthcare system, the most inevitable requirement is to give the protection against the patient's information that has to be preserved confidential. There are several other approaches to address this issue, but the usual effective solution chosen in this paper is by Blockchain technology. The reason behind in choosing the Blockchain technology is mainly due to its unremarkable features like peer-peer, decentralized, distributed, scalability, extensibility, immutability, interoperability, and public ledger that ensures trustworthiness, protection, and security in supporting the healthcare system. The main basic idea behind this paper is whenever the patient's information needed to be accessed that has to be authorized and protected using encryption algorithms. So, in this study, the idea in designing framework is to achieve maximum security against in accessing the patient's medical record. To accomplish this task, entire framework is partitioned into three modules and they are Authentication, Encryption, and Data retrieval.

Keywords Blockchain · Authentication · Data retrieval · Proof-of-work

1 Introduction

Satoshi Nakamoto [1] and his team were the inventors of the Blockchain in 2008 to promote Bitcoin cryptocurrency to serve as a public ledger that is record keeping database, where it has a log of genuine transactions executed in the network. Other applications of the BC are asset management, insurance, payments, smart appliances, IOT, supply chain sensors, government, music, etc. In centralized healthcare systems, like Electronic Health Records (HER) or Electronic Medical Records (EMR), the

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patient's medical records are not so confidential that can be accessed without the patient's intervention and not so secure because the traditional algorithms like encryption are easily hacked [2]. BC technology in terms of security gains trust in several ways. BC is similar to the linked list. In linked list, each node contains pointer to the next node where as in BC, each block contains cryptographic hash of the previous block, transactional data, and timestamp.

Very first block in the BC is called Genesis block, contains data, its hash value, and hash value as 0. If more than one transaction is associated with block, the hash value is calculated using Merkle tree [3].

Merkle tree data structure retrieves transaction from every leaf and hash value of each transaction is calculated. Since Merkle tree has branching factor 2, again two has values will be combined, calculating new hash value as shown in Fig. 1 say Hash01 and this procedure continues till we get the single hash value and that becomes the hash value of particular block. There are 3 types of BCs.

- Public BC like Bitcoin and Ethereum.
- Private BCs like Hyperledger and R3 Corda.
- Hyper BCs like Dragonchain.

Public BC are fully decentralized, which are open to anyone and join the network irrespective of location, and they have a token-based design to incentivize and reward participant in the chain [4]. Private BCs participants need to get consent to join the networks, transactions are private, and available to particular application, and private BC are not fully decentralized [5]. Hybrid BCs combines privacy benefits of private BCs and security and transparency benefits of public BCs [6]. There are two types of node. (1) Full node. (2) Lightweight node. For example, full node in the Bitcoin

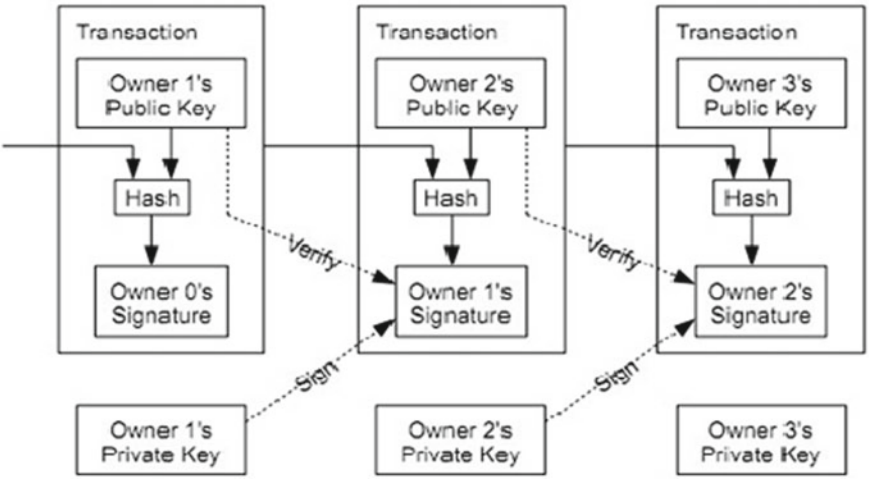
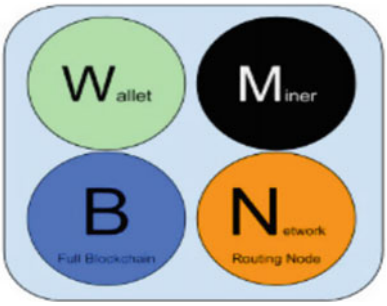


Fig. 1 Blockchain

Fig. 2 Bitcoin full node



carries four functions namely routing, BC database, mining, and wallet services as shown in Fig. 2.

As name indicates lightweight nodes handles part of BC and transactions associated with it are verified using an algorithm called Simplified Payment Verification. The function of the miner in the full node is to validate new transaction by performing mathematical calculation and recording them on the global ledger. Thus, who gives first response will get the incentive or reward and response is called as Proof-Of-Work.

The purpose of the contribution of this paper is how actually the BC ensures security when hacker wants to modify the data. If hacker attempts to modify the data, hash values related to that node will change and that will not match the next block. If at all, hacker wants to recalculate the hash value in all other blocks, which takes enormous amount of time and power consumption, which is extremely impossible task for the hacker. In this paper, our designed system maintains the patient's information in the public ledger that can monitor the patient's medical records if any unauthorized persons are accessing; thus, BC not only provides security but also achieves transparency, immutability, and scalability.

The remaining part of paper is organized as follows Sect. 1 is about Introduction, Sect. 2 Related to Block chain, Sect. 3 Methodology and Sect. 4 Conclusion.

2 Consensus Algorithms

The intention behind the evolution of Blockchain technology is to transfer money and useful information without having any third party involvement like government or bank and hence revolution of versions. In Blockchain 1.0, the idea of creating money was by solving computational hard problems and Bitcoin was the best example for this. Bitcoin has many disadvantages like scalability and mining [1]. To solve these problems, evolution of the next version that is beyond the concept called as Smart contracts. Smart contract are tiny computer programs and they execute automatically in the Blockchain whenever condition gets satisfied. Most renowned example is the Ethereum, which is the platform for distributed applications in the

Blockchain network. In version 3.0, introduction of DApps [7] known as decentralized application that runs in a decentralized application. The uses of Blockchain technology is incorporated into multiple business applications like banking, healthcare, finance, entertainment, insurance, etc. [1]. Blockchain is the digital platform behind Bitcoin, Ethereum, Hyperledger and other cryptocurrencies. Cryptocurrencies allow secure online payments using virtual tokens [8] and security are achieved by means of various encryption algorithms and cryptographic techniques [5]. Blockchain is designed in a more efficient way to transmit, receive, and maintain the tracks of the user in a very secure manner. In perspective of cryptocurrencies like Bitcoin or Ethereum, the BC uses cryptographic hash functions in its consensus mechanism. Consensus mechanism [9] is done through consensus algorithms [10]. In Blockchain whether a particular node is to be added or not to be decided with the help of the consensus algorithm, which is nothing but they agreed on one state of a Blockchain to add the new node upon some predefined conditions. In Blockchain, word there are many consensus algorithms [1, 11].

1. Proof of Work
2. Proof of Stake
3. Delayed Proof of Work
4. Delegated Proof of Stake
5. Proof of Weight
6. Proof of Reputation
7. Proof of Elapsed Time
8. Proof of Existence.

3 Types of Blockchain

1. *Permissionless Blockchain*
2. *Permissioned Blockchain*
3. *Consortium Blockchain*

Figure 3 gives hint to select which network is useful to upgrade the business applications to get the maximum benefit and to achieve overall system performance. Throughput is very less in the permissionless network [9] as participant's identity is not known to each other, when compared to the permissioned and central server [5].

Applications of Blockchain
Initially Blockchain usage was confined to the in the field of cryptocurrency, but now its usage is expanding in wide areas as shown in figure and even more.

Blockchains in Voting System
When dealing the current circumstance, Blockchain system is suitable environment to give security and avoid tampering [28]. Whenever a particular user appeals for a

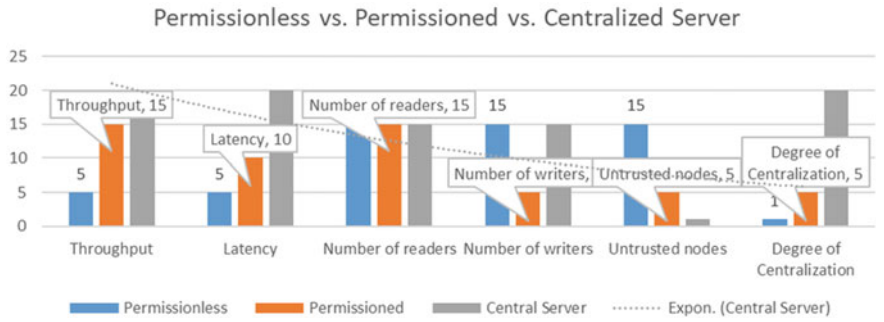


Fig. 3 Comparison of blockchain platforms

vote, his/her vote will be sent to the one of the nodes in the Blockchain. Once voting is made, the node executes the smart contact to verify and validate the vote [29].

Blockchain in Music System

Fair Trade Music is a grassroots campaign raising standards helps standard of living for all musicians in their community [12].

Blockchain in IoT

Interconnection of computing devices embedded in day-to-day objects, enabling them to send and receive the data. The usage of IoT [30] is increased rapidly due to technology dependency [31].

The password generated by CLCG has more strength when compared to LCG as shown in Table 1.

We assume that a1, b1, a2, b2 and m are known and the seed (x0, y0) is secret. Coupled LCGs [32] turn out to be more secure than a single LCG [33]. Quantum

Table 1 Comparison between LCG and CLCG

	LGC (a = 6, b = 6)	Password strength (%)	CLCG (a1 = 6, b1 = 6 a2 = 6, b2 = 4)	Password strength (%)
1	WMnfdpNo	32	ag%ˆrmnw	44
2	MSGgfqhH	30	uCEdZFb#	60
3	ZzNpmDˆr	64	iU8F2OpT	72
4	CwjghG6P	58	)wQ*Rge5	80
5	Y4FFhofd	54	ZPN&ba&T	69
6	THDmQl5P	60	K6wtWqvk	57
7	9AHsCLtN	58	Gr(kS!Jd	76
8	3%rKCASr	67	*EI9t8!A	90
9	UavZOlAb	60	AP!6fBH6	77
10	Tpsi#NZe	58	iSEya8(g	72
	Average	54.1		69.7

digital signature [34, 35] uses one-way function that are easy to compute, but little hard in calculating their inverse functions. These one-way functions are used in modern cryptography and are used in pseudorandom generator, authentication of messages, and digital signature.

In this study, secured healthcare system is partitioned into three modules. Authentication uses quantum digital signature, encryption uses AES, and data retrieval uses SHA. This framework ensures protection of the patient's data and hence gains trustworthy of the healthcare system.

3.1 Authentication Using Quantum Digital Signature

Authentication process runs in two steps.

3.1.1. *Registration for a new patient*.

3.1.2. *Generating authentication ID for the doctor*.

3.2 Encryption Using AES

AES is a symmetric encryption algorithm and input for the encryption is plain text and secret key. The patient's data is encrypted with private key, which stands key measure for protection of the patient's medical record. Encrypted patient's medical record is stored in the private cloud and its address is added into the Block chain.

3.3 Retrieve the Medical Report Using SHA

The validated and authenticated doctor has an authority to perform data retrieval using Secure Hash Algorithm. SHA is a cryptographic hash function which receives its parameter as input of any length and returns 160-bit hexadecimal hash value which is also called as message digest that is stored in the Blockchain. The entire framework is split into three modules as follows.

Pseudocode for Patient Authentication Module

Input: Patient Identification Number.

Output: Message indicating about registration.

1. Get Patient (P) to Hospital (H)
2. if (P==NewUser)
3. then Register(PID, PPBK, PPRK) using CLCG

4. else Login(PID)

Pseudocode for Doctor Authentication Module

Input: Doctor Identification Number

Output: Address of Patient medical record gets stored in Blockchain

1. Get specialist and Register using AES (PID, PPRK, PPBK)
2. **if** Patient Information is added into PR
3. **then** Get Permission from Patient
4. **if** (Permission===Granted)
5. **then** Update (PR)
6. Encrypt Patient Information using AES using key supplied by patient EK (PR, KEY)
7. Store Encrypted data in Private Cloud associated with timestamp PC (PR, T)
8. Address of PR is stored in BC

Psedocode for Data Retrieval Module

Input: Doctor Identification Number.

Output: Authenticated Patient's Information.

1. **If** Doctor (authenticated)
2. then Get the Address from the BC
3. else **if** (D==New)
4. **then** Authenticate the doctor using AES
5. **if** (authentication == true)
6. **then** get the address from BC
7. Using address Get (Encrypted Data)
8. Using SHA Decrypt DK (PR, PPRK, PID)

4 Conclusion and Future Scope

Since we are living in the era of advanced technology, everyone's demand is to have better life than what we have today, and also most of them prove themselves by inventing new technologies for their individual as well as social benefit. Thus, the invention of Blockchain technology and it is a replacement of our traditional centralized system. In this paper, brief introduction about BC is explained and also how to achieve the maximum security for patients medical records. In this paper, designed framework meets the needs of the issues faced in the confidentiality of the patient by gaining trust, ensuring, security, and validation. Future scope of the work is if the BC is of public type and more than 50% of the blocks found to be malicious, we cannot guarantee the security and trust. The other limitation is BC consumes

more power which is approximately equal to the power consumption of some nation because of the mining. These two limitations are to be addressed as a future scope.

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Comparative Analysis of Machine Learning Algorithms Based on the Outcome of Proactive Intrusion Detection System

A. Abirami and S. Palanikumar

Abstract Machine learning plays a vital role in the current world. In the case of an Intrusion detection system to classify the normal and the malicious packet, the machine learning classification algorithms are used. When the live packets are captured and classified without allowing it to enter the network or the host represents a proactive intrusion detection System. Every machine learning algorithm has its pros and cons. This article works on the KDD dataset to classify the captured packets using the machine learning-based classification algorithms of Decision tree and Random forest. The implementation work with Denial of Service attack, Man in the middle attack, and buffer overflow attack. The attack packets are captured and classified using Random forest and decision tree and based on that, the classification algorithms are also compared with Accuracy, precision, and recall parameters.

Keywords Machine learning · Packet classification · Packet analysis · Data mining · Network attacks · Security

1 Introduction

The intrusion detection system will prevent unwanted packets to enter the system. The system can be divided into two categories of reactive and proactive IDS. The reactive IDS react after the malicious packet enters the network and damages the network. In the case of reactive IDS, the system classifies the packets and identifies the malicious packets before entering the network [1]. The system explained in this paper is about the proactive IDS and classify the packets using various classification algorithms. The dataset is one of the famous dataset used in the world of the intrusion detection system. The dataset carries 42 attributes and the attacks are classified into 5 major

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categories of DoS, Probe, R2L, U2R, Normal. The features, attributes, the attacks are all explained in [2]. The features are selected and based on the attack it's used in this implementation. Machine learning is a part of artificial intelligence that makes the system learn and take decisions. For this implementation, a machine learning-based classification algorithm is used which is based on supervised learning. Machine learning can be done in three ways supervised learning, Unsupervised Learning, and Reinforcement Learning. Supervised learning works based on training happens with the guidance of a labeled dataset. Unsupervised learning happens through self-learning through previous experiences. Reinforcement learning is the combination of both means for input if a labeled dataset is available then it will act as a supervised learning else as unsupervised learning.

2 Literature Survey

A survey on the KDD dataset is done and the needed and the unwanted attributes are identified for the research. The survey to identify the best classification algorithm is done with the help of implementing the various classification algorithms using python. In this survey, the unwanted attributes which do not contribute to the attacks are dropped and the remaining attributes are considered for the implementation. For this comparative analysis, the algorithm considered is Random Forest, Decision Tree, Naïve Bayes. To select the classification algorithm, 10% of the KDD dataset is used with 70% of the same as the training dataset and 30% as the testing dataset and the duplication entries in the dataset are also removed. The parameters used for this comparative analysis of the classification algorithms are Accuracy, Precision, Recall, and F-Score. The algorithms are chosen based on the survey carried out in [3].

3 Proposed System

The proposed system collects the incoming packet using wireshark [4] and identifies the feature needed for the proposed implementation and give as the input to the classifier. The classifiers used in this system are based on Decision tree and random forest. The implantation identifies the following attacks DoS, Buffer overflow, the man in the middle attack.

Steps of the proposed system

Step 1: Capture the incoming packets.

Step 2: Feature selection of packet parameter.

Step 3: Classify the packet with the machine learning algorithms.

Step 4: Update the dataset for future decisions.

Step 5: Compare classification algorithms.

Random forest
This classifier has a collection of a Decision tree which improves the accuracy in the prediction with less classification error [5]. Sometimes the accuracy gets affected by providing false decisions for some new inputs, this happens when the random forest creates a noisy tree.

Decision Tree
This classification method is one of the popular machines learning technique for various applications which involve large data and need good decision making. These use a divide and conquer method and each branch of the decision tree represents an output decision [6].

For the implementation to be tested, a dummy website is created to launch the attack which is shown in Fig. 1. This dummy website is designed to show the attack and which helps the system to generate attack packets and the packets are collected to classify and to update the dataset for the upcoming prediction.

The GUI console which is shown in Fig. 2 is used by the user to mention the URL to launch the attack; in this case, it's the URL of the dummy website address. This GUI guides the user to start and stop the attack, to capture the packets for the classification, to detect the type of attack, and also to show the graph which compares the classification algorithms.

Once the dummy website URL link is inserted and clicked on "Start Attack" as shown in Fig. 3. A response code is received which shows that the DoS attack has been launched.

To test whether the DoS attack has been launched, the Dummy website is reloaded which provides an error as "this site can't be reached" as shown in Fig. 4 which means it's unable to load the Site. The error message represents that the attack is launched successfully.

In Fig. 5 the captured packet details after the attack launch are shown. The packets are captured and the features are selected based on the dataset to update the dataset for the future classification.

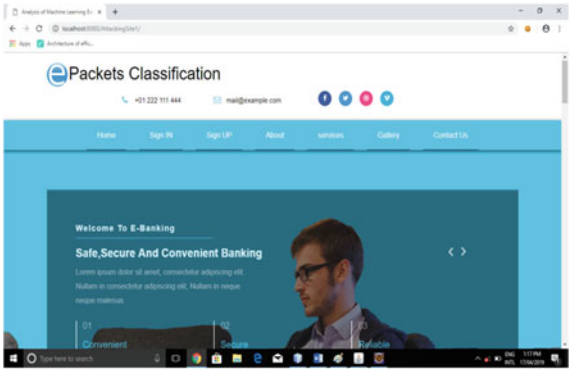


Fig. 1 Dummy website

Fig. 2 Attack console

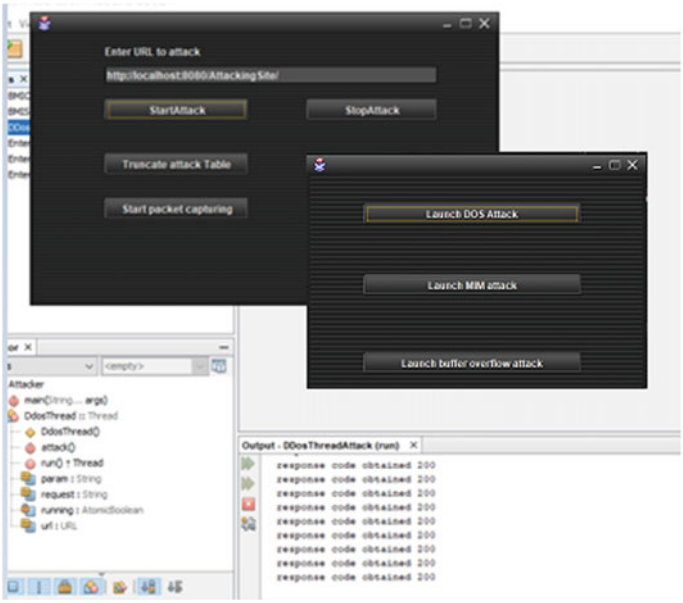


Fig. 3 Launch of DoS attack

Similarly, the buffer overflow is launched and the data packets are captured and maintained in the dataset as shown in Figs. 6 and 7.

Now comes the Man in the middle attack which is shown in Figs. 8 and 9.

As per the attack launched and the packet captured the classification algorithms detect the attacks which are shown in Fig. 10.

The comparative analysis of the classification algorithm based on Precision, recall, and accuracy are shown in Fig. 11.

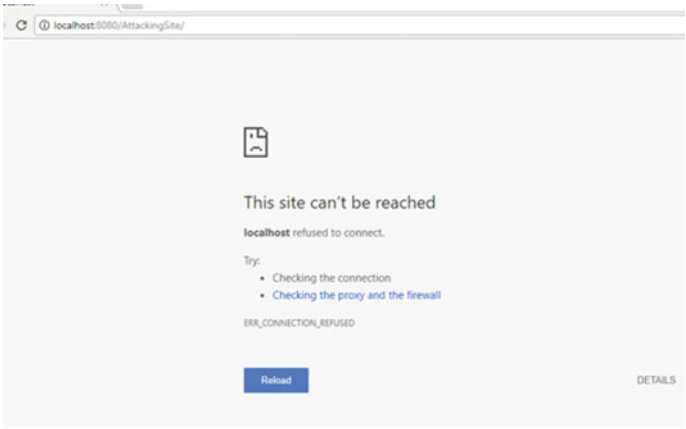
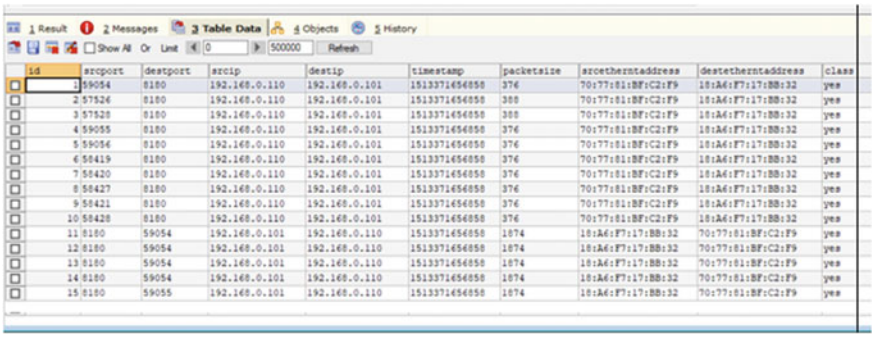


Fig. 4 Dummy website after the DoS attack



id	srcport	destport	srcip	destip	timestamp	packetsize	srcetherntaddress	destetherntaddress	class
1	59054	8180	192.168.0.110	192.168.0.101	1513371456858	376	70:77:81:BF:C2:F9	18:A6:F7:17:BB:32	yes
2	57526	8180	192.168.0.110	192.168.0.101	1513371456858	388	70:77:81:BF:C2:F9	18:A6:F7:17:BB:32	yes
3	57528	8180	192.168.0.110	192.168.0.101	1513371456858	388	70:77:81:BF:C2:F9	18:A6:F7:17:BB:32	yes
4	59055	8180	192.168.0.110	192.168.0.101	1513371456858	376	70:77:81:BF:C2:F9	18:A6:F7:17:BB:32	yes
5	59056	8180	192.168.0.110	192.168.0.101	1513371456858	376	70:77:81:BF:C2:F9	18:A6:F7:17:BB:32	yes
6	58419	8180	192.168.0.110	192.168.0.101	1513371456858	376	70:77:81:BF:C2:F9	18:A6:F7:17:BB:32	yes
7	58420	8180	192.168.0.110	192.168.0.101	1513371456858	376	70:77:81:BF:C2:F9	18:A6:F7:17:BB:32	yes
8	58427	8180	192.168.0.110	192.168.0.101	1513371456858	376	70:77:81:BF:C2:F9	18:A6:F7:17:BB:32	yes
9	58421	8180	192.168.0.110	192.168.0.101	1513371456858	376	70:77:81:BF:C2:F9	18:A6:F7:17:BB:32	yes
10	58428	8180	192.168.0.110	192.168.0.101	1513371456858	376	70:77:81:BF:C2:F9	18:A6:F7:17:BB:32	yes
11	8180	59054	192.168.0.101	192.168.0.110	1513371456858	1074	18:A6:F7:17:BB:32	70:77:81:BF:C2:F9	yes
12	8180	59054	192.168.0.101	192.168.0.110	1513371456858	1074	18:A6:F7:17:BB:32	70:77:81:BF:C2:F9	yes
13	8180	59054	192.168.0.101	192.168.0.110	1513371456858	1074	18:A6:F7:17:BB:32	70:77:81:BF:C2:F9	yes
14	8180	59054	192.168.0.101	192.168.0.110	1513371456858	1074	18:A6:F7:17:BB:32	70:77:81:BF:C2:F9	yes
15	8180	59055	192.168.0.101	192.168.0.110	1513371456858	1074	18:A6:F7:17:BB:32	70:77:81:BF:C2:F9	yes

Fig. 5 Captured packet data

4 Conclusion

The system is tested under three attacks under two classification algorithms of Random forest and Decision tree. As per the analysis both the algorithms are providing almost equally good prediction. Random Forest is slightly better than the Decision Tree. The attacks involved in this study are Denial of Service, Man in the Middle, Buffer Overflow attacks. As the future scope, more attacks can be tested with a more updated feature of the dataset and classified with more models to get a better outcome.

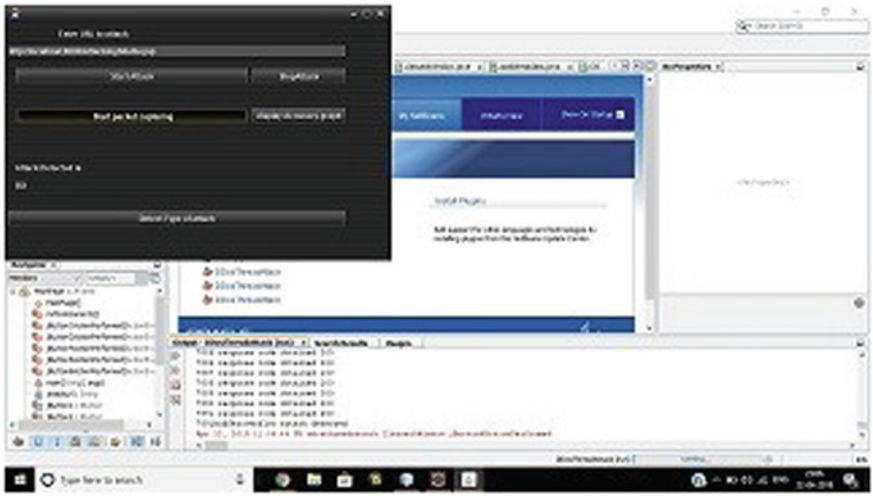


Fig. 6 Buffer overflow attack

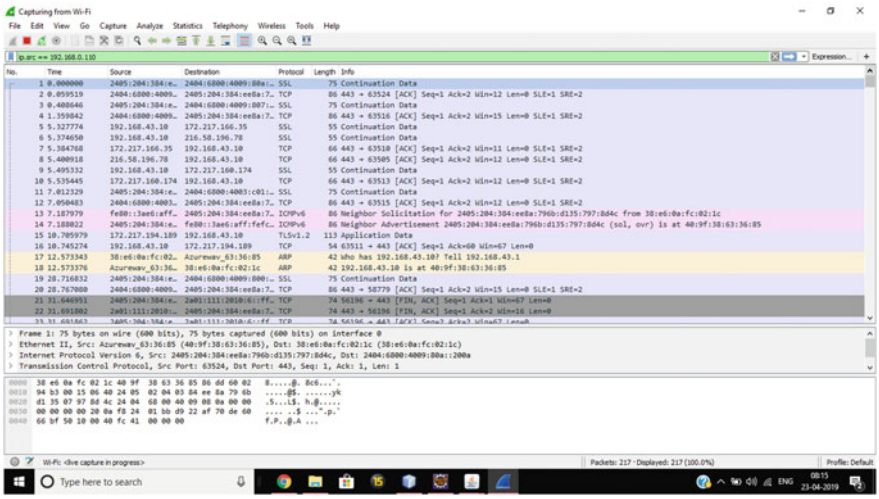


Fig. 7 Buffer overflow packets

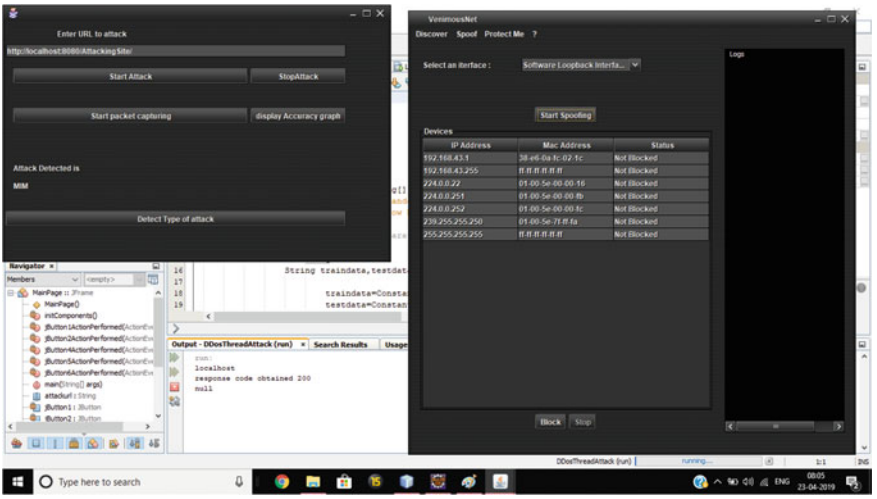


Fig. 8 Man in the middle attack panel

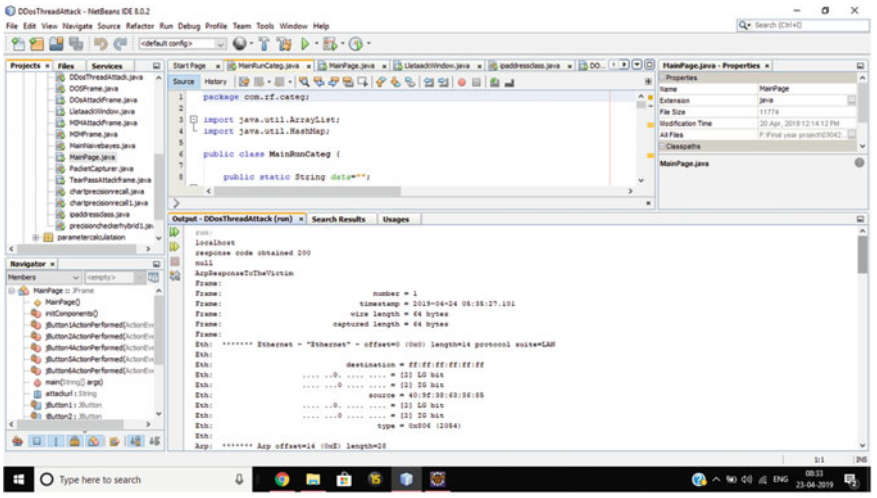


Fig. 9 Man in the middle attack

Fig. 10 Attack detected

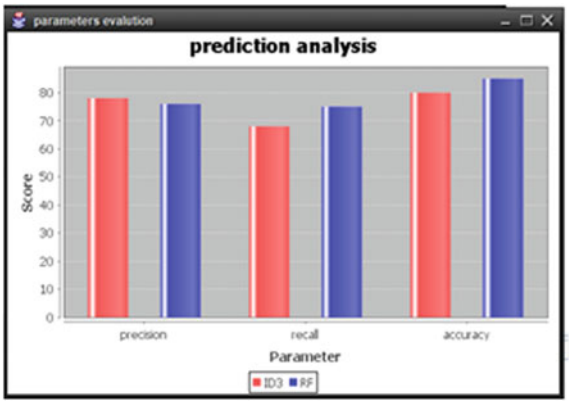


Fig. 11 Comparative analysis of classification algorithms

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Blockchain Based Electronic Healthcare Record (EHR)

Bipin Kumar Rai, Akanksha Tyagi, Bhawana Arora, and Shivani Sharma

Abstract The nature of medical system is viewed as perhaps the main factor of a nation. Currently Electronic Health Record (EHR) is being used to store the patient's medical data. However, EHR faces some issues like interoperability, security, privacy. All such issues leads to the decreased quality of medical system and also to an increase in healthcare costs because data is being shared between different medical facilities over different places. The management of medical data also include some different challenges such as access to data and the way that data is often accessed at different places other than the medical facility. Blockchain technology can help in improving current healthcare system. The objective of this research paper is to show how EHR can be implemented into healthcare sector for maintaining patient's data using blockchain technology i.e. how the data can be gathered, uploaded and accessed. Blockchain provide the way to efficiently handle the medical data.

Keywords EHR · EMR · Privacy · Security · Blockchain · Pseudonymization · Depersonalization

1 Introduction

Technology employed in healthcare sector can help in efficiently operating of organizations to meet growing demand in order to deliver better patient care. All such advantages are provided by Electronic Health Record (EHR). EHRs are an information system that digitally maintains all medical records of a patient. It contains different sorts of health related data of a patient and understands the outline or integration of various electronic health data and fulfil the management related needs of the hospitals [1, 2].

Security and Privacy Issues: We need to handle the following security issues in a proper way while accessing EHR.

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1. **User Authentication**: Only approved users will have the option to get access to the health record.
2. **Confidentiality and Integrity**: It is associated with the protection of medical data from unauthorized access and reliability of physical computer and network systems.
3. **Access Control**: It's been a fundamental security issue wherever healthcare data keeps in databases and traded with the help of heterogeneous documenting system.
4. **Data Ownership**: It is additionally a significant issue associated with ability to access of medical data. Obligations of information possession ought to be handled straightforwardly [3].

Using blockchain technology is the most efficient way to provide security to the data stored in an EHR. Advantages like storage of medical data electronically, management of appointments of patients with the doctor, bill management and storage of laboratory tests are all provided by EHR system [4].

2 Related Work

The process of data management and de-identification by which we can restore in person specifiable data by artificial identifiers or pseudonyms is known as pseudonymization [5]. Individual data can be identify and distinguish from related data using the process known as depersonalization [6–8]. Algorithms for calculating the pseudonym can depend upon encryption or hashing strategies [9–11]. According to Kerckhoff's principle algorithm which is applied to the system is accessible by anyone but we need to keep the keys secretly [12, 13]. Thielscher et al. [14] proposed a system in which decentralised keys are kept on smart cards. Two different methodologies were proposed by Pommerening et al. [15, 16], which were each kind of like the system proposed by Thielscher et al. Their system design is a blend of a hashing and an encryption method. Similarly, Peterson [17] came up with the approach which is dependable on centralised table used for reidentification motive. This centralised table also faces issue that a centralized list can be attacked from inside and outside of the system. In 2001, Schmidt et al. [18] also projected some other architecture. Yue et al. was first to implement blockchain technology into healthcare system. Xia et al. [19] proposed a blockchain-based methodology for the sharing of medical records of a patient using cloud-based solutions. They proposed the system for sharing medical records called as Medshare with the goal to provide various advantages such as access control and enhanced security of medical records. Liang et al. [20] using blockchain technology drafted a mobile-based application to share medical data. This secure user centric approach uses channel formation plan in order to provide privacy and access control. Jiang et al. [21] blockchain based approach is based on exchanging healthcare data. Ichikawa et al. [22] utilize a non-public blockchain to make sure the integrity and convenience of medical data which is stored in the system. They

construct an application called as mHealth with the help of smartphone. A medical insurance storage system i.e. MIStore was given by Zhou et al. [23]. Wang and Song [24] came up with two approaches which are a blockchain based EHR system and an attribute based crypto system.

Current pseudonymization algorithms and parameters by a non-expert person are difficult to understand and to realise privacy guarantees. Hence using blockchain technology to provide better and efficient platform to the users.

3 Blockchain for Ehealth Care

Blockchain is about enabling peer to peer transfer of digital assets without any intermediaries. Shortly this technology was getting used in several different industries, such as finance, healthcare and manufacturing [4, 25]. Blockchain does the work of establishing trust among unknown peers and record the transaction in an immutable distributed ledger [26, 27]. Data is distributed across many different nodes over the network and method of encryption is used to maintain the quality of the stored data [28, 29]. Blockchain technology provide us with different advantages like enhanced security, secrecy and integration of data without the interference of any third party. All such advantages prove that blockchain technology is a correct option for the storage of a patient's medical data.

4 Proposed Solution

4.1 Entities Involved

4.1.1 Patient

A patient is the one who generates the medical history and is the owner of the health data. For sharing of resources a patient usually pass his medical data to the distributed storage in encrypted form. Patient is the one who builds up and keeps up the smart contract and also generate and supply characteristic private key to the user in order to access medical data.

4.1.2 User

User can be any of the hospital, doctor, lab, insurance organizations. The user node can access the data of a patient as per the rights given to them.

4.1.3 Blockchain Database

This is used to keep encrypted health data of a patient and keyword indexes related to this data is forwarded to the database by that patient. Various kinds of users hold pre-defined rights for accessing the medical data of the patient.

4.2 System Design

The proposed system consists of users: patients, doctors and administration.

4.2.1 User Layer

Users perform essential tasks of creating, reading, updating and deleting the medical data. The users would get to the framework's usefulness by a browser called DApp browser.

4.2.2 Blockchain Layer

- **Blockchain Assets**: Transactions in blockchain are referred as assets. Assets are the piece of data that can be shared with some other user over the network or simply can be stored for different purposes.
- **Governance Rules**: Blockchain technology operates over some rules, it utilizes Proof of Work (PoW) consensus algorithm.
- **Network**: In the blockchain network all the nodes are associated as peers. So, all these associated nodes have equivalent status and rights.

4.2.3 Transaction

The framework incorporates following transactions:

Add Records: This process includes the creation of medical records of a patient through DApp browser. It is comprise of various fields such as ID, name, Blood group and IPFS hash.

Algorithm Add Account (Name, email, category, password)
assign ID;
Patient Id = = Pid;

Add Data:

Add Patient Record (Name, Address, Disease, Blood Group, Contact No, Age, Gender, City)

Add Doctor Record (Name, Qualification, Specialization, Gender, Contact No)
If (m.sender == doctor) **then**
add data to particular patient's record
else Abort session
else if
retrieve Data;

Update Records: This is the process of updating of patient's medical records.

Algorithm Update Data:
If (m.sender == doctor) **then**
If (id == patient id && name == patient name) then
Update data to patient particular patient record
else return fail

View Records: This allows a user to see patient's medical data which is stored within the DApp browser. Both the patient and the doctor can view medical records.

Algorithm View Patient Record (Patient Id)
If (m.sender == doctor || patient) then
Retrieve data from specified patient (Id)
Return (patient record)

Delete Records: This allows a user to delete medical records of any patient.

Algorithm Delete Patient Record (patient id)
If (m.sender == doctor) **then**
If (id == patient id && name == patient name) then
Delete particular patient's record
return success
else fail

Grant Access: Users should have access to perform any above mentioned transactions. Medical records of a patient can only be added or updated by the doctor or nursing staff.

4.3 Work Flow

4.3.1 Process of User Registration

In this process, users have to submit their personal information, then a set of key pairs representing a user's identity will be generated by the EHR platform. Also the hash value will be created which would be a unique identifier of that user. Figure 1 represents the user registration process and validation of a user's identity related data. Whenever a user join the EHR system, a unique identifier and key pairs for that user would be created.

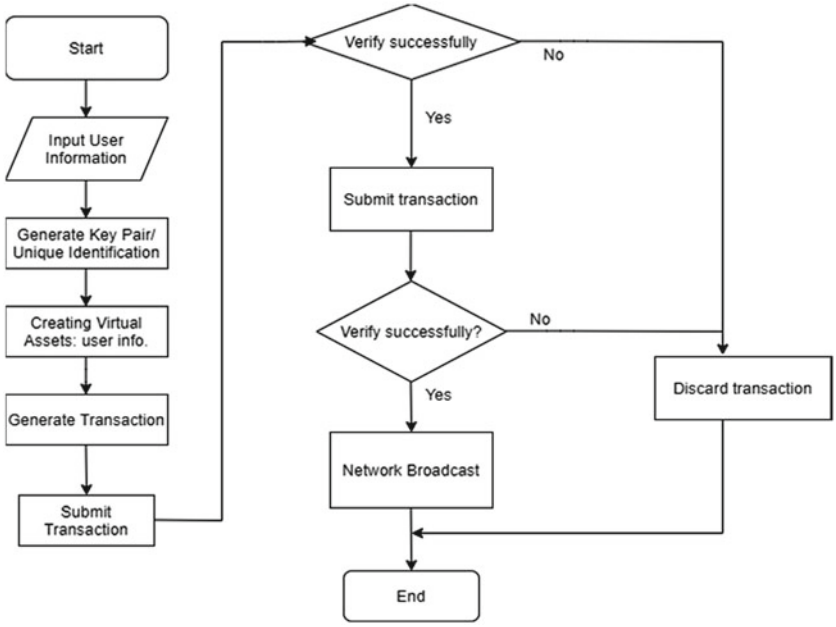

Fig. 1 User registration process

4.3.2 Process of Uploading Health Record

Doctor needs to get the patient's approval prior to uploading that patient's medical record to the blockchain database. Figure 2 represents the process of uploading health records. The EHR at the user node would be encrypted using the private key only if the user approve it. A transaction would be sent arbitrarily to a medical node in order to begin consensus and needs to decrypt the received transaction with the help of public key provided by the user. Decoded content must be fully matched in order to encapsulate transaction content into some new block and then that block gets added to the blockchain.

4.4 Smart Contract Implementation

See Fig. 3.

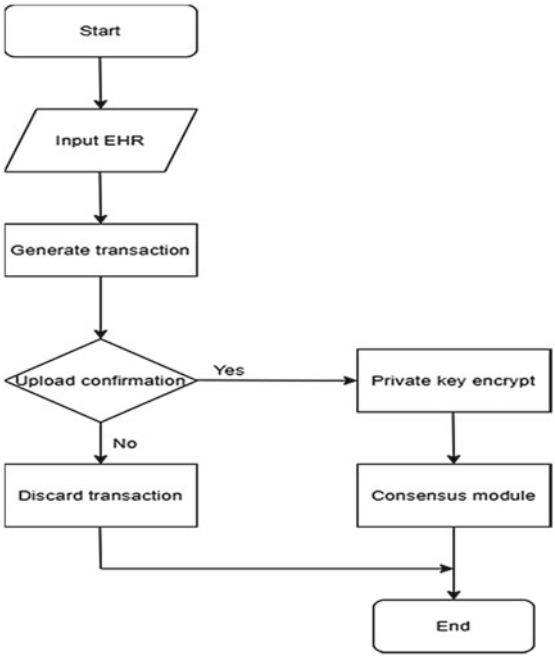

Fig. 2 Uploading health records

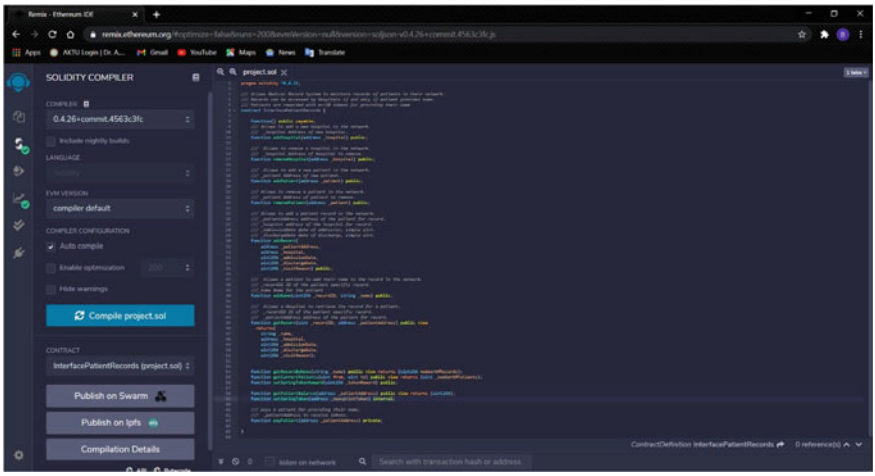

Fig. 3 Code for implementation of smart contract

5 Conclusion

In this paper we discussed the use of blockchain technology in healthcare sector and how it can be used for implementing EHR. Using blockchain technology can

provide solution to all the issues faced by EHR platform. Our proposed work provides with access rules to medical records as well as secure storage to those records. This proposed framework get rid of the central authority and security is accomplished using immutable ledger as the system become temper-proof. After having all such benefits it can be concluded that blockchain can be next revolutionary technology in healthcare sector.

6 Future Work

Blockchain technology provides secure way to share health data and also provide improved healthcare transactions. At present blockchain technology is not considered as of much importance in healthcare industry, however soon it will from numerous points of view as it is a definitive resource tracker. This kind of blockchain technology based way to deal with healthcare industry would allow users to transfer medical data in a protected way. This also provide users a way to anonymously share their medical data for the goal of medical research. Those systems which are empowered by blockchain technology have the capability of significantly decreasing the expense and the grating of current intermediates.

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Automated Voice Assistant

Shivani Sharma, Vishnu Kushwaha, Vishal Tyagi, and Bipin Kumar Rai

Abstract For blind and motion-impaired users, we implement Automatic Voice Assistant, which offers more powerful and natural interaction, greatly enhancing the experience of graphic interface interaction. We humans have therefore created applications such as Personal Voice Assistant with the ability to communicate with the world only through one of the materialistic modes of human interaction. Our proposed system has the potential to operate with and without access to the Internet. It is an automatic assistant, which receives input from the user as voice or text, processes it, and then sends the results back to the end user in various forms, such as actions to be taken or order search results.

Keywords Personal-assistant · Motion-impaired · Alexa · Siri · Cortana

1 Introduction

We can do things in the new age of fast-moving technology that we never felt we could do before, but there is a need for a platform to accomplish and achieve these thoughts, which can quickly and comfortably automate all our activities. Mobile technology is now very common for the user experience, since accessing the apps and services from anywhere in your Geolocation is very easy. Several popular and iOS, Apple, Windows, Blackberry, and so on are commonly used smartphone operating systems [1]. All Operating Systems provide users with multiple programmes and facilities. The Contacts Apps, for example, are used to store the user's contact information and can help users link a call or send an SMS to another person using the content stored in this programme. Through the Apple Store, the Play Store, etc., we can get similar kinds of applications worldwide. All these features give rise to different types of sensors or features that can be introduced on mobile devices. The most popular iPhone application is "SIRI" which allows the end user to communicate voice to the mobile end user and responds to the user's voice commands. Now, every available voice assistant has its own function, but it has some similarities, allowing you to

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perform some basic operations, such as sending and reading text messages, making calls, sending, and reading emails, and answering basic information and questions. The Google "Google Voice Search" that is used for Android phones is also creating the same kind of application [2]. A voice assistant is an agent for apps that, through different commands, executes tasks or services delegated to it by the user [3]. It will record the voice of the user when it hears the passphrase and send it to a dedicated server, which processes and interprets it as an order.

2 Related Work

All the reviewed literature describes the existing systems and the problems that we must overcome, some of them are discussed here:

Bhardwaj et al. [4] the project performed a wheelchair mobility test using a skilled voice. When the music is light, correct word recognition is good, but increasing the volume makes it more difficult to recognize the consumer's voice.

Kiran et al. [5] a chatbot framework is designed to mimic a human conversation, an algorithm to simulate knowledge online communication between a person and a machine using natural language.

Seo et al. [6] in this, a life-log device that offers a speech-to-text feature over mobile environments for real-time voice recording. The proposed system records user life data by means of a mobile microphone. Recorded information is submitted, processed, and dictated by a speech-to-text service to a server, and stored as text files. Our device users can use text to scan their live log sound files.

Aripin et al. [7] a very different concept than what is currently available on the market is Voice Activated Home Automation. It is also a significant aspect of the present world, where people are so busy.

Kuei-Chun et al. [8] this device performs image to text to speech conversion based on Google personal assistant with home automation.

Uddhavkhadilkar et al. [9] this explains the creation of an intelligent wheelchair using smart phones to track the rotation of the wheelchair based on voice and gesture activity for physically disabled people. Disadvantages: Control the rotation of wheelchair based upon voice and gesture movements.

Apte et al. [10] an application that is useful during evaluation for visually impaired individuals because they do not require any additional university facilities.

Anwani et al. [11] an application to assist us with coping with the mailing service through voice order.

Disadvantages: Sending error comes when mailing text files.

Mhamunkar et al. [12] this paper suggested an application that would allow the user to retrieve the meaning of the word in the form of a voice.

Sutar et al. [13] an application where the customer can easily send messages with voice messages and try to use most of the applications integrated with voice commands. Disadvantages: Texting through voice command comes handy but with recognition errors.

3 Proposed System

By eliminating the need to use the mouse or type in some situations, the software will minimize the process of using a computer it makes the process a little more appropriate for most people who are of age, mostly because of the larger display, and since it is a desktop application. In addition, the whole process of launching applications, playing music, opening websites, etc. will save the user's time and in turn improve their productivity. The program would also enable disabled users to use a computer (e.g., users unable to use a keyboard/mouse or users without vision). Finally, because some speech synthesis features will be included in the application, it will be possible for users (including those with impaired vision) to have a degree of contact with it no matter how little. The system is also fraught with drawbacks, despite the various advantages offered by speech recognition. The design of speech recognition applications also inherits these constraints by default like accents for consumers, Interference with the background noise is also another disastrous issue with speech recognition apps, Lack of reliability, and misinterpretations. The following are the areas where this software can be applied:

1. At Home: helping old and needy people use computers
2. Industry of telecoms to promote the growth of enhanced self-care services
3. To help create more robots that are 'human-like' (that can listen and talk).

It is possible that the system we provide can use both the Internet and it. Speech recognition intelligence is called a personal assistant, which records and processes user comments in the form of voice or text and returns the results to the end user in various forms, such as actions to take or feedback. instructions for search results. In addition, the proposed system changes the way end users communicate with users.

Objective: the goal is to create an automated desktop voice assistant that can perform day-to-day tasks for everyone. To perform simple operations for both blind and regular users.

4 Methodology

The proposed system is a desktop application which is made using following technologies:

We used Python for the back-end programming of our application because python gives our application a good environment, we used python modules some of which are discussed below:

1. A custom module named Akhbaar is made by us to give the user real time news from a respected news publishing house using API key.
2. The Wikipedia Module is used to access data from Wikipedia easy to parse.
3. Speech Recognition Module is used for Google Speech Recognition API to perform speech recognition.

4. Web-browser Module is used to access Web-based documents. We used the Web-browser module to open a platform-independent browser.
5. We used datetime module to give the user real time date and time just by a command, and many more modules.
6. We used OS module to control the system tasks like opening and closing apps present in the system
7. We used PSUTIL to view device information and process utilities module. It is used to keep track of the system's usage of different resources. It is possible to monitor the usage of resources such as the CPU, memory, discs, network, sensors.
8. PYTTSX3 is used as a text-to-speech conversion. Unlike alternative libraries, it works offline.
9. We used SMTPLIB module, since it specifies an SMTP client session object that can be used to send mail to any SMTP-enabled Internet computer.
10. We used PYJOKES to give user a good laugh when needed.
11. We used PYAUTOGUI for taking screenshots for some apps or sites which block taking screenshots it will be not possible for assistant to take screenshot at that window. Some functions like telling weather, reading newspaper are using API in which we must generate unique key to make it work.

First the assistant will greet the user according to the system clock like good morning, afternoon etc. Then it will ask the user to give command accordingly if the users are unable to understand the functionality, they can ask for help from the assistant and the assistant will provide help to the user by interacting and telling its functions.

We used Machine Learning Modules like Open CV is being used for face lock and unlock. The user will have to say the lock and unlock command so that assistant will open the camera and scan the face for locking and unlocking of the system. NumPy is being used for sorting files after getting commands from the user. For front-end we made a windows app through .Net [14] to make the application more interactable then we used window scheduler as a final step to complete our application.

5 Architecture

This use case diagram represents some of typical workflow or method presents the steps as different forms, and their order by linking them with arrows. In the app, the login function will be offered, though it will not be needed. After the program is successfully executed without any error the assistant will greet and ask user for to give command. Then after recognizing the function to be performed from the command the assistant will perform the given tasks as said. Some functions of our proposed system are opening apps like by saying "open chrome" "open notepad", "read e-mail", "logout or shutdown the system" and open a particular application in system.

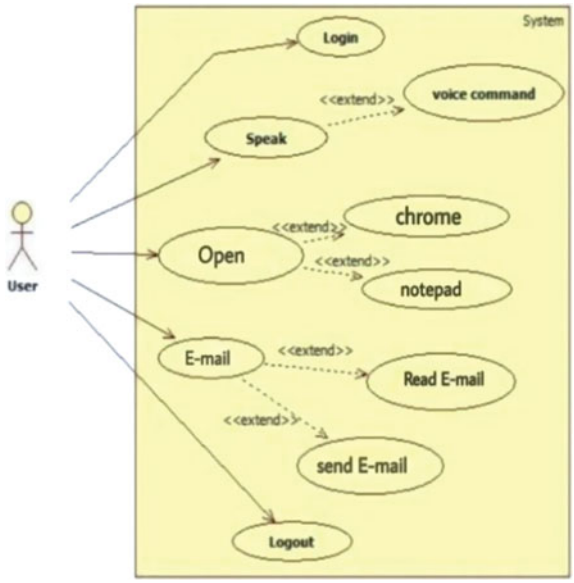

Fig. 1 Use case diagram

The user just must speak the command and given functions and tasks will be performed by the assistant. The face unlock option is also available for the user. The user can also sort the files just by a command. This voice data is translated to text by googlevoiceapi, and the operation is performed according to the user's order. The mic begins after the successful login and waits for the user to speak while the mic receives the data, translating the data into text format.

Then the text is matched to the operation to be carried out. The method is executed. Speech modality (isolated, discontinuous, or continuous speech, read or spontaneous speech), role and language c in terms of vocabulary size and confusability, the performance of speech recognition systems varies. There might some error occur during the listening process of the application due to interference from surroundings by noises or by voices of others. Google Server is used for our voice assistant application. This method involves translating acoustic speech into a collection of words and is carried out by a part of the programme (See Fig. 1).

6 Implementation

The added voice assistant will conduct the following role that will open YouTube, Gmail, Google chrome. Predict current time, search Wikipedia for abstract information necessary, predict weather in different cities, receive top news, and can also answer computational and geographical questions [15].

Algorithm

1. Installing and importing all the required libraries is the first step. To load libraries before importing them, use pip install. Some of the main libraries used in this software are listed below:

The Speech Recognition library enables Python to access, transcribe, and save the audio from system's microphone, the text-to-speech kit from Google, gTTS, translates your audio to text. This bundle will communicate with the API of Google Translate.

2. Implementing machine learning modules.
3. Making application through .net.
4. Using windows scheduler to make it run continuously.

Pseudocode

```
Installing modules
    engine = pyttsx.init('sapi5')#setting voice recognition
    engine.setProperty('voice', voices[1].id)
    #speak function
    def speak(audio):
    engine.say(audio)
    #assistant's features
    def personal()
    features ()
    functions programmed
    while True:
    query = takecommand().lower()
    functions called in main
    if 'function' in query
    perform functions
    #exit
```

7 Conclusion

In the past few years, the ambiguity and variety of speech detection technologies and speech enabled assistant applications to have evolved exponentially. Apple, Amazon, Google, and Microsoft voice assistant apps currently available allow users to ask questions and issue commands in natural language to machines. There are many possible future uses for this technology, from home automation to translation to companionship and caring for the elderly. With the currently available voice assistant devices, however, there are still some issues. There would need to be privacy and protection controls Enhanced prior to using voice assistants for something that needs confidentiality. Our application will therefore be beneficial to new users as well as people with hectic schedules. By increasing user loyalty and convenience, our

application strengthens the existing state of the art. We have concluded, based on a literature survey and by evaluating existing systems, that the proposed system would not only be cost-effective, the application domain of current systems available on the market will also extend, however.

8 Future Scope

Voice assistants can greatly change the way people communicate with machines. Reading and typing are barriers for many people to obtain information. The knowledge gap of these users can be filled with voice assistants. Recent research shows that voice assistants can help you answer the questions of people with dementia at any time through ubiquitous voices, without losing patience and providing help when needed. Some people may find it difficult to read the doctor's advice. Incorporating these skills into currently available consumer technology will be more cost-effective than dedicated systems, and many consumers can now easily manage these devices. The voice assistant can also read user books and other long documents. Although they still sound like robots, the voice skills of voice assistants are improving rapidly. More complex activities, such as searching databases and applying for an interlibrary loan, can go beyond devices that can only provide voice input.

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Role of Deep Learning and Machine Learning in Automatic Knee Ligament Injury Detection

K. Suganthi and Kavita Joshi

Abstract Knee ligament injury is a common medical dilemma affecting the sportsman and common people during their prolific years of career. It is possible to visualize soft tissue elements, bone and cartilage of the knee joint using Magnetic Resonance Imaging (MRI) leads it to the most popular method for detection and diagnosis for knee ligament injury or intra-articular structure injury, gives best visualization result. Analysis of MRI images, manually is time consuming, subjective and unpredictable. Ligament injury can be detected automatically using image segmentation and various techniques like machine learning; deep learning where layers will be learned features automatically and are appropriately model the complex structure and their interpretations. In this paper, techniques used for the detection of knee ligament injury partial or complete are covered.

Keywords Ligament · Computer tomography · MRI · Machine learning · Deep learning · Convolutional neural network

1 Introduction

Knee is the largest joint in the human body and plays vital role for movement in vertical and horizontal directions like walking, running, jumping and carries the weight of a body [1, 2]. The anterior cruciate ligament (ACL) injury is due to sudden twisting motion and posterior cruciate ligament (PCL) injury is due to direct or sudden impact during accident or while tackling football [3]. Tears of the ligaments are common among people therefore, finding a new method to increase the correct diagnosis is necessary. The statistics given by Rajesh et al. is, among the knee injuries, the most commonly injured structure is anterior cruciate ligament (76%), followed by medial meniscus (38%), lateral meniscus (26%), lateral collateral ligament (17%),

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posterior cruciate ligament (15%) and medial collateral ligament (9%) [4]. This paper presents the survey of various machine learning and deep learning methods for the knee ligament segmentation and injury detection. Rest of the paper is structured as follow: Sect. 2 describes anatomy of leg and generalized structure of ligament injury detection system. Sections 3 and 4 gives detailed description of the machine learning and deep learning based techniques for the segmentation and injury detection, Sect. 5 elaborates the gap identified from survey and challenges faced by traditional methods. Finally, Sect. 6 concludes the paper and open the area for future improvement.

2 Human Leg Knee Joint Anatomy

In the human body, the knee joint is the largest joint structure has weight bearing function and is very complex facilitates the movement in forward and reverse direction is mostly inclined to injury. The knee joint composed of leg bones like Tibia (shinbone), Femur (thigh bone) and Patella. These bones are stabilized by the Anterior Cruciate Ligament (ACL), Posterior Cruciate Ligament (PCL), Medial Collateral Ligament (MCL) and Lateral Collateral Ligament (LCL). The Medial menisci and the LCL are connected to Tibia bone [5]. For detection and diagnosis of knee ligament injury along with Clinical examination various radiological methods like X-ray, Computer Tomography (CT scan) or Ultrasound, Magnetic Resonance Imaging (MRI), Arthroscopy are used. MRI imaging is the most superior and popular method than Computer Tomography (CT scan) or Ultrasound radiological method, as it is possible to visualize soft tissue elements, bone and cartilage of the knee joint, has high resolution, improves signal to Noise ratio, has multi-planar slice capability and is not harmful as it does not ionize radiation [6, 7].

2.1 Generalized Process for Knee Ligament Injury Detection

The generalized flow diagram for the knee ligament injury detection is shown in Fig. 1 that encompasses image preprocessing, segmentation, feature extraction, classification and verification by experts [8].

Image pre-processing can consists of noise removal and enhancement of the quality and contrast of the images. Further, segmentation techniques can be applied to segment the actual region of interest to avoid processing of non-interested MRI

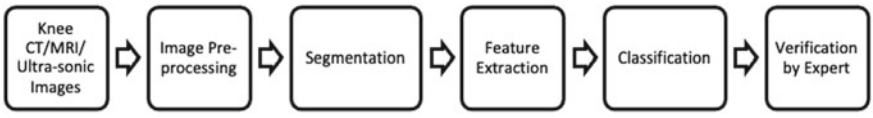

Fig. 1 Generalized flow of knee ligament injury detection (Modified from [8])

objects. Feature extraction helps to capture the salient and discriminative properties of the injured ligament object. In the next phase, machine learning or deep learning classifiers are applied to classify the knee ligament injury which can be further verified by the medical experts to improve the performance of the computation algorithm.

3 Machine Learning Techniques for Knee Ligament Segmentation and Injury Detection

Segmentation is important part in knee ligament injuries detection that is used to find an individual object in an image. Computer-aided segmentation is an important stage in defining the application in computer assisted diagnosis, clinical studies and treatment planning [9]. Sharma et al. [10] discussed different computer aided segmentation methods used for CT and MRI images. Textural feature based segmentation technique with atlas or look up table provides outstanding result for segmentation on medical images. Kose et al. [11] presented an automatic histogram and statistical segmentation based location method for locating meniscal tears at knee region that resulted in 93% accuracy. Subsequently, Vinay et al. [12] presented an algorithm for semi-automatic method for detection of ACL using active contour method for image segmentation technique in MRI images with morphological operations. Staiduhar et al. [13] presented Histogram of Oriented Gradient (HOG) and GIST based decision support model for partial ACL knee injury detection. Also used Support Vector Machine (SVM) and Random Forest model for the classification purpose. Kohut et al. [14] proposed a watershed algorithm to analyze MRI images in sagittal plane to recognize healthy Meniscus and damaged structure automatically using image processing methods and MATLAB software. Watershed segmentation gives more accurate result of 83.3% when compared with direct thresholding and region growing methods. Uozumi et al. [15] proposed a computer aided 3D graphics segmentation method on the femur and tibia bones, the segmented PCL was visualized using proposed method with a processing time less than 15 s. Zarychta et al. [16] presented a Fuzzy C-mean algorithm to segment the region of Interest and to extract anterior and posterior cruciate ligament from leg MRI image. Hanafi et al. [17] proposed orthogonal MRI protocol and oblique-sagittal MRI for partial and complete ACL rupture detection. It resulted in high sensitivity and highest accuracy.

4 Deep Learning Techniques for Knee Ligament Segmentation and Injury Detection

Many segmentation techniques performance is dependent on the manual tuning of parameters. Performance of the machine learning based methods is restricted for larger database and has less correlation and connectivity in the raw features

extracted for the classification of knee ligament injury. Deep learning supports better feature representation capability, easiness for larger database and huge efficiency has attracted attention of researchers for the knee ligament segmentation and injuries detection. Convolutional neural networks (CNN) is the most common model in deep learning which automatically learn the raw data and representations of images. It can give better correlation between the raw features of the MRI images [18]. Deep learning with convolutional neural networks (CNNs) help radiologists accomplish diagnostic excellence and improve patient healthcare, now achieving wide attention due to its high performance in recognizing images. Zhou et al. [19] proposed a deep Convolutional Neural Network for effective and correct segmentation for knee joint structures with knee osteoarthritis in patients. Manual interpretation and machine learning based interpretation of MRI image is time consuming and may results in diagnostic error. Bien et al. developed [20] deep learning model known as "MRnet" for detection of abnormalities and diagnosis of ACL tear and meniscal tear on a knee MRI image. Lai et al. [21] designed a deep learning model based on combination of few selected traditional features and high-level features that are extracted from a Deep Convolutional Neural Network. It overcame the problems of high resolution of the medical images and the small dataset size. Liu et al. [22] developed a fully automated deep learning using 2 deep CNN layers that segment the ACL from the T2 weighted MRI knee images and detect the structural abnormalities. Ölmez et al. [23] proposed an Recurrent CNN (R-CNN) for segmentation and detection meniscus region used morphological image analysis to improve the segmentation performance. Tsai et al. [24] investigated Efficiently-Layered Network with a size less than 1 MB in which CNN architecture enhanced for the initial diagnosis of knee MRI. Germann et al. [25] explored DCNN based method to select the coronal and sagittal MRI scans from the dataset. Further, they used machine learning techniques for the prediction of ACL tears. The comparative analysis of different method is given in Table 1.

5 Gap Identification and Challenges

The gap identified from the widespread literature survey and challenges of automatic knee ligament segmentation and injury detection are summarized as follows: Traditional machine learning based approaches are sensitive to the low contrast, blur, illumination variation, and size of ligament, scale and orientation of image. Very few research papers are available using Machine Learning and deep learning on the ACL tear detection. Performance is limited for the larger database. However, availability of the larger database is challenging due to unavailability of the patient or storage of data. Shallow or deep learning based techniques gives poor optimized solution for the noisy and larger database. No generalized method is available for the knee ligament segmentation and injury detection that can deal with compatibility issues of the input training and testing data. Parameter optimization and poor feature discrepancy leads to higher recognition time.

Table 1 Comparative analysis of major methods for ACL injury detection

Author	Database	Methodologies	Observation
Štajduhar et al. [13]	969 knee MRI 12- bit grayscale images	HOG + SVM	Can detect partial and complete ligament rupture
Kohut et al. [14]	7 MRI images of knee 3-healthy	Watershed algorithm	Correctly diagnosed portion of the meniscus is 83.3% and 16.7% is diagnosed as possible injury
Zhou et al. [19]	100 MRI images	Deep convolutional encoder-decoder network	Can be used in multiple ligament and bone injuries
Bien et al. [20]	1370 (569 female) MRI knee images of mean age 38.0 years	Convolutional neural network	Model detect ACL tears, meniscal tears, general abnormalities in MRIs
Liu et al. [22]	175 MRI images of knee	Deep convolutional neural networks (DCNNs)	To detect ACL tear
Tsai et al. [24]	1370 knee MRI image	Deep neural network	Average AUC (0.913)

6 Conclusion

This paper presents the extensive survey of various machine learning and deep learning techniques for the segmentation techniques such as watershed, thresholding, region growing and active contour model and depicted the performance of the under-segmentation and over-segmentation of the ACL on the injury detection. Deep learning algorithms have shown better performance for the knee ligament segmentation and injury detection. Still, performance of the deep learning algorithms can be enhance using parameter optimization, improving intra-class and inter-class variability of features, and using deeper structure of deep learning algorithms.

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Latency Analysis of Different Functional Split Options of C-RAN with Slot Based DBA on TWDM-PON

Prasanna Dubey, Raksha Upadhyay, and Uma Rathore Bhatt

Abstract In the next generation mobile communication network, the number of base stations (BSs) increase tremendously concerning the increase in operating frequency range as these BSs will be able to cover a very small area. Centralized Radio Access Network (C-RAN) architecture with Passive Optical Network (PON) at wired fronthaul (FH) is proposed in replacement to distributed architecture to afford and serve these many BSs. With distributed architecture and centralized architecture, various functional split options are also proposed in the literature to optimize various parameters like latency, bandwidth, flexibility, etc. In the present work Time Division Multiple Access (TDMA) and Wavelength Division Multiple Access (WDMA) techniques are integrated as T-WDM in PON to improve latency of C-RAN. Additionally, slot-based Dynamic Bandwidth Allocation (DBA) with transmission division technique is used to further reduce the latency. The results are derived for different functional split options in terms of latency and an affordable number of Optical Network Units (ONUs). It is concluded that latency reduces as we move from a higher split option towards a lower split option and with the increase in the number of transport packets in which a transmission time interval (TTI) is divided.

Keywords 5G · C-RAN · Passive optical network · Latency · Functional split · Dynamic bandwidth allocation

1 Introduction

Continuous growth in innovative applications and their quality of service (QoS) requirements are increasing the traffic demand with supporting communication infrastructure. There is a wide variety of various communication technologies with the upcoming generation of communication networks. These networks have very healthy requirements like speed as high as 10 Gbps and latency less than 1 ms [1]

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and one technology/network cannot fulfil all these stand-alone. Therefore, it is a need to integrate various technological aspects and update all the segments of the network to implement the standards and satisfy all the requirements. The FH is a network segment that connects Baseband Unit (BBU) to the end-user and the back-haul (BH) network segment connects BBU to the Core network [2]. The network architecture utilized for third and fourth generations of communication is distributed in nature. As FH, it has wireless Long-Term Evolution (LTE) access network and as BH wired PON. In a distributed architecture, the transport network capacity and latency requirements are very relaxed but power consumption at the base station is very high and lack of coordination are drawbacks of this architecture.

The concept of C-RAN is introduced to overcome these disadvantages. In C-RAN, all the processes of BBU are moved to a centralized location called BBU pool and the cell site is left with only the RF functionalities and called the Remote Radio Head (RRH) [3] as shown in Fig. 1. In a centralized architecture, the FH and BH are still LTE and PON respectively but it has many advantages. Energy efficiency is improved due to pooling, cooling and stacking gains. Coordinated Multipoint (CoMP) which refers to Joint Transmission (JT) and Joint Reception (JR) at the physical layer and Medium Access Control (MAC) layer are other advantages of C-RAN, but at the same time it entails more capacity requirement at the transport network [4]. Latency constraints on the FH are also very strict in C-RAN as all the time-critical processes are performed at BBU pool very far away from the end-user. The advantages of distributed and centralized architectures need to be combined to achieve the standards of next-generation communication. The functions need to split up between Centralized Unit (CU) at BBU pool and Distributed Unit (DU) at RRH in such a way that it does not put much load on FH and at the same time fulfils all the needs.

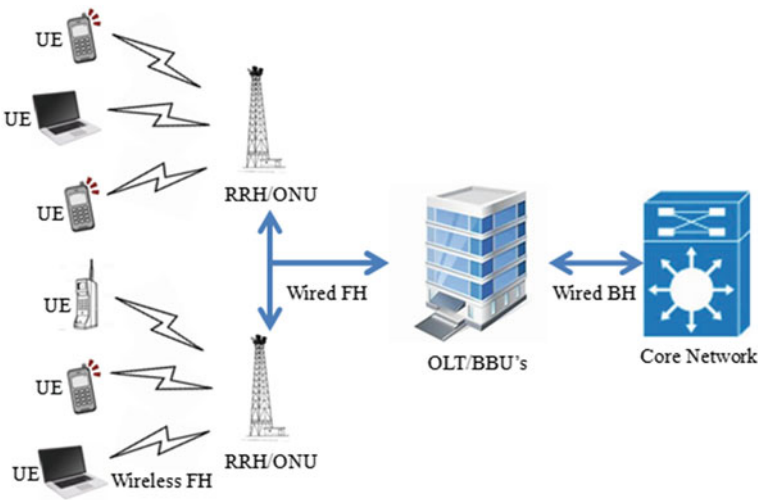

Fig. 1 C-RAN architecture

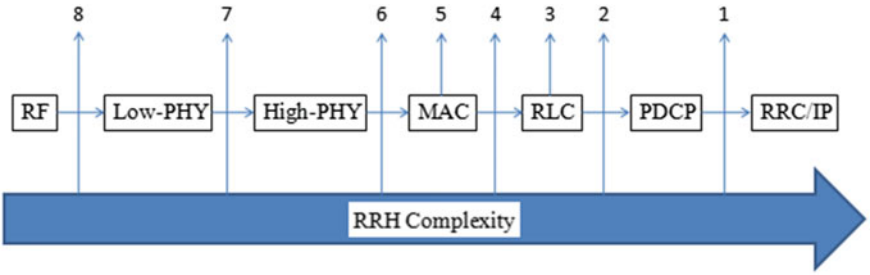

Fig. 2 Location of functional split options and RRH complexity

In literature, different functional split options are considered and their impact on the FH of fifth generation new radio (5G-NR) is investigated. In Fig. 2, proposed locations of the functional split options are shown to the increase in the complexity level at RRH. In split option 8 (RF/PHY) only radio functions are performed at DU [5], which is the simplest version of DU. With this simplicity, it can support multiple Radio Access Technologies (RAT's). All other functions are performed at CU, which facilitates the maximum possibility of resource sharing. In split option 7 (Low PHY/High PHY), Fast Fourier Transform (FFT) is moved to the DU, and by moving FFT to DU, the cyclic prefix can be removed which causes the capacity requirement of the transport network to decrease. An overhead is added in this split option for synchronization purpose. Split option 6 (MAC-PHY) separates physical layer functions from datalink and network layer functions. With FFT the pre-coding, resource element mapper and modulation is moved to DU. This results in a further reduction in transport network capacity largely due to modulation, as in modulation multiple bits are assigned to a single symbol. The complexity of the DU is increased in this split and an extra overhead due to scheduling, synchronization and framing is also increased.

In C-RAN, the uplink transmission between ONUs and optical line terminal (OLT) is controlled using a bandwidth allocation algorithm. General DBA algorithms do not satisfy 5G standards and require more time to uplink the whole data. In literature, different DBA techniques are utilized to reduce the overall latency and to maximize bandwidth utilization. In [6], the number of wavelengths assigned to a group of ONUs as well as the length of time slot in TDMA depends on the load conditions of ONUs. The work in [7, 8] utilizes a mobile-DBA scheme to reduce the latency in TDMA based mobile FH. However, these have not been applied with the proposed hybrid T-WDMA based FH and at different locations of functional splits.

This paper presents a slot-based DBA technique to control uplink data via hybrid T-WDMA, which improves the latency of the network. The technique is applied on eighth, seventh and sixth functional split options where latency constraints are very strict. From other lower split options, the hybrid automatic repeat request (HARQ) is moved to the DU and therefore latency constraints become light. To further reduce the latency, the transmission division technique is also adapted. In this method, the

TTI is divided into transport packets, which reduces the total send and wait time. As a result of these techniques, the overall latency gets minimized.

Section 2 of the paper describes the considered network architecture for FH which is TWDM-PON. Section 3 introduces the DBA and transmission division methods for latency reduction. Calculation of latency and derivation of the expressions of total latency for different functional split options is incorporated in Sect. 4. The results based on the number of accommodable ONUs and total latency are demonstrated in Sects. 5. In Sect. 6 the paper is concluded.

2 T-WDM Network Architecture for Wired FH

The network architecture considered at the FH is a combination of wired and wireless networks. The wired network follows 10G PON or XG PON which is an ITUT's standard and it can provide a transport rate of up to 10 Gbps on the existing fibre network. Because of the large bandwidth, transport capability and range, PON becomes the most promising option for BH as well as wired FH for next-generation network architectures. The wireless network follows Common Public Radio Interface (CPRI) LTE specifications developed by 3GPP. CPRI defines the specifications for the interface between User Equipment (UE) and RRH. It supports both electrical and optical interface at the physical layer and the data transmission is in the form of digitized samples [9]. The wireless end of the network makes the whole architecture more flexible. The wireless network in the fourth-generation access network ranges up to a few km. In the next-generation network architecture, the range of wireless access network will be smaller and will range maximum up to a few hundreds of meters [1]. The transmission between BBU and RRH utilizes a combination of two techniques, TDMA and WDMA, i.e., Time and Wavelength Division Multiple Access (T-WDMA) to take advantages of both. WDMA facilitates OLT to utilize channels with maximum bandwidth efficiency and TDMA allows different ONUs to transmit with flexibility [10].

WDMA-PON provides at least four wavelengths per fibre, each wavelength can transmit data at 2.5 Gbps to a maximum of up to 10 Gbps. This technique provides more capacity, but 10G-PON requires more capital expenditure (CAPEX). In WDMA, different wavelengths can be assigned to different users and it can provide the best fitting bandwidth to different services. By employing appropriate bandwidth management techniques CAPEX can be reduced and bandwidth efficiency and latency can be improved [6]. TDMA is expected to be a flexible and cost-effective solution along with WDMA as a wavelength is to be shared between multiple ONUs for data transmission [11].

Figure 3 depicts a typical T-WDMA scenario. Here m is the number of wavelengths which is equal to the number of groups of ONUs and n is the number of ONUs in each group. So OLT can access data from m * n number of ONUs at any given instant of time. To access data from different ONU groups, WDMA is utilized. OLT dynamically allocates wavelength to an ONU group based on a statistical database.

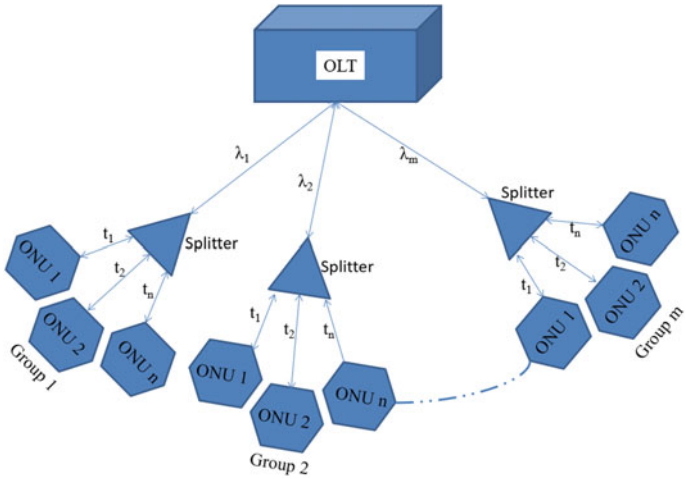

Fig. 3 T-WDMA network architecture

This database is prepared based on mobile scheduling information which is available with the download control indicator (DCI) signal. DCI controls the uplink data transmission of each UE scheduled by the BBU. Many DBA techniques are studied in literature to reduce the latency and efficiently utilize the available bandwidth.

3 DBA Technique

In general DBA algorithms, on the arrival of DCI signal at UE, that UE starts data transmission to ONU. DCI controls uplink data transmission from UE and after the arrival of data ONU sends a request signal to OLT for allocation of a channel for data transmission. OLT receives a request signal and starts the DBA, then a grant signal is sent to ONU and a wavelength is allotted for transmission. In Fig. 4, a group of n ONUs are transmitting simultaneously using TDMA. On arrival of grant signals, a particular wavelength is assigned to n ONUs for transmission, then all n ONUs starts transmission of data received from n UE's respectively in TDMA fashion.

So the transport network total latency can be calculated as [7]

$$\mathrm{T_{total}} = T_{DBA} + T_{wait} + T_{send} + T_{proc} + T_{prop} \tag{1}$$

where T_{DBA} is bandwidth allocation time, T_{wait} is the time ONU must wait for other ONUs to finish their transmission, T_{send} is the sending time, T_{proc} is the processing time required by ONU and OLT and T_{prop} is the time required for the propagation of the signal from ONU to OLT. By proper utilization of the statistical database of UE's transmissions through DCI, one can start a DBA algorithm in advance and grant a

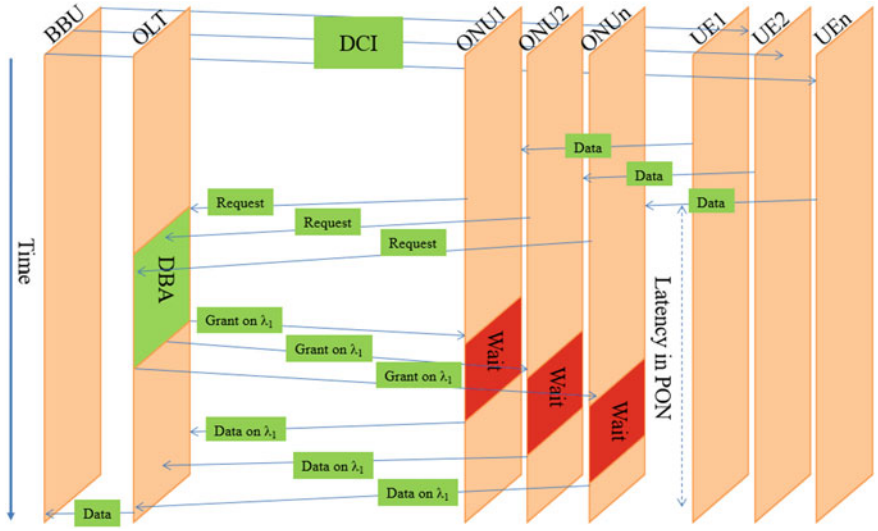

Fig. 4 Uplink transmit without mobile-DBA for one ONU group

channel to ONU without a request signal as shown in Fig. 5. This technique is known as Mobile-DBA [8] and results in a zero bandwidth allocation time ($T_{DBA} = 0$).

The other components of latency like T_{proc} depend on the processes/functions performed by ONU and OLT and T_{prop} depend on the distance between ONU and OLT. Now we are left with two parameters T_{wait} and T_{send} which can be reduced by dividing the TTI into multiple parts called transport packets and taking one transport packet at a time from each ONU for transmission [7]. This will reduce the sending

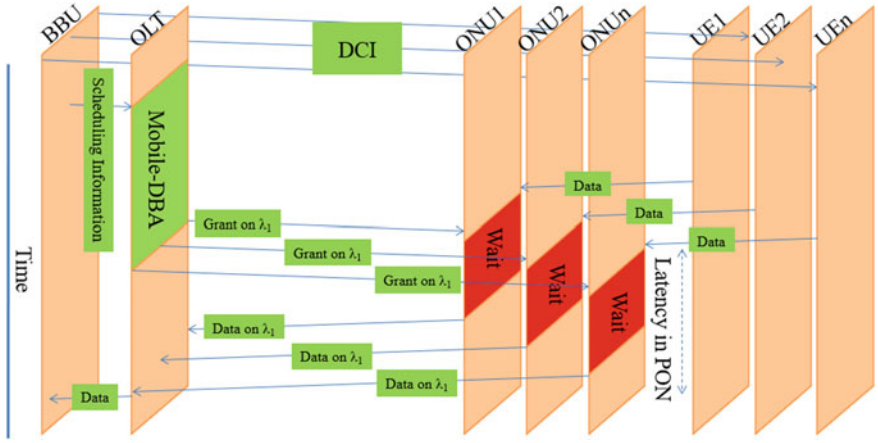

Fig. 5 Uplink transmit with mobile-DBA for one ONU group

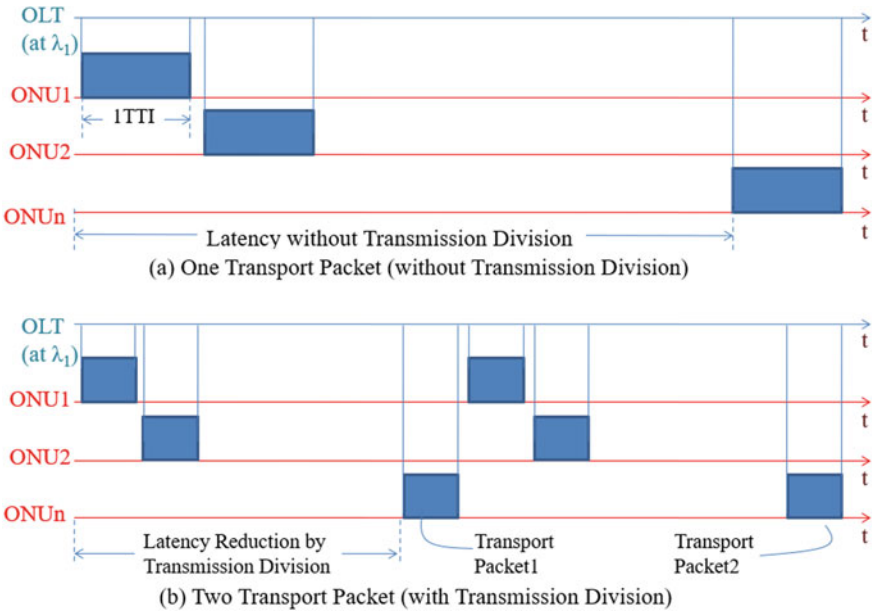

Fig. 6 Transmission division scheme for one ONU group

time and waiting time for each ONU and make the OLT busy in receiving data in the form of transport packets instead of TTI units.

The data transmission from ONU to OLT without transmission division is shown in Fig. 6a. It can be observed that each ONU must wait until all other ONUs finish transmission, which increases send time and wait time as one TTI duration data is to be transmitted at ones. The transmission division method is shown in Fig. 6b. With transmission division, the data is divided into transport packets and one packet is transmitted at a time from each ONU. This reduces the send time and the wait time for each ONU as each packet is of less duration which is a fraction of TTI duration. As we divide TTI into more transport packets, T_{wait} and T_{send} further reduces.

4 Latency Formulation

This section formulates the total latency in the uplink of the data from ONU to OLT with T-WDMA incorporating the mobile-DBA approach. As mentioned before, in TDMA, T_{DBA} will become zero after utilizing scheduling information and assigning a channel in advance to the ONU. So total latency from Eq. (1) can be expressed as

$$T_{total} = T_{wait} + T_{send} + T_{proc} + T_{prop} \tag{2}$$

In the above equation the wait time T_{wait} depends on the payload length and burst overhead. As payload length and burst overhead increases the total wait time T_{wait} for each ONU will increase. So T_{wait} can be expressed in terms of payload length and burst overhead as

$$T_{wait} = (T_{PL} + T_B) * (N_{ONU} - 1) \tag{3}$$

where N_{ONU} is the number of ONU which is equal to the number of RRH and burst overhead T_B consists of the time required to turn on T_{on} and turn off T_{off} the laser, synchronization time T_{sync} and delimiter time T_{dlmt}. In WDMA, if we utilize m number of wavelength and there are m*n number of ONUs. Then the number of ONU groups can be defined as

$$G_{ONU} = \frac{N_{ONU}}{n} \tag{4}$$

Applying TWDM on the expression of T_{wait} in Eq. (3), we have

$$T_{wait} = (T_{PL} + T_B) * (G_{ONU} - 1) \tag{5}$$

Further, the send time T_{send} depends on the payload length, time duration to turn on the laser, synchronization time and delimiter duration. The expression of T_{send} can be written as

$$T_{send} = T_{PL} + T_{on} + T_{sync} + T_{dlmt} \tag{6}$$

In Eqs. (5) and (6), the payload length T_{PL} of transmissions between ONU and OLT, depends on TTI length T_{TTI}, the rate at which wireless network transmit data R_{wl}, forward error correction rate R_{fec}, the rate of the increase caused by mobile FH R_{mfh} and provided PON bandwidth B_{PON}. The expression of payload length can be written in terms of these parameters as

$$T_{PL} = \frac{T_{TTI} * R_{wl} * R_{fec} * R_{mfh}}{B_{PON}} \tag{7}$$

Now if N_{tp} defines the number of transport packets in which transmission time interval T_{TTI} is divided then the expression of payload length from Eq. (7) can be modified as

$$T_{PL} = \frac{T_{TTI} * R_{wl} * R_{fec} * R_{mfh}}{B_{PON} * N_{tp}} \tag{8}$$

By utilizing Eqs. (3)–(8), the expression of transport network total latency from Eq. (2) can be rewritten as

$$T_{total} = \left(\frac{T_{TTI} * R_{wl} * R_{fec} * R_{mfh}}{B_{PON} * N_{tp}} + T_B \right) * G_{ONU} - T_{off} + T_{proc} + T_{prop} \quad (9)$$

From the above expression, it can be understood that the transport network total latency will be minimum with the largest possible value of the number of transport packets in which TTI can be divided. Equation (9) stands for the total latency of split option 8 in which all the functions are centralized. Similar expressions can be derived for split options 7 and 6. In option 7, FFT is moved to DU which results in a reduction in capacity requirement by 40% [12]. The overhead in this split option increases by 8% due to synchronization [13]. As a result, the modified expression for split option 7 is given by

$$T_{total} = 0.6 * \left(\frac{T_{TTI} * R_{wl} * R_{fec} * 1.08 * R_{mfh}}{B_{PON} * N_{tp}} + T_B \right) * G_{ONU} - T_{off} + T_{proc} + T_{prop} \quad (10)$$

In split option 6, physical layer functions are moved to DU. This result in a further reduction in capacity requirement by 70% compared to option 8 and an increase in overhead by 14% [13]. The resultant expression of transport latency is given by

$$T_{total} = 0.3 * \left(\frac{T_{TTI} * R_{wl} * R_{fec} * 1.14 * R_{mfh}}{B_{PON} * N_{tp}} + T_B \right) * G_{ONU} - T_{off} + T_{proc} + T_{prop} \quad (11)$$

For other lower split options, the transport latency constraints are relaxed as HARQ is moved to DU [14], therefore those options are not considered in calculation and for further discussion.

5 Results

For the analysis of presented DBA and transmission division techniques on latency, MATLAB toolbox version R2017a is used. For the calculation of latency typical values of parameters are considered as defined in Table 1 [7].

Figure 7 shows the maximum latency to the number of transport packets for three ONUs per splitter. Three different curves correspond to latency for three different split options which we have calculated using Eqs. (9), (10) and (11). The results show a maximum latency of 415 μs, 276 μs and 155 μs for split options 8, 7 and 6 respectively. It can be observed from the results that as we increase the number of transport packets, the maximum latency reduces up to 42 μs, 34 μs and 27 μs for 8, 7 and 6 split option respectively. If we consider a maximum latency constraint of 100 μs, then the optimum number of transport packets can be defined for the split

Table 1 Parameters value used for calculation

Parameter	Notations	Value
Transmission time interval	T_{TTI}	1 ms
Processing time	T_{proc}	10 μs
Propagation time	T_{prop}	10 μs
Laser turn ON time	T_{ON}	25.6 ns
Laser turn OFF time	T_{OFF}	25.6 ns
Synchronization time	T_{sync}	742.4 ns
Burst delimiter time	T_{dlmt}	6.4 ns
Wireless transport rate	R_{wl}	1 Gbps
Forward error control (FEC) rate	Rfec	248/216 bps
Increasing rate caused by MFH overhead	R_{mfh}	1.14
PON bandwidth	B_{PON}	10 Gbps
Number of ONUs per group	N_{ONU}	3, 6, 9
Number of transport packets	N_{tp}	1–20

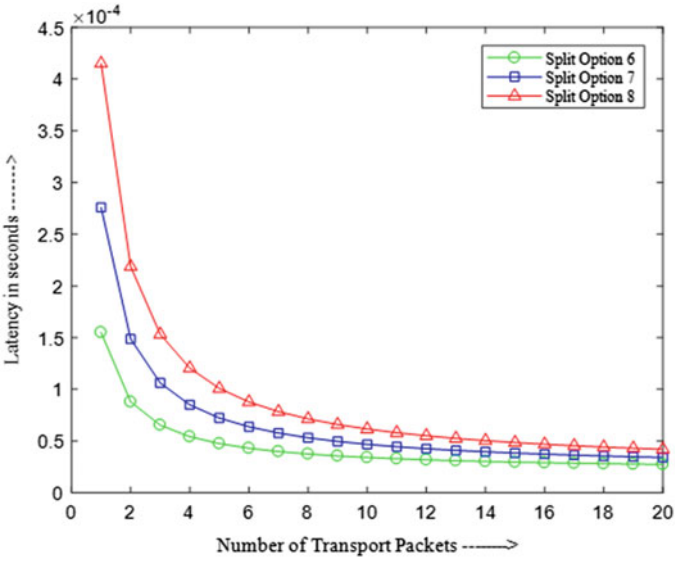

Fig. 7 Latency with a group of three ONUs

options considered in the present work. This comes out to be 6, 4 and 2 transport packets for split options 8, 7 and 6 respectively.

A similar kind of result is obtained for six ONUs per splitter using Eqs. (9), (10) and (11) as shown in Fig. 8. The results show a maximum latency of 810 μs, 531 μs and 290 μs for split options 8, 7 and 6 respectively. In this case, as we increase the

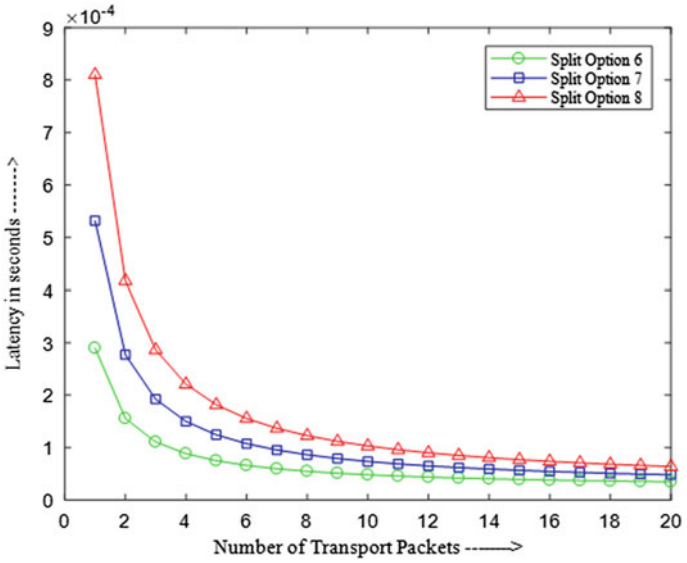

Fig. 8 Latency with a group of six ONUs

number of transport packets the maximum latency reduces up to 64 μs, 48 μs and 35 μs for split options 8, 7 and 6 respectively. Again, considering the maximum latency constraint of 100 μs, the optimum number of transport packets comes out to be 11, 7 and 4 for split options 8, 7 and 6 respectively.

In the same fashion, Fig. 9 shows the maximum latency to the number of transport packets for nine ONUs per splitter. The results show a maximum latency of 1205 μs, 788 μs and 425 μs and as we increase the number of transport packets the maximum latency reduces up to 86 μs, 62 μs and 42 μs for 8, 7 and 6 split option respectively. For the maximum latency constraint of 100 μs, the optimum number of transport packets comes out to be 17, 11 and 6 for split options 8, 7 and 6 respectively.

6 Conclusion

In this work mobile-DBA along with the transmission division method is applied on three higher split options to reduce the latency considering hybrid T-WDMA based network architecture. By comparing the results for different split options, it can be concluded that the transport network total latency reduces as we move from a higher split option towards a lower split option. The transport network total latency also reduces exponentially with the increase in the number of transport packets in which transmission time interval is divided. In evaluation, a minimum latency of 27 μs is obtained for split option 6 with 20 transport packets and three ONUs per splitter.

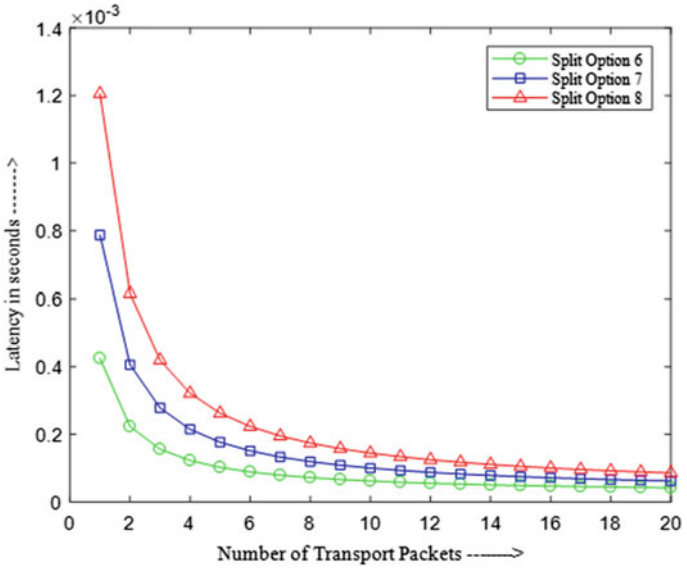

Fig. 9 Latency with a group of nine ONUs

The plots are exponentially decaying, which put a saturation on minimum possible latency to the number of transport packets.

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Particle Swarm Optimization Based Multiobjective Rank Aggregation

Shabnam Parveen and R. K. Chauhan

Abstract Building assessment among dissimilar opinions is a very important part in any field of research. Different ranking systems differ greatly in ranking the same item from a set; some rank aggregation method is compulsory for combining the individual rankings into a single list. Idea behind rank aggregation is to create such a consensus ranking where each input ranking should be accounted for with same preference. There are a number of rank aggregation procedures available but the distance centered rank combination is the most shared and widespread technique of building consensus among those. Multiobjective Particle Swarm Optimization (MOPSORA) centered rank aggregation system is implemented which creates the agreement ranking from participation rankings with the objective as reducing the distance among production ranking and the participation rankings. Proposed approach not only minimizes the average distance but also the standard deviancy of these distances is reduced instantaneously. Kendall's.

Keywords Multiobjective particle swarm optimization rank aggregation · Robust rank aggregation · Genetic algorithm

1 Introduction

Rank aggregation can be believed of as the unsupervised resemblance to regression, in which the motive is to find an aggregate ranking those confines the distance to all one of the ranked lists in the data set. Rank aggregation has likewise been offered as a practicable practice for closest neighbor locating of straight out information, and offers a strong technique to deal with the problem of joining the opinions of authorities with several scoring arrangements [1–3].

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1.1 Rank Aggregation Methods

Numerous RA techniques have existed for specific uses; in any case, they are regularly ill suited for other applications. What's more, most techniques are not rich roughly which circumstances they can manage. A few statement to effort for halfway or topmost positioned records; in any case, the ideas of such records are ambiguous [4].

1.2 Rank Aggregation as an Optimization Problem

The issue of Rank Aggregation is bothered with disclosure an understanding position list that addresses and mirrors the consolidated rankings of various web search tools and will be pretty much as near as promising to every one of the solitary positioned records at the same time [5]. Finding such an agreement rundown of rankings is a NP-Hard issue since it can't be said that the got totaled rundown is the best rundown. The totaled rundown will be the streamlined rundown around then. For taking care of the NP-Hard issues, advancement procedures are utilized. Along these lines, Optimization strategies can likewise be utilized for tackling the Rank total issue [5, 6]. Particle Swarm Optimization strategy is one of the improvement methods that assume a significant part for tackling NP- Hard issues. In this paper, Multi Objective Particle Swarm Optimization is utilized for executing Rank Aggregation issue. This methodology is typically used to make appropriate goals to streamlining and look through challenges [7].

1.3 Ranking Based on Distance Metric

In the point of view of rank total, the distance metric is characterized as a task that shows the level of difference among two rankings. Essentially, it is the synopsis of the whole dissimilarities among the positions of all particular components from both all-around requested records joined if the rundowns are irregular in size. Lesser the estimation of the measurement, more similar the rundowns are. The distance between two rankings is continually sure, coordinating and symmetric. Sure of the best normal distance measurements are Spearman's Foot rule Distance and Kendall's Tau Distance. Here, Kendall's Tau Distance measure is considered for processing the distance among two positions [8, 9].

We have implemented a Multiobjective particle swarm optimization centered rank aggregation (MOPSORA) arrangement which makes the unison rank from participation ranks with the objective as lessening the distance among production rank and the participation ranks. While lessening the normal distance among participation rank lists and reference rank list, sometimes it is noticed that although the average distance is less but the distances differ from each other highly. This indicates that the

reference ranking is closer to some of the input rankings whereas it is distant from the others. Therefore, the deviation among the distances should also be considered for this case. Motivated by this fact, in our proposed approach, not only the average distance is minimized, but also the standard deviation of these distances is reduced instantaneously. Kendall's Tau distance extent is castoff for computing the distance among twofold ranks.

2 Related Work

The investigation effort achieved in this field by different scholars is presented as follows:

Broder et al. [5] published a framework for approaching probability distributions over Webpages using graph aggregation based on random walk. The framework proposed by author can approach the famous PageRank distribution by adjusting the classes according to the group of pages on every Webhost. Liu et al. [1] proposed a supervised learning approach to operate the job by using labeled data. A general structure for managing Supervised Rank Aggregation is built up by the author and learning is formalized with optimization which reduces dis-agreements among the labeled data and ranking results. Chong [6] introduced a novel type of algorithm for page ranking by engaging classified tree with static algorithm of page ranking-PageRank, which allows the classified tree to be established according to numerous users' similar searching results. Akbari and Ziarati [10] presented a alteration on the standard PSO algorithm named as rank based particle swarm optimizer, or PSO rank, using cooperative nature of the particles to significantly improve the achievement of the original algorithm. In this approach, for the sake of systematically control the local search and convergence to global optimum solution, the best particles are selected to contribute for the upgrading of the location of a candidate particle. Yan et al. [11] proposed a genetic PageRank algorithm (GPRA) based on PageRank algorithm with the condition of preserving PageRank algorithm advantages, GPRA takes advantage of genetic algorithm so as to solve web search. Dubey and Roy [12] introduced two methodologies for positioning: HITS idea and Page Rank strategy. The two methodologies zeroed in on the connection design of the Web to discover the significance of the Web pages. The Page Rank calculation computes the position of individual site page and Hypertext Induced Topic Search (HITS) relies on the center points and authority system. Bull [8] gave hypothetical outcomes on Expected-improvement calculation's asymptotic conduct which are the most mainstream techniques for tackling the issue. The creator gave union rates to this methodology, ideal for elements of low perfection, and portrayed an altered calculation accomplishing ideal rates for smoother capacities. Ishii et al. [9] proposed an appropriated randomized methodology, where website pages are treated as specialists figuring their own PageRank by speaking with connected pages.

The creator expands upon this way to deal with decrease the calculation and correspondence loads for the calculations. Pop and Dobre [13] thought about that the traffic

signals are constrained by workers and a score for every street is figured dependent on proficient PageRankapproach and is utilized in cost capacity to decide ideal choices. The creator showed that the total commitment of every vehicle in the rush hour gridlock regards the primary oblige of PageRank approach, safeguarding every one of the properties of M framework consider in model. Hegde and Phatak [14] covered the well-known positioning calculation utilized today by the web indexes: HITS. The creator gave right answers for information disclosure and extraction on the web and afterward recognized and killed commotion hyperlinks from the website pages accordingly productive mining can made be conceivable. Kaur et al. [15] carried out Rank Aggregation utilizing Genetic Approach. The creator executed Multi-Objective Genetic Algorithm and results are contrasted and that of Stuart strategy and Mean Method. From the analyses, the creator presumed that exhibition of GA lies between the Sturat and Mean strategy. Desarkar et al. [2] introduced a solo position total calculation that is reasonable for meta search. The creator showed the viability of the introduced calculation over standard strategies about regulated assessment measurements. Dewancker et al. [16] proposed the system for searching at the exhibition of various enhancement methodologies for various execution measurements across improvement issues. Kaur et al. [3] Rank Aggregation methods are applied for various applications like democratic, interpersonal organization, metasearch under web crawler execution check and choice. The creator zeroed in on different Rank Aggregation techniques with execution on genuine world dataset. Arun et al. [4] introduced a re-positioning calculation which uses distance connection coefficient to refine the output created by a given recovery model. It includes two-venture grouping of the underlying recovery list followed by a versatile method for refreshing the comparability scores among pictures dependent on the made bunches. Also, the Particle Swarm Optimization-based likeness score combination system introduced in this work ideally consolidates the recovery results. Deng et al. [17] considered the agreement issue of second-request multi specialist frameworks. First and foremost, an improved agreement control convention is proposed. At that point, the union of the proposed control convention is dissected by applying Lyapunov security hypothesis. To improve the control impact of a given framework, the molecule swarm streamlining (PSO) calculation is presented and an improved PSO calculation is proposed. Parveen et al. [7] rank accumulation has moreover been proposed as a compelling strategy for nearest neighbor situating of straight out information, and gives a hearty method to manage the issue of uniting the finishes of experts with different scoring plans. Sun et al. [18] for the proposed PSO calculation, the irregular examining procedure of control boundaries is planned, which can advance the adaptability of calculation boundaries and all the while improve the refreshing arbitrariness for both molecule speed and position. Li et al. [19] directed recreation study to inspect the presentation attributes of an assortment of existing RA techniques that are reasonable for genomic applications under different settings reproduced to imitate functional circumstances. Parveen et al. [20] Powerful position collection transforms into hard in real worldwide circumstances in which the appraisals are uproarious, fragmented, or possibly disjoint. We adapt to those challenges by broadening various standard

strategies for rank conglomeration to remember comparability between contraptions inside the different positioned Lists, further to their appraisals.

3 Proposed Work

This technique is used to optimize more objective function simultaneously. Two objectives are simultaneously optimized

- Minimization of the average Kendall's Tau space among the prearranged mention rank result and other participation ranks
- Minimization of the standard deviancy among those distances.

Both target capacities are limited all the while. To get an agreement among different information rankings, first and foremost, we need to limit the normal distance between reference positioning and those info rank records. Besides to stay away from the inclination we additionally limit the standard deviation between those distances.

Presently for computing the wellness of a molecule the normal Kendall's Tau distance between this reference positioning and other information rankings is determined. Therefore, we have to reduce the main fitness task f1 specified in Eq. 1

$$f1 = 1/N \sum_{i}^{N} K(R, Input - Rank[1]) \tag{1}$$

where N is the quantity of positioning plans present in Input-Rank, K is a capacity that figures the Kendall's Tau distance between two extraordinary and R is the reference positioning as encoded in the molecule. The second wellness which is likewise to be limited is portrayed in Eq. 2

$$\text{f2} = \text{SD}(\text{K}(\text{R}, \text{Input} - \text{Rank}[\text{i}])|\text{I} = 1, 2, \text{N}) \tag{2}$$

SD indicates the standard deviation. Consequently, the standard deviation among the produced Kendall's Tau distances is taken as the subsequent wellness. The standard deviation is considered for forestalling the reference positioning from being one-sided towards a specific information positioning.

3.1 MOPSO Algorithm

Step 1: Set a population of particles X_N, such that all particles have an arbitrary location vector x_i and a speed vector v_i. Fixed limits c_1 and c_2, the extreme total of groups T_{max}, and the generation sum $T = 0$.

Step 2: Compute the appropriateness of entirely the elements in X_N (T).

Step 3: Recommence the locations and speeds of elements centered on the subsequent calculations: here w = inactivity mass, c1 = intellectual quickening constant, and c2 = societal quickening constant, r1 and r2 are the arbitrary standards between 0 and 1, xpbest is the individual finest of the element and xgbest is the overall top of the element. X^t is the present location of ith element at repetition t. V^t is the speed of ith element at repetition t.

Step 4: Compute the appropriateness of the elements and recommence each ideal location and overall best location of the elements.

Step 5: (End inspection) if the finish condition is fulfilled, then output the overall ideal location and the appropriateness value. Else, let T = T + 1 and reoccurrence to **Step 2**.

$$V_i^{t+1} = wV_i^t + c1r_1(x_{pbest}X_i^t) + c2r2(x_{gbest}X_i^t) \tag{3}$$

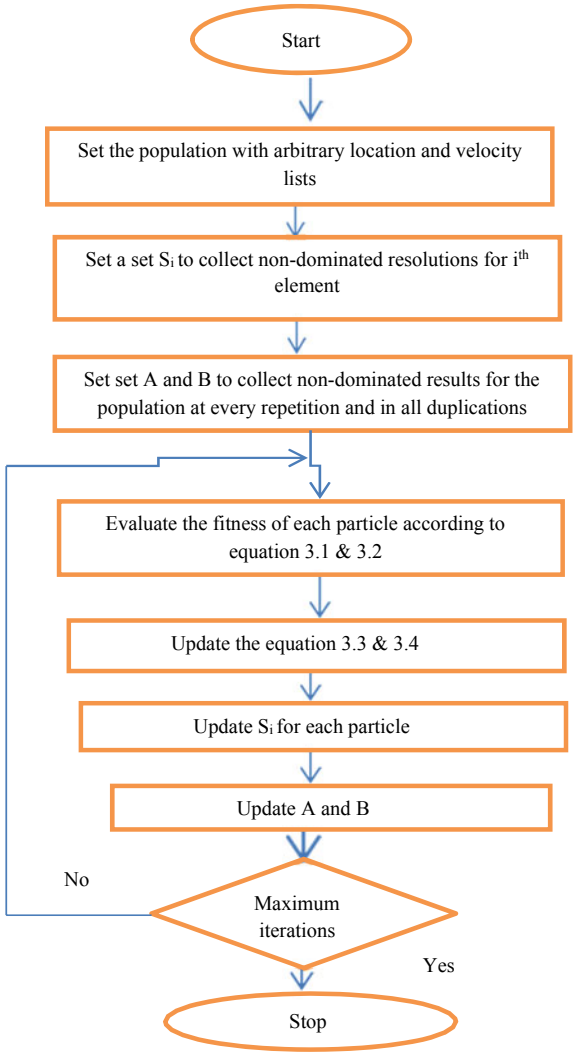
$$= X_i^t + V_i^{t+1} \tag{4}$$

Input: Input rank matrix dt, C = number of genes, rm = number of other ranking method, N = number of particles.

Output: output rank R

1. [xn v n]n^N: = initialize(dt)
2. P best = xn;
3. **repaet** i = 1: N **do**
4. f = 0;
5. **repeat** j = 1: rm **do**
6. [index] = arrange(xi);
7. f = f + kend _ distance(index dtj);
8. distance(j) = kend _ distance(index dtj);
9. **end**
10. f itness1i = f rm;
11. P 1i = f itness1(i);
12. f itness2i = std(distance)rm;
13. P 2i = f itness2(i);
14. **end**
15. Ar = Non-dominatedSort(xn f itness 1 f itness 2) (Fig. 1) [4];

Fig. 1 Proposed flowchart



3.2 Dataset Used

The real-life datasets are assembled from Rank Tracker version 8.33.5 Reveals search engine rankings with a click of a button Supports 566 different search engines Tracks multiple results for keyword.

Table 1 Projected scheme and other input rankings

Input ranking			Output ranking		
Google	Bing	Yahoo	RRA	GA	MOPSO
0.4932	0.4856	0.4780	0.4658	0.4740	0.4973

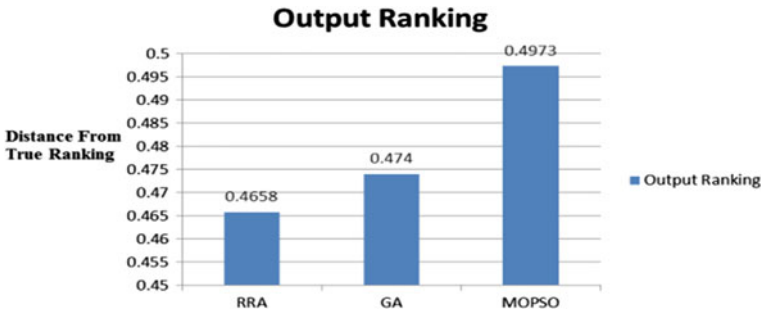


Fig. 2 The Kendall's Tau distance among offered and others rank collection approaches

4 Result and Analysis

The key indication is that a search engine can be entitled worthy when it performs similar to a minimum noisy proficient for a inquiry. At the end of the day, a decent internet searcher is one that is near the joined positioning. This concurs with our prior thought of what a specialist is and how to manage loud specialists. Consequently, the cycle to rank the web indexes themselves (concerning a request) is as per the following: get a position mix of the results from a few web search tools and rank the web search tools developed on their (Kendall or foot rule) distance to the consolidated positioning. The outcome of the projected system is matched with that of Robust Rank Aggregation (RRA) and Genetic Algorithm (GA) (Table 1 and Fig. 2).

5 Conclusion and Future Scope

For surfing the internet many users rely on search engines but results are not fully effective. This gave birth to the invention of Meta-Search Engines (MSEs), which merge and aggregate results from multiple search engines to derive user preferred and efficacious results. A Particle Swarm Optimization system is considered on the multi objective framework for creating the collective grade taking the aims as reducing the distance among mention rank list and participation ranks and also standard deviancy between the distances. Kendall's Tau distance extent is measured for estimating the distance between twofold different ranks. The presentation of the planned scheme is matched with that of the other present rank aggregation approaches such as RRA

and GA. It has been found that the planned system consistently outpaces the other rank aggregation approaches.

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MHCT: Determining Member Head of Cyber Terrorists in Social Blog Networks

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Abstract Social Blog Network facilitates the users to create and disseminate their idea quickly. Cyber Terrorist (CT) do influence general users of Online Social Networks (OSNs) and motivate them to join their group and to even train them to achieve their intended purpose. This work proposes a novel method of determining the Member Head (MH); highly influential blogger influencing number of different bloggers in the network. A pre-identified CT group is analyzed with appropriate parameters to demonstrate that determining MH is adequate and accurate.

Keywords Blog documents · Cyber terrorist · Influential blogger · Member head · Social blog network

1 Introduction

New web platforms allow easy spread of information, including Terrorism [1]. CTs use SBNs for accomplishing their tasks like weaponization, recruiting new members, and training them. Study [2] shows wide usage of social media by terrorist groups to propagandize their mission.

In SBN, the members express their interest in the form of blog documents and others may get attracted with the available content based on their interest. They may perform various activities like; trackback, bookmark, scraping, comments etc., on other's blog documents.

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In order to accurately determine the MH of a pre-identified CT group in SBN, our *contributions* are:

- to establish that Scraping, Trackback and Bookmark are the appropriate parameters in identifying the content diffusion in SBN.
- to analyze the blogger influencing number of unique bloggers, the key parameter in determining the MH.
- to evaluate the adequacy of MHCT algorithm in determining the MH.

The rest of the paper is *organized* as follows: Sect. 2 gives literature survey of related work and Sect. 3 defines the problem. In Sect. 4, the proposed system to determine MH is presented whereas, Sect. 5 illustrates proposed method. In Sect. 6, *MHCT* algorithm is framed. Section 7 demonstrates the proposed system through simulations on pre-identified CT group to analyze the results, and Sect. 8 concludes the paper along with the scope for future work.

2 Literature Survey

Influential users [3] are identified in a blog network considering maximun number of activities on one's document. There are methods [4] to understand the nature of threat, organizational structures that can take timely, coordinated, and effective actions, describing the nature of terrorism; how the members of terrorist groups communicate, train the new members and address their vision in a planned and hidden way. The approximation algorithm [5] significantly out-performs with de-selection heuristics.

A visual analytical system [6] focuses on depicting the fundamental concepts. The Counter-Terror Social Network Analysis and Intent Recognition (CT-SNAIR) [7] develops automated technique and tool to track and detect potential intent in dynamically changing terrorists network. The behavioral pattern of terrorists in social networks is analyzed to infer that the main target for terrorists are youth [8]. Mechanisms used to control the inhuman activities are proposed to analyze the terrorists' network [9], using which the nodes and their relationship are determined.

Research on information security data conducted using internet provides the behavioral pattern of terrorists with a game theoretical model for behavior of cyber-terrorists and hackers [10]. Access to human resources, level of Internet presence and human resource availability are considered to determine the extremist's organization [11]. The laws in various countries are not efficient in restraining the cybercrime and urges to modify the laws for curbing cybercrimes [12]. The lack of education, awareness, along with poor cyber laws are the main reasons behind increased cyber-crimes [13].

The text content in datasets are analyzed with weighted methods using classifiers [14] and the study on Russian and Turkish legislation on Cyber terrorism says that both their laws still indicate poor cyber laws [15]. Hitting Self-avoiding Walks (HSAWs) algorithm [16] addresses to identify subset of Cyber-Epidemics. A study

has built Terrorism Knowledge Graph with Wikipedia having enriched terrorism entities and relationships from Global Terrorism database [17]. There are techniques for detecting cyber terrorists having vulnerabilities and limitations [18]. Advancement on Bidirectional Encoder Representation from Transformers (BERT) [19] proved its efficiency in constructing anti-terrorism knowledge map.

3 Problem Definition

Given a set of activities performed by various other members of the group on one's blog document, the problem is to determine the unique members who have been influenced by the blog documents of that member.

4 Proposed System

The member bloggers activities performed in SBN are gathered and subjected to analysis in order to appropriately determine the head. To overcome the disadvantage of existing methods, a novel technique is proposed to identify the MH in a SBN based on the activities done by other members on their blog documents.

Since the main mission of terrorists is to make many new bloggers to join their group and to involve them to their different missions, the member head in such network cannot be the one with just higher activities on his documents. Hence in proposed method, the number of unique bloggers performing activities on other's documents is considered, and is refered to as the MH. As soon as an activity is performed between the documents of members involved, then any further actions between them need not be counted, which helps us in tracking MH and his Member Head Power (MHP) in the SBN appropriately.

The link between the members are depicted using the activities performed on the documents of a member blogger by others. The proposed method considers comment activity as weak link since it cannot guarantee that, a blogger who comments on a blog document, is influenced. Hence, all comment activities are excluded from activities list while determining MH of the network. If a document is bookmarked by others, it clearly depicts that the document is of same interest to them, thus has influenced the member who bookmarked it. Scraping and trackback activities performed infer to establish the diffusion of content lin the SBN.

5 Senario Illustration

Figure 1 illustrates a scenario of different activities in a SBN. Cyber Terrorists CT-A, CT-B, CT-C, CT-D, and CT-E shown respectively have created blog documents-D1,

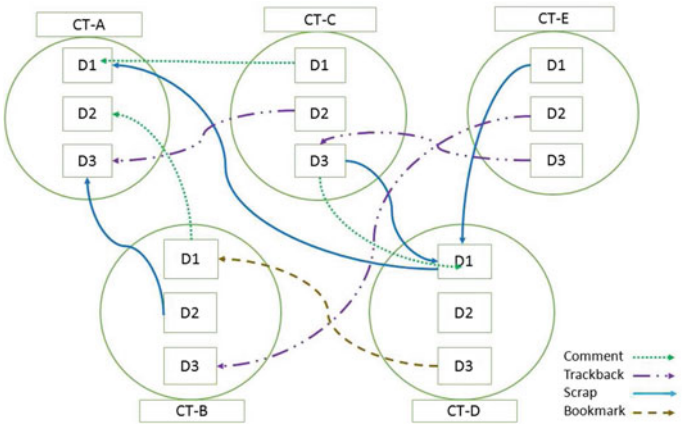

Fig. 1 Different activities performed by cyber terrorists in a social blog network

D2, D3 and so on, in their blogs. CT-B has commented on D2, scrapped its D2 from D3 of CT-A. D3 of CT-E is trackbacked to D3 of CT-C and D2 of CT-C is trackbacked to D3 of CT-A. CT-D has bookmarked D1 of CT-B and so on.

The amount of impact a particular member has created on others cannot be computed just by User Content Power (UCP) which is the sum of Document Content Power (DCP) of that particular member's documents unlike existing method. The influential power of members is defined based on the number of unique members who got influenced by their activities as the Member Head Power (MHP) of that SBN.

6 Algorithm

Many activities may be carried out on one's documents by others. Only one activity is sufficient to establish the link between documents and also proves that it has impacted the other member. Based on this logic, the Member Head of Cyber Terrorist (MHCT) Algorithm is developed.

7 Simulation Results and Performance Analysis

For analysis, the data set gathered from the social blog application [20] is used. According to the existing work [3], DCP and UCP values are computed. Further, MHP is determined as per the proposed MHCT algorithm and MH of SBN is identified.

For analysis purpose, in this work only those bloggers who belonged to pre-identified CT group are considered. Figure 2 shows UCP of each user in different

Algorithm 1: *Member Head of Cyber Terrorists (MHCT) Algorithm*

Input : Log data of activities performed by CT member bloggers in the SBN
Output: Member Head of Cyber Terrorists

while *True* **do**
  for *each and every CT member blogger in the SBN* **do**
    Initialize Blog Document Weight (BDW)={null}
    for *each and every document of a CT member blogger* **do**
      Find all the activities done by different members
      Exclude comments to get other activities
      Extract and update BDW of blog document considering set of different CT members doing other activities
    Compute MHP of that CT member considering number of unique CT members doing other activities
  Compute Max(MHP) from the MHPs of all the CT member bloggers under consideration
  Determine MHCT of SBN having Max(MHP)

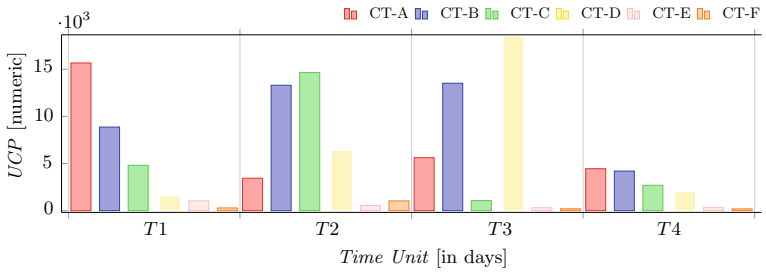

Fig. 2 UCP values of CT group members over time

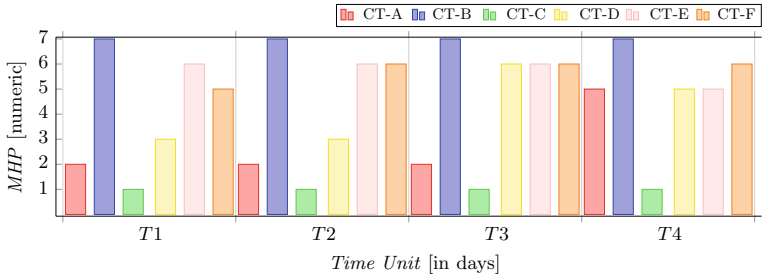

Fig. 3 MHP values of CT group members over time

time units and is observed that blogger with highest UCP as influential, varying over different time units. Activities like Trackback, Scrap, Comments performed on each document are considered while determining DCP of documents.

Figure 3 depicts the MHP according to the proposed method. The graph shows CT-B having higher MHP in all time units and hence considered to be the MH of that group in the network. In the method proposed, depicted results show high stability of MH over time because of the fact that MHP value changes only when a new CT member blogger performs any activity on the documents of other and the occurrences of which is predictively less.

8 Conclusions

Considering the information on members activities in a SBN, a novel method is proposed for determining Member Head of CT, who influence more number of different members of pre-identified CT group in SBN. The experimental results show that Scraping, Trackback and Bookmark are the appropriate parameters in identifying the content diffusion and that the MH continues to be the influencing member of SBN unless other unique members perform activities.

The avenues for future work is to detect the existence of malicious content in the blogs of multi-group terrorist network in OSNs.

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Fault Diagnosis of Voltage Source Inverter Using Machine Learning Techniques

Vaishali Sonawane, Sanjay B. Patil, and R. B. Dhumale

Abstract This paper proposed the technique for fault diagnosis of open circuit faults in three phase voltage source Inverter (VSI).Fault diagnosis is determining which fault occurred. Fault diagnosis (FD) methods of the power converter are implemented using Park's Vector Transform, Discrete Wavelet Transform, Artificial Neural Network, Fuzzy Logic, etc. These methods are implemented needs to train machine learning based algorithm which needs to features extraction as well as features selection. This work proposes an open switch fault diagnostic method in a three-phase voltage source inverter to minimize volume of selected features to diagnose faults.

Keywords Fault diagnosis · Voltage source inverter · Open circuit fault · Artificial neural network

1 Introduction

Consistency has always been a significant feature in the evaluation of engineering manufactured goods as well as apparatus. High-quality manufactured goods design is certainly important for manufactured goods through high consistency. On the other hand, no issue how superior the manufactured goods drawing is, manufactured goods worsen over time as they are working under definite stress or load in the genuine surroundings, frequently concerning uncertainty. Maintenance has, consequently, been initiated as a proficient method to guarantee an acceptable level of dependability throughout the functional life of a physical benefit. New well-organized maintenance

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advances for instance *Condition-based Maintenance (CM)* are being executed to hold the condition. Martin [1] in brief summed up the record of MS expansion for machine tools. Certainly, the record relates to other kinds of machines and schemes too. CM is an MS method that advises maintenance measures based on the information gathered through condition monitoring.

The complex electrical appliances used in various industrial applications are VSIs to convert *Direct Current (DC)* to *Alternating Current (AC).* Three phases ***VSIs (VSIs)*** are used globally as AC induction motor drives. Induction motor drive use includes automation, petrochemical and natural gas plants, processing industries, packaging industries, textile industries etc. [2]. However, VSIs are prone to a variety of faults that can result in catastrophic breakdowns and to some extent impedance on the induction motor drive [3]. Failure of the VSI may result in shutdown of industrial processes. Such closures can lead to a loss of efficiency, causing security and green issues that may worsen the organization's position. Therefore, condition monitoring and fault diagnosis of the three phases VSI is an interesting research topic.

Different techniques have been applied for the diagnosis of faults in three phase VSIs [4]. These techniques are based on current signal analysis. Signal processing techniques are suitable for position control and VSI defects. The *Wavelet Transforms (WTs)*, *Park Vector Transforms (PVTs)* and entropy methods are used to extract the VSI's three-phase current characteristics in healthy and defective conditions [5, 6]. The different techniques such as WT and *Fuzzy Logic (FL)*, *Discrete Wavelet Transform (DWT) -Artificial Neural Network (ANN)* and entropy-ANN are suitable for diagnosis of faults in VSIs [7]. But these methods are less robust under variable load conditions [8]. The WT-FL technique is dependent on threshold and threshold values need to be adjusted in terms of load conditions [8]. In contrast DWT-ANN and entropy-ANN techniques, it is very difficult to collect initial training data under variable load conditions [9].

2 Approaches for VSI Fault Diagnosis

VSIs intended for industrial use are manufactured with a more or less comprehensive security system. They provide protection against disturbances and observe closure if it fails to prevent serious damage. Common Troubleshooting Functions that diagnose Fault are given below and shown in Fig. 1.

- Fuses and fuse monitoring and drive close down if a fuse is blown, via sensors and central control, for fuses in mains supply line and for control equipment as well as base drives power supply;
- Switching devices overcurrent with switch off and drive power cut or controlled transistor resume, via desaturation recognition circuits in the base drive and the main control;
- Switching devices overvoltage detection and reduction, via circuits in the base drive;

- Power converter overcurrent detection and reduction, via main control;
- Mains supply voltage monitoring and shut down in case of under voltage or missing line;
- Power supply voltage monitoring and drive shut down in case of under voltage.

However, recent power converters have been created with numerous additional protections, and thus diagnostic functions, such as the current limitation with regard to fan diagnostics or ambient temperature, which will not be presented in detail at this point. They can add up to 50 or more tasks. As such, industrial drives are equipped with diagnostic tasks, but there are still tasks that typically do not have coverage due to a number of additional sensors, such as required additional computational power or diagnostic methods in the wrong place. For example, regarding the fault allocation in the power converter given earlier, there is an important diagnostic function that is not covered by the schematic schemes above, since there are power transistor faults [2].

This work proposes an open switch fault diagnostic method in a three-phase voltage source inverter to minimize volume of selected features to diagnose faults under variable load conditions using **ANN**.

3 Proposed Methodology

Three-phase Pulse Width Modulation (PWM) VSI is simulated using Matlab-Simulink. OCF in VSI is produced through IGBT's collector terminal. In this simulation, the data obtained for healthy and defective conditions are collected for additional authentication by experimental analysis. The various results obtained by simulation are presented.

The experimental setup for the proposed 'Fault Diagnosis of Voltage Source Inverter using Machine Learning Techniques' is shown in Fig. 1. The ability to generate OCF in VSI by opening the collector terminal in the test box has been created. IM, VSI with the real-time interface is in the data acquisition system (DAS). The safety circuit is offered to avoid damage due to different defective conditions of IBGT. The proposed model of fault detection and diagnostics of open switch faults in three phases VSI with operation is shown in Fig. 1.

4 Algorithm to Classify Open Switch Fault

The **Back Propagation Neural Network (BPNN)** algorithm is distinctive from other networks that are used to development weights calculated in the learning phase. The general difficulty with the multilayer perceptron is adjusting the weights of the hidden layers in a capable technique that would change a particularly miniature or else zero output error. Network training develops into complex when hidden layers

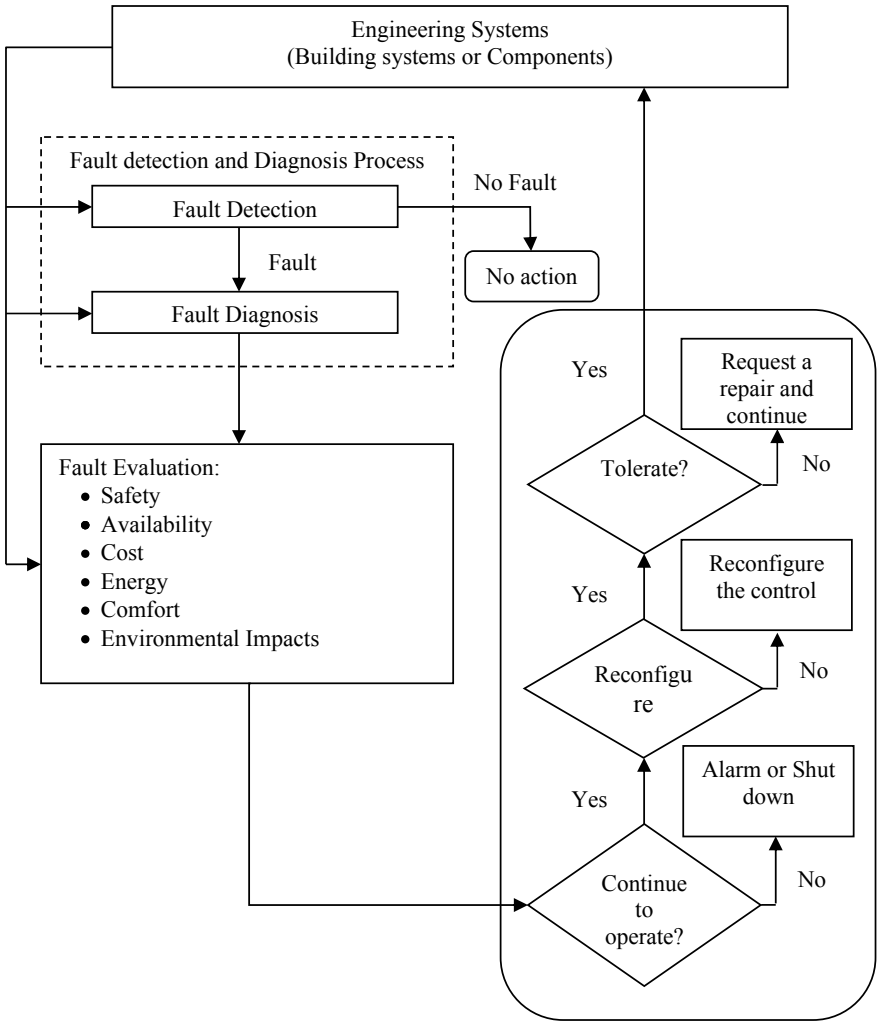

Fig. 1 The proposed model of fault detection and diagnostics of open switch faults in three phases VSI with operation

are additional. Error calculation is needed to inform weight. The error on the output layer is simply considered. Error information is not straight calculated on the hidden layers. The final target is to decrease the error on the hidden layer by using previous methods to decrease the output error. BPNN training is done in the following three phases.

1. The feed-forward of the input training pattern,
2. The computation as well as back-propagation of the error,
3. Modify the weights.

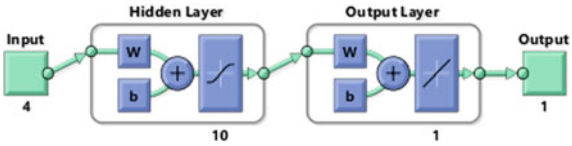

Fig. 2 Structure of trained ANN to diagnose fault in VSI

The BPNN is used to see if the given image of the tomato is infected with GBNV. To train this network, 3X220 data was created using four features. The fifth column in it shows the output in which the collected features indicate whether they are switch is faulty or not. Four features were extracted from the current signal and these features are used to train the Artificial Neural Network. During the training, different structures are trained to select the best performing structure and the right structure was selected. The performance of an ANN depends on its hidden layer. It is also important to know the learning step size while training. The size of the hidden layer was varied between 2, 4, 5, 10, 15 and 20. The created structure is 0. Learning rates of 1, 0.05, and 0.08 were trained. The best structure in the trained algorithm is 4-10-1 as shown in Fig. 2 and the learning rate is 0.05. Figure 3 is the performance of the training. The best validation performance is 0.0014 at epoch 13.

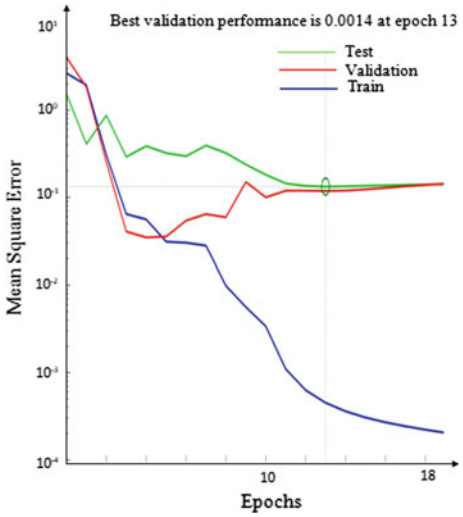

Fig. 3 Neural network training performance

Table 1 Performance analysis of algorithms used in classification

Techniques	Training accuracy (%)	Testing accuracy (%)	Overall accuracy (%)
Back-propagation neural network	88.33	88.83	88.53
Radial basis functions	84.50	83.58	84.04
K-self organization feature maps	88.32	85.36	82.34
Linear vector quantization	84.38	81.08	82.83
Support vector machine	84.82	83.28	84.00

5 Results and Discussion

The performance assessment of the open switch fault classification of switching devices in VSI is evaluated based on the statistical performance using two measurable evaluation factors to properly identify. The parameters are sensitivity and specificity. The comparison of above fault diagnosis method is given in Table 1. From this analysis it is observed that the Back Propagation Neural Network shows better performance over other classifiers. The most serious factor is the identification of faulty switch according to the various features associated with them.

6 Conclusion

In this work, an analysis of large mixed sets of faulty signals is presented, which together present the signal collection, feature extraction, training and testing of ANN. The framework is a generalization of different sophisticated techniques for individual aspects. This framework affects numerous data sets, including healthy and faulty switches, to demonstrate efficiency and calculate its efficiency.

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Internet of Things (IOT) Based Technologies in Smart Agriculture

Santosh Konde and S. B. Deosarkar

Abstract Current agricultural process have tremendous changes occurred as old traditional agricultural process the new emergences are related to the IOT used in the farming process which move the production process stastical to quantative methods. The changes occurred in the process of current agriculture towards the new challenges are creating the opportunities and developing the new process of the agriculture. This discussion are coming up for the New equipment and major technologies used on the basis of the smart Agriculture process to the old traditional Agriculture process. The major equipment and technologies are related with the sensors and IOT in agriculture like soil preparation, crop prediction, irrigation system, water quality monitoring, pest control etc. This technology are helping to produce agricultural process from the sowing to the transportation and favourable application to improve the crop production, crop surveillance and unmanned aerial vehicles (UAV) we are highlighted the IOT based smart agriculture process through review on equipment and technologies.

Keywords IOT · Smart agriculture · Automation · Agriculture process

1 Introduction

According to the high population rate we are not matching the demand and supply chain on the basis of the fewer resources and labour efforts to improve the agricultural yield from the stastical data in 2050, the world population is expected to touch the 9.8 billion, as we considered it with current figures it is almostely increase approx 25% [1]. as we considered the figures forecasted with developing countries [2]. The trend of urbanization is currently 50% [3] that will be forecasted to accelerated about 72% of the world population to the urban until 2050. Specially developing countries the multiple growth of the income level will increase their production twice upto 2050 [4, 5] as the current level, the demand level of the food. It is not related food

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but crop production related with industrial manufacture process are also important to developing the bioenergy sources with help of cotton and rubber. Recently the demand of ethanol are increase by using the fuel source. The production of the ethanol are manufacturing by the coarse grain [6, 7]. Such demand and supply of food are create pressure on the food security due to utility of the coarse gain.

We know that only farming land are limited area for the crop production. Their have major limitation for the crop production due to the region of temperature, water ability, environmental condition, soil fertility etc. some are not suitable for the production of crop because they are non homogenous. The availability of land are not suitable for climate pattern and their have the new fear of continuous development of urbanization. So the availability of the land for the farming purpose are minimize.

In the traditional farming procedure farmer visit the farming site frequently through out the crop production upto the final output of the crop. The 80% of the farming time are consume on the frequently monitoring and supervising the crop instead of actual work. These draw back of the time consuming instead of actual work to be removed by the latest IOT base technologies. By using wireless sensor, wifi, cloud base technique, automatic heavy machinery and equipments etc.

Which provide the farmer to improve the crop fertility services without actual present in the form the wireless sensors are continuously monitoring and gives feedback to the farmer with unwanted states of the crop. The farmer are taking necessary action in early stage to control the wastage of the crop. In the farming process like attacking weeders, pesticides implementation, borrowing of seeds, harvesting of crop, safety transportation etc. All the activities in the agriculture are done through the smart technology used in the farming process.

In the modern agriculture involved the automatic tractors, drones (UAV's) sensors, robot provides the collecting primary data and data analyse every step and improvement can be taken in the crop field application. The IOT is the major technological tools implemented for the modern industries. In the atomization which develop high efficiency product with accuracy and precession measurement.

The IOT technology are the key role in the agriculture sector by developing the wireless sensor module, automatic vehicles, mobile devices related with cloud base technique etc. the equipment provide the basic data in the form of decision making and provide the facility to the farmer to take the necessary action. Such a capabilities are improving the agricultural sector in non efficient sector to efficient sector to improving the financial growth of the farmer. Figure 1 shows the key technology and Fig. 2 shows the major challenges to implement the smart agriculture activity. According to the necessity of the market requirement the manufacturing company are developing the new technological equipment on the basis of IOT such as unmanned aerial vehicles (UAV's) highly monitoring devices, harvesting robots and heavy machinery to improved the facility in the farm sector.

The government are also taking necessity actions and develop the new policies to the manufacturer to maintain food security and safety environment [8, 9]. This paper are focus the IOT base agriculture research and application. The new development in the smart agriculture we are contributing the expectation of the world

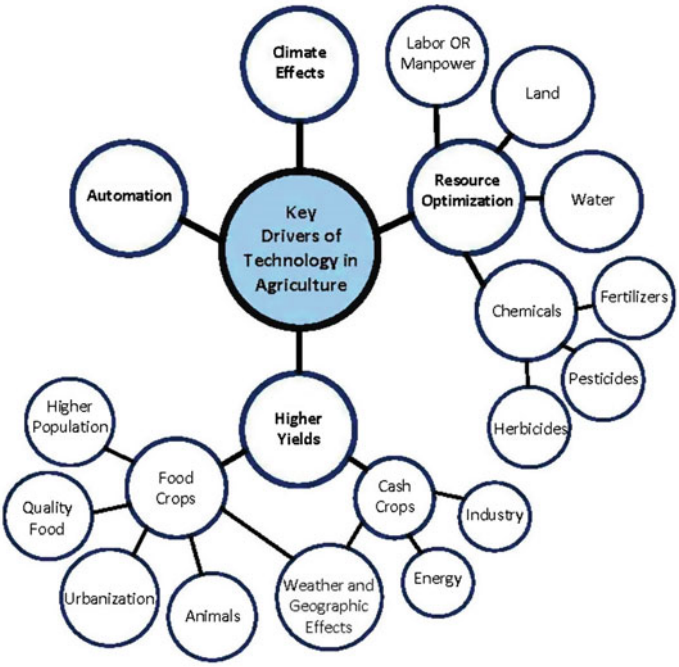

Fig. 1 Key drivers of technology in agriculture industry

Fig. 2 Major Hurdle's in technology implementation for smart agriculture

from the agriculture industries. The solution are made easy to developing the application with scholarly the role of IOT application are facing the problems of shortage resources, wastage of food, pollution and weather changes, non availability of water etc. This article are related to the development and skill improvement related with the new emerging technology mainly highlighted wireless communication, cloud base facility, automatic robots, new generation tractors, UAV's (drones) and high efficiency equipment in the field of agriculture.

2 Major Equipment and Technologies

In the modern farming process we are using the recent modern technologies equiped with GPS, GIS facility sensors and wireless sensor and wirless sensors with fully automatic partially automatic equipment like tractors, robots or harvesters. These equipment are using for the borrowing seeds, harvesting, fertilization and other farming process the new technologies are collecting data from the data acquisition system through the satellite, UAV's multi functional devices with high accuracy. The data identified the location by using the GPS platforms and implemented respective treatment to the specific location. In the last few decades the agriculture sector has transform farming operation in small and medium industries. Which also include commercial farming to increase the profit, the measurement are important factor to control the cost. The new generation technologies base on IOT are given boosting to world. The automatic and well planned technique to maintain high accuracy and precision. The agriculture robot are performing borrowing the seeds, automatic spraying water, maintain growth of the plant, pick the fertilize output, packing the final products etc. The new advance technology are given more profit, low input cost and minimize the losses. This technique are also monitoring the labour cost. We are discussing the above factors which are increasing agriculture market at the growth the rate of 19.8% per year during the period of 2018 to 2023. Always priority demand and market growth are totally depends upon the information and communication technology (ICT). The main key technologies and equipment are shown in Fig. 3 are available for farming purpose. Most of the different agricultural activity are depends on the new variety sensors and communication technique.

2.1 Wireless Sensors

The wireless sensors are playing vital role in the collecting data from the crop condition these sensors are use for various application in advance agricultural tools and machine to collect the specific information on the field location. Table 1 shown the system, their placed and purpose where they can be used.

Fig. 3 Selected IoT based products and prototypes for smart agriculture

2.2 IOT Based Tractors

In the old farming process there are time limitation and slow agriculture work from the labour. The stress work develop to non availability of man power. The stress can be remove from the agriculture process to enter the new generation tractors and other helpful machinery to expand the growth of agriculture production. The tractors works more than 40% to traditional farming labour. According to the requirement of agriculture base manufacturing companies are given the new option to the farmer for the fast working ability to perform the agriculture work. The new generation tractors are John Deere, New Holland, ford etc.

The tractors have the facility in the form of auto driven, GPS base technique. They are avoiding the repetitive visit to same area or overlapping nearby inches area. Most of the facilities are very precession and less error for the spraying pesticides, hits the weeders. Ascending to the study fully automatic self steer and driven technology in advance equipment will be expected around 750,000 required during the period 2028. The well equipped facility like unmanned, fully automatic IOT technology are expected around 45,000 tractors upto 2039. All manufacturing companies are developing low cost and high monitorising device [10] with high accuracy software for the agriculture sectors. Their tools and devices can be use in universal technique. The overall cost of the modern tractors will be low and it gives opportunity to the farmer for his expectation. Farmer are given priority to detecting the object and avoid

Table 1 Some selected sensors and their possible uses in IoT based agriculture

Sensor/system	Target/placed				Considered purpose/parameters							
	Plant	Equipment	Soil	Weather	Yield	Temp	Moisture	Location/tracking	Wind	Pollution/Co_2	Water	Fruit/stem size
Loup 8000i		✓			✓		✓					
XH-M214			✓				✓					
Ag Premium weather		✓		✓		✓		✓	✓			
FI-MM	✓											✓
PYCNO			✓	✓		✓	✓				✓	
MP406			✓			✓	✓					
DEERE 2630		✓			✓		✓					
Sol chip com (SCC)				✓						✓	✓	
SenseH2TM	✓								✓	✓		
DEX70	✓											✓
Piccolo ATM		✓						✓				
CI-340	✓						✓			✓		
Wind sentry 03002				✓					✓			
AQM-65				✓					✓			
POGO Portable			✓			✓	✓				✓	
SF-4/5	✓											✓
Met station one				✓					✓			

(continued)

Table 1 (continued)

Sensor/system	Target/placed				Considered purpose/parameters							
	Plant	Equipment	Soil	Weather	Yield	Temp	Moisture	Location/tracking	Wind	Pollution/Co_2	Water	Fruit/stem size
SD-6P	✓											✓
B-102		✓						✓				
Yieldtrakk		✓			✓		✓	✓				

the collision by using the LiDAR sensors, high profile camera, networking data by using cloud computing to the final output. Shown in Johndeer [11] tractors. The new generation tractors perform the real time data in the application by using the internet and wifi technique for the crop analysis.

2.3 Harvesting Robots

In farming process harvesting is the complicated process. This process is the last step in the crop production while in the other crops its perform various time. After time gap this process to be done in various times. If we consider the labour utility this causes serious problem due to non availability of manpower within the time. The climate changes are also major factor for the harvesting. The U.S. decline in the production due to above mention issue. They have $3.2 billion decline in the crop production [12]. According to the study conducted by the agricultural department overall 15% farm cost are given to pay the labour wages. The labour intensive are increase upto 40% from the cost analysis if we are using the automatic machine on the basis of IOT in the harvesting process robot gives more accurate result in the field production. The recent decades the role of robot are continuously increasing in the harvesting process many researchers have put their knowledge to develop the robot according to the need of farmer. They are useful to detecting fruit size, shape and location of the fruit.

In the fruit harvesting very needful sensors are required to detect the parameter of the fruit and particular information of the crop [13]. Most of the technique are related with computer vision in 3D form, signal processing, image processing and machine level technique. Robots are depend on various types of special tools to differentiate the fruit size, shape and colour for the particular crop from these basic needs researcher can be developed new generation robots for the specific food production. As SW 6010 model, octinion are use only for strawberry farm. Harvesting robot, SWEEPER use for peppers and FFROBO for the apple production. These robots are collecting 1 lakh apple within 1 h. They are detecting the define path like rails, robots, can move only forward and backward direction. When collecting the strawberry packed by the human operator. New robots are operated on solar source energy, battery and zero emission model as Tektu T-100 collecting fruits which run on the principle of IOT use for harvesting purpose.

2.4 UAV'S (Unman Aerial Vehicle) in Smart Agriculture

In the new generation IOT base equipment are play important role in the field of subsidiary products as poultry farm, fishing farm, horticulture and related products. The specific communication in the agriculture they have low quality base station, wifi network. The basic facility of the improvement in the IOT with smart agriculture are

worst in developing countries due to this reason IOT have challenges in the rural area. The specific situation can handle by the alternative arrangement of UAV's are the best solution to visit and supervision on the farming land. UAV's are communicate with large hectors of farming lands. The spread sensors are collecting the information and synthesize data to take necessary action. Commonly known as drones which are highly resolution cameras, high configure sensors and advance equipment are used to detect and supervision purpose.

The role of drones are surveillance to cover large areas [14]. In the agriculture application in the macro view application we are using the satellite image, airplane image, both views are give good quality images in the form of macro images. But for collecting information related with micro image which develops serious issue for monitoring large forest, crop monitoring or particular area.

When we consider the 'The eye in the sky' through the UAV's above mentioned issue are eliminated with high resolution cameras. UAV's have the ability to monitor the weeding effect, crop assessment, plant growth etc. The particular data synthesize and given faster response through NAVI technique. So the farmer can take necessary action.

There are two types of UAV's differentiate on the application purpose as fix wing drone and multi rotar drones [15]. Figure 4 shows drones are differentiated on the basis of hardware technology and cost effective. When we required to supervise the large area fix wing drones are suggested due to their capacity of long range flight. ex: sense fly's e Bee SQ and DATA hawk. For the general purpose application the

Fig. 4 Types of agricultural drones

multi rotar drones are use for the fast and easy takeoff. Multi rotar drones are not depend upon the wind planning and getting the fly precisely. Multi rotar drones have the best choice in crucial application generally monitoring the agriculture farming activity DJI matrice 200 [16] and American robotics [17]. Fully automatic drones are the convenient for the application. The drones have ability to collect the information from the ground by reflected light the drones are well equipped with thermal sensors and high resolution camera the sensor collecting the information of water from leaves and produce the images as the same way the infrared sensors are also collecting the information related with NIR reflection and visible reflection through NDVI technique. The reflected light are ability to distinguish the plant types, height, size of the crop. Cameras are the detect the unwanted herbicide and weeds the multi spectral photos are helping to distinguish the weeds and unwanted development in the farm [18] crop.

2.5 Cloud Computing

In the modern agriculture shows the benefit with help of cost saving, in the data conversion of farm filed to its cloud base the different stages implemented with effective technique the end point data can be make decision efficiently. All these conversion are depend upon the cloud services the predictive services are stored their primary information to cloud and farmer getting these services in the farm of advice from the source. The basic crop prediction, consumer data base, supply chain, billing system and related activity.

The cloud services have more challenges to implement in the recent techniques the variety of sensor and their own data to be stored in the particular format on the basis of semantics. The specific application are develop on the basis of past and future data analysis the farmer accessing this information with the specific format as soil monitoring and testing, weather information, water scarcity, fertilizer information etc. the cloud facility are given by Ag junction [19] to the farmer in the form of message base or voice telecast related with cost saving in the agricultural activity. The 'The AKisai [20] are also developed cloud services related with environmental factors purpose by Fujitsu which gives information related with food transportation. Figure 5 represent the information related with services, infrastructure, storage and security in the smart IOT environment.

2.6 Communication in Agriculture

In the precision agriculture activity collecting and sending the information on the time base technique. The balance technology are totally depended on communication. The telecom operator play important role in the communication technology. If we play the IOT techniques in the farm sector which gives the information related with cost

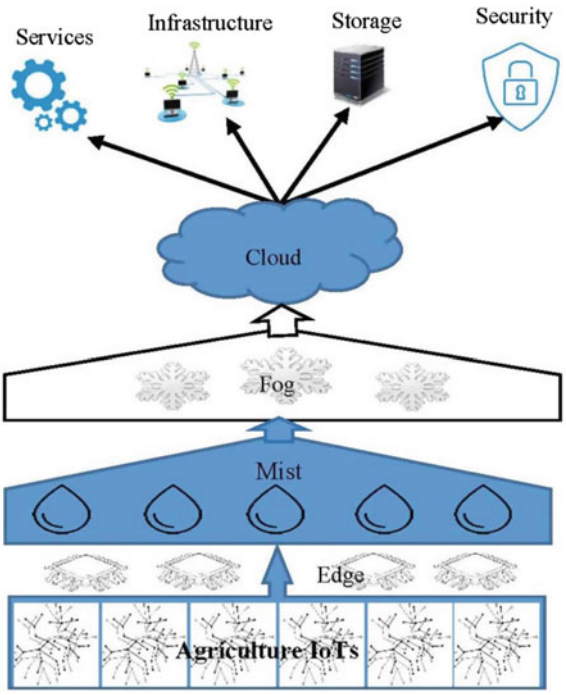

Fig. 5 Fluid computing infrastructure for smart farming

saving energy related information specific required application etc. Figure 6 shows the information in the field of communication as with different layers and interact with each other to provide better solution in the agriculture process.

3 Current Challenges and Future Expectation

The plan establish in the year of ending 2014 which names the '2030 agenda for sustainable development. This agenda is related with WHO and international community have decide the hunger on or before 2030. The recent figure declared by WHO that are not supporting to the deciding agenda 2030. It shows food shortage by 801 million people throughout the world. In which the one people out of nine [21]. Shows the hunger.

The food quality is also making the serious issue. The industrial basic needs from the crop are also generated within last few decades like generation of ethanol, need of cotton for the textile industry, raw material like rubber, gum are the serious issue for the financial growth. In the Fig. 7 represented the challenges as expected on 2050. The issue content how we can feed the 11 billion people with minimum availability of farming land. Reducing the pollution, water scarcity, labour challenges environmental issues and urbanization problems. The age factor are also develop

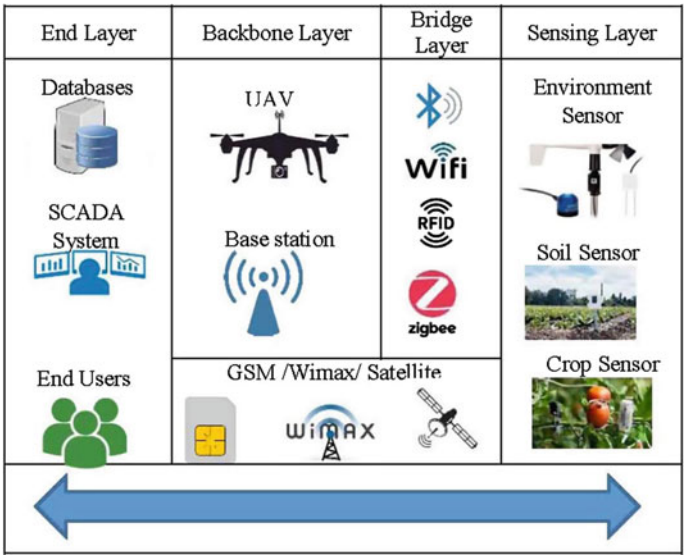

Fig. 6 End to end communication for smart farming

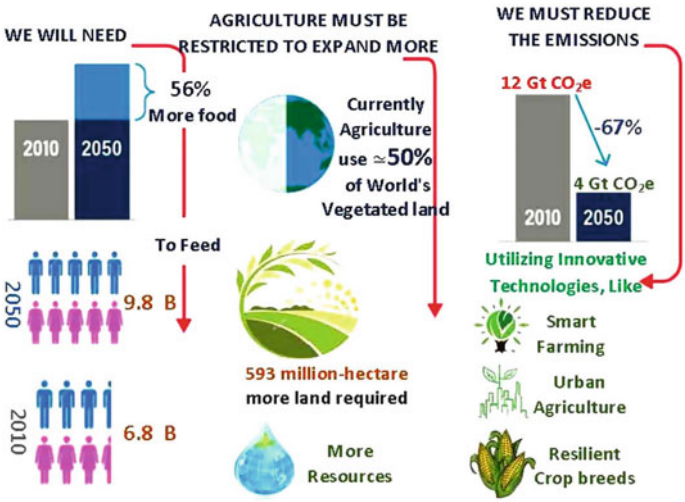

Fig. 7 Major challenges for sustainable future agriculture

in the farming sector. The above discussion are the major reason in the improvement of smart technology in the field of IOT environment. The new concept related with artificial intelligence, cloud base services, agriculture base skill development in technical parameters to create a new area for super fusion.

4 Conclusion

Above discussion related with paper are in form of new challenges and emerging area to identify for the further research. The researcher have given path related with following.

1. Soil monitoring and testing are the major factor to develop in the food production and agriculture growth.
2. Water related issue will discuss on the availability of water for the future planning in irrigation field.
3. Pollution in the agriculture field to calculate the fix environment parameter.

All these issues focus in the various technologies specially related with IOT to improve the future expectation in the smart agriculture sector.

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Design and Development of Secure Gateway Modules for Secure Communication in Industrial Control Systems

L. Rajesh and Penke Satyanarayana

Abstract Industrial Control Systems (ICS) are using for surveillance and controlling various industrial process plants in National Critical Infrastructures. These systems are exposed to the outside world through internet for remote assistance and corporate networks for data sharing. This connectivity of ICS systems to outside world opens the doors for cyber attackers. It needs to protect these systems from cyber-attacks. SCADA system is one of the underlying components in ICS systems. MODBUS is the most widely deployed communication protocol between HMI or Data Acquisition Server (DAQ) and Programmable Logic Controller (PLC) for bidirectional data transfer of sensor data. There is no security in the design of Modbus protocol and it is vulnerable to cyber-attacks. In this paper, we designed and developed secure Modbus gateway client and server modules which were used to provide secure transfer of sensor data between DAQ Server and PLC. This method provides interoperability and can be easily applicable to existing legacy systems. It protected ICS systems for 97% of cyber-attacks.

Keywords Industrial control systems · SCADA · MODBUS · Cyber security

1 Introduction

Every aspect of Modern human life depends on Industrial Control Systems. Supervisory Control and Data Acquisition Systems (SCADA) are using in Industrial Control Systems (ICS) for monitoring and controlling various process plants and factories. They are helping for automation and digitization of plants like Oil & Gas Refineries, pipelines, Power generation & Transportation facilities like substation automation, Nuclear Reactors etc. [1]. SCADA systems are deployed for monitoring and controlling various process plants. In earlier days these systems were isolated from external

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world and installed in a control room where outside access was not allowed. But now-a-days these SCADA systems are connected to internet for remote monitoring and sharing SCADA data to other systems like Enterprise Resource Planning (ERP) systems, Leak Detection System (LDS) in Oil & Gas Pipelines, Energy Management Systems (EMS). They open the doors for cyber-attacks on SCADA systems. These systems are vulnerable to security attacks [2]. It needs to protect ICS/SCADA systems from cyber-attacks for secure operations.

1.1 Security of Industrial Control System

In SCADA systems, communication protocols like MODBUS, DNP, IEC 60870-5-101/104 will be used for bi-directional data transfer between SCADA Server and PLC. Modbus is most widely used communication protocol. Modbus was designed without security in mind. It has lack of following security features [3]:

- Integrity of data frame—No checking of integrity of the frame
- Confidentiality of data in Modbus frame—Plain text data transfer
- It is open protocol and everybody know the frame structure
- No time stamp in frames
- No authorization and authentication.

Modbus protocol is suffering from the following cyber-attacks because of non-availability of above features [4]:

- False Command Injection
- False Response Injection
- Replay attacks
- DoS attacks.

As Modbus is vulnerable to above cyber-attacks it needs to provide secure data transfer of sensor data between Data Acquisition Server (DAQ) and PLC in ICS systems using Modbus protocol.

1.2 Related Existing Works

Some of the research scholars worked for security issues of ICS/SCADA systems, communication protocol security, cyber security of industrial control systems. They also provided some solutions to these problems. Yusheng et al. [5] explained about various vulnerabilities of Modbus protocol. They proposed real-time deep inspection for Modbus TCP traffic in intrusion detection of Industrial Control Systems based on Modbus protocol. It is a detection method only. Fovino et al. [6] developed a secure Modbus protocol based on RSA signature and SHA hash but they did not verify the protocol specific parameters at Controller. The frame was transferring in plain text

format. Amir et al. [7, 8] developed cryptographic solution using AES, RSA, SHA for achieving security in Modbus protocol. They modified the frame formats of Modbus protocol. Authors in [9] used AES and hashing for securing IEC 60870-5-104 and Modbus in multicasting polling scenarios. Dudak et al. [10] described enhancement of features of serial Modbus protocol. They developed uBUS protocol by adding some of the protocol specific features. You et al. [11] developed Modbus protocol for building security. Phan et al. [12] concentrated on authentication feature of Modbus protocol. Erez et al. [13] developed anomaly detection in Modbus SCADA control registers. It is also a detection method only. Hayes et al. [14] enhanced security in Modbus by using hash-based message authentication codes and stream transmission control protocol. All above works modified the Modbus protocol frame formats by adding some extra fields.

From the literature review it understood that Modbus has been suffering from lack of security features and vulnerable to cyber-attacks. It requires to provide secure data transmission between DAQ Server and PLC using Modbus protocol. The existing methods modified the Modbus frame structure or formats. Hence they are not suitable for existing legacy systems and not support interoperability. An open solution is required for supporting existing legacy systems which shall also supports interoperability among various manufacturers' products. In this paper we designed and developed an open solution by Secure Modbus Gateway Client and Server modules to provide secure data transmission between DAQ Server and PLC.

The remaining paper was organized as follows: Sect. 2 gives the design details of the proposed Secure Gateway Modules. Section 3 describes the Test bed and testing procedure. The results were presented and discussed in same section. The paper was concluded in Sect. 4.

2 Design and Development of Secure Modbus Gateway Modules

In this section, the methodology was provided. The design and development of Secure Modbus Gateway Server and Client Modules were described. Initially we described the architecture of the modules, flow charts and algorithms. Next we explained about performance of the modules.

2.1 Design and Development of Secure Gateway Modules

The following modules were designed and developed for this research. The details are outlined in this section.

1. Secure Modbus GateWay Server (SMGWS) Module
2. Secure Modbus GateWay Client (SMGWC) Module.

The network architecture of gateway modules is shown in Fig. 1. These modules were placed in between DAQ Server and PLC as shown in Fig. 2. Instead of transferring the data between DAQ Server and PLC directly, the data was transmitted through these Secure Modbus Gateway Server (SMGWS) and Secure Modbus Gateway Client

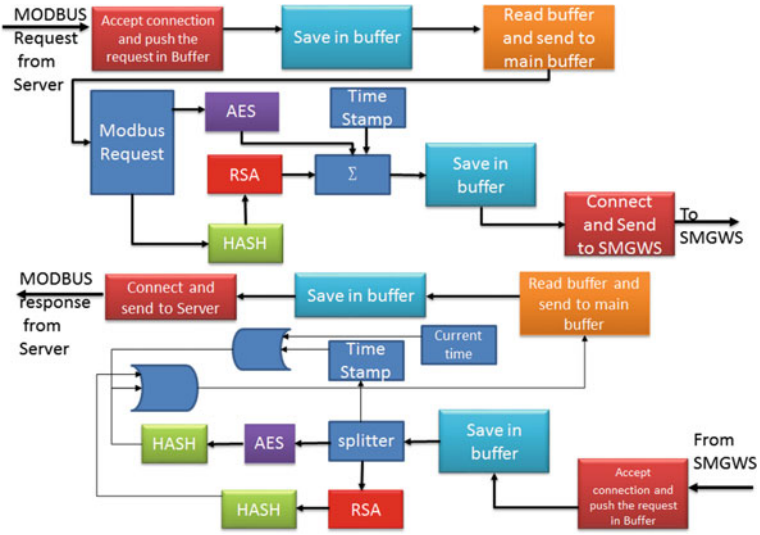

Fig. 1 Internal block diagram of Secure Modbus Gateway Modules

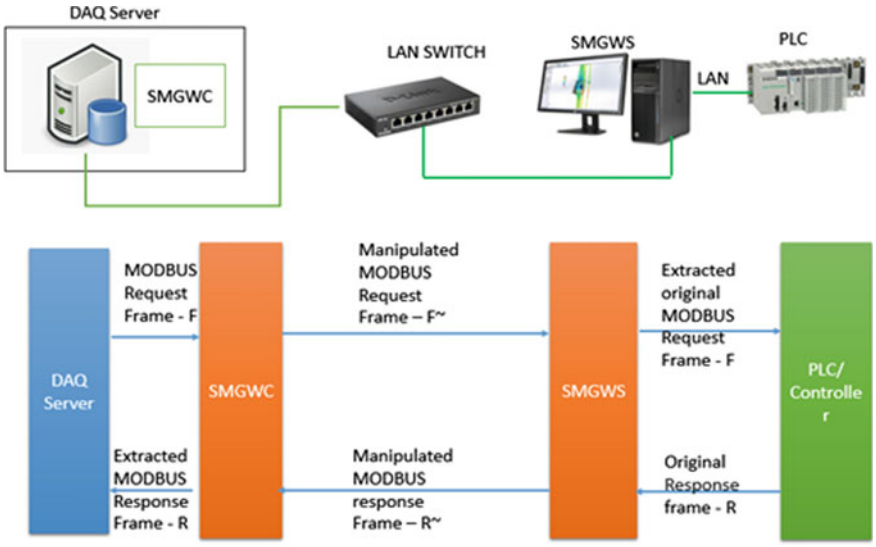

Fig. 2 Test bed with block diagram representation of secure gateway modules

(SMGWC) between Server and PLC. These modules were connected at Server end as well as PLC end. The developed algorithms were running in these modules. SMGWC module was loaded in Data Acquisition Server, where Modbus protocol was running and polling the PLC. In configuration of DAQ Server, the IP address of PLC was replaced with IP address of SMGWC. At PLC side, we loaded one computer (gateway PC) with SMGWS and connected to PLC. Using this set up, the communication was established between server and PLC through these modules. The PLC LAN port was connected directly to SMGWS module (in gateway PC) instead of connecting into the network. The SMGWC module was loaded in the same DAQ Server Computer. But it can also be loaded separately in another computer. The source and destination devices are DAQ Server and SMGWS for SMGWC module. For SMGWS module, source is SMGWC and destination is PLC controller. The modules shared RSA, AES and credentials during handshaking process. The gateway Modules were deployed with RSA 2048-bit algorithm, AES 256-bit algorithm and SHA 512 hash value for providing secure data transfer. The main steps in the module were:

1. The original Modbus request message (M_0) was encrypted with AES-256 algorithm using shared key and it was designated as M_1.
2. The hash (SHA-512) value on M_0 was calculated and designated as M_2.
3. The above hash value (M_2) was encrypted using RSA algorithm with its private key and it was called M3.
4. The M_1 and M_3 were combined with time stamp designated as M_4.
5. Connected and sent the packet, M_4 to the target device.

At SMGWS module the connection was accepted from SMGWC after verification of IP address authorization and credentials like username and password. The IP address of source was verified with saved and configured IP addresses to provide authorization. The credentials also verified for authentication of connection.

After successful acceptance of connection, the following operations were performed on the received frame.

1. The received frame M_4 will be divided into time stamp and frame M_1, M_3.
2. The current time will be calculated and compared with time in received frame for checking the freshness of the frame. If the time difference is more than configured time period, the frame will be discarded to avoid replay attacks.
3. The frame (hash), M_3 will be decrypted using RSA key and designated as M_2.
4. The frame (encrypted original Modbus frame), M_1 will be decrypted using AES key and designated as M_0.
5. The hash on M_0 will be calculated and stored in H_0.
6. The calculated hash value H_0 will be compared with hash value stored (H_1) in frame M_2. If both are equal then the frame will be sent to PLC, otherwise rejected.

These modules provided basic information security features i.e., integrity, confidentiality and non-repudiation as follows.

Integrity: The hash value (SHA-512) of the message provides the integrity of the Modbus Frame. If the packet is modified by any man-in-the-middle attacker, the

hash value will be different and the frame will be rejected at destination because of mismatch of hash values of actual message and received message at destination gateway module.

Confidentiality: Confidentiality of the message frame will be provided by cryptographic algorithms AES-256 and RSA-2048. The Modbus request or response frame packet cannot be sniffed by attacker because of encryption.

Non-repudiation: The RSA algorithm also support non-repudiation feature. The packet can be decrypted at other end with sender's public key. This ensures that the packet was sent by intended transmitter and received by legitimate receiver.

3 Results and Discussion

Performance: Initially we set up a test bed with a SCADA DAQ Server and PLC. We used HP Z4 PC as DAQ Server and Schneider M340 PLC. These two components were transferring data using Modbus protocol. A laptop was connected in the network. A Modbus simulator was loaded in this laptop. We simulated Replay attack, False Data or response Injection, False Command Injection attacks using this simulator and observed that all these simulated attacks were reached PLC and disturbed the data values as show in Fig. 3. It displays the False Data Injection attack on tank level. Next we connected another computer system and it was called as gateway PC (HP Z4) which was connected to PLC directly through LAN as shown in Fig. 2. The SMGWC module was loaded in DAQ Server and SMGWS module was loaded in this gateway PC. Modbus client module in DAQ Server was connected to SMGWC and SMGWS in gateway PC was connected to PLC. Next we simulated number of attacks for each category and observed how many attacks were passed through these

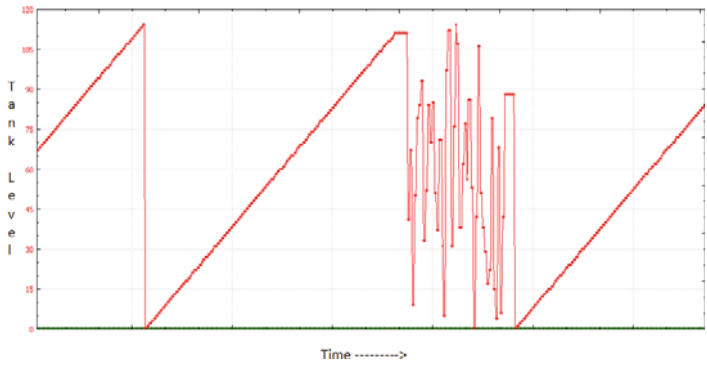

Fig. 3 Effect of false data injection on Modbus data

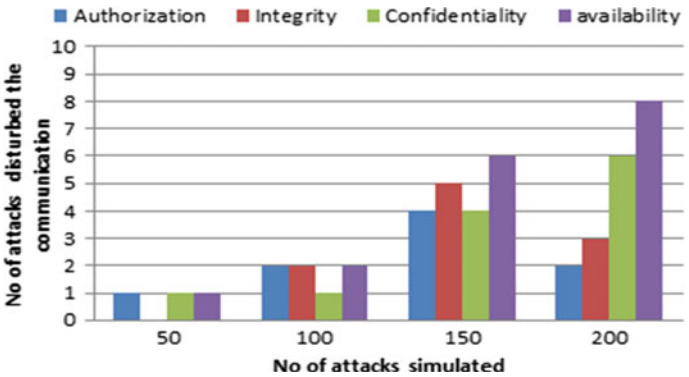

Fig. 4 No. of simulated attacks versus no. of attacks disturbed the communication

secure gateway modules and reached to PLC. Figure 4 displays the number of simulated attacks versus no. of attacks disturbed the data by reaching PLC. We simulated 50, 100, 150, 200 number of attacks and observed how many attacks were disturbed the communication. We observed that on average, 97% of attacks were blocked by these modules and only 3% attacks were disturbed the communication.

Overhead: These modules incurred 28 ms extra time delay on round trip time duration of Modbus frame to response. We calculated this time by shorting Digital Output signal to Digital Input at PLC and sent a control command from SCADA HMI. The time difference between command trigger and feedback response receive time, gave the round trip time duration.

Comparison: This solution is a new method which provides interoperability.

4 Conclusion

Modbus is most widely used communication protocol in Industrial Control Systems. The protocol has been suffering from security issues and more vulnerable to cyber-attacks. In this paper we designed and developed secure Modbus gateway Server and Client Modules to provide secure sensor data transmission between DAQ Server and PLC using Modus protocol. These modules were successfully blocked 97% of cyber-attacks. The method overheads 28 ms extra time delay on total round trip duration.

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A Micro-strip Antenna for Dual Band Energy Harvesting Applications

Arun Mohan, K. Hariharasudhan, Saroj Mondal, and Anamiya Bhattacharaya

Abstract Harvesting energy from multi-band Radio frequency (RF) signals is fast emerging as an alternative energy source for energy autonomous/IoT application where other energy sources, like solar, thermal, vibrational, etc. are absent. For realizing such a system, a multi-band radio frequency antenna capable of receiving multiple RF frequencies is essential. A microstrip antenna for scavenging ambient RF energy from two different bands of frequency is presented in this paper. A coaxial probe is used to feed the proposed antenna, and has two resonant frequencies at 1.81 and 2.37 GHz. The bandwidth achieved at 1.81 GHz and 2.37 GHz are about 60 and 70 MHz, respectively. A gain of about 1.8 dBi and 2.1 dBi at 1.81 and 2.37 GHz resonant frequencies, respectively is obtained.

Keywords RF energy harvesting · Co-axial feed · Energy harvesting · Multi-band antenna

1 Introduction

Due to the excessive use of wireless technology in all fields such as satellites, mobile phones, Wi-Fi connections, radio network broadcasting etc. it is nearly impossible to imagine the globe without wireless technology [1]. As a result, radio frequency signal energy is readily available in our environment. A major portion of these signals in an urban area emanate from mobile phones and Wi-Fi networks. These RF ubiquitous RF signals can be converted into useful form of energy [2], for supplementing/replacing battery power. RF energy harvesting technology is being widely seen as an attractive

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and low-cost alternative for powering a wireless-sensor node in places where solar, thermal, and vibrational energy sources are absent [3]. This growth is driven by the ubiquitous nature of wireless technology such as mobile phones, Wi-Fi, radio, and television broadcasting, which ensures the availability of sufficient RF energy in an urban or semi-urban environment. Each source radiates at different resonant frequencies [4]. When harvesting ambient RF energy, it is important to note that where in the frequency spectrum the RF power density is at its highest. If the bandwidth is more, the more RF energy will be available, the more energy will be able to harvest from different sources and more efficient your device will be. For battery-less operation of a device, the availability of sufficient RF energy has to be ensured. This can be achieved by harvesting energy from multiple/all RF energy sources [5]. For this purpose, broad band or multi-band antennas are essential to receive power from multiple frequencies.

Among the several antennas designed for harvesting from multiple frequencies [6–10] microstrip antennas are preferred over other antennas. Because it is well fitted with the circuit on which the energy harvesting technology is implemented. These antennas are low profile antennas and are compatible with planar, non-planar, and monolithic microwave integrated circuits (MMIC). They are easy to manufacture using printed circuit board (PCB) technology and hence are inexpensive [6]. By making changes in the patch dimensions and shape, it is possible to make the microstrip antenna to radiate at the desired resonant frequencies.

In this paper, the design, working and characteristics of a microstrip antenna for harvesting RF energy from GSM and WiFi bands is presented. The bands centered at these two frequencies are selected since they are the most commonly available radio frequency bands. The rest of paper is organized as follows: Sect. 2 introduces the proposed antenna. Section 3 discusses the bandwidth, gain and radiation pattern characteristics of antenna followed by conclusions in Sect. 4.

2 Antenna Design

The proposed antenna contains a metallic patch on a square shaped substrate. The substrate material is chosen as FR4 Epoxy since it is easily available and comparatively low cost. The dielectric constant of this material is 4.4 and dielectric loss tangent is 0.02. The dimensions of the substrate are 150 mm × 150 mm (L1 × L2). The star like shape of the patch is obtained from two pentagonal patches. The pentagonal patches are arranged at 36 degrees to each other giving the star like shape. Both the pentagonal patches are of same radius equals to 70 mm (R). The arrangement of the pentagonal patches is in such a way that at the center of each side of a pentagon merges with the apex of the other hexagon. The top and rear view of the proposed antenna is shown in Fig. 1a, b, respectively.

The proposed antenna is given excitation by means of coaxial feed with a lumped port as source to the feed. The coaxial feed is kept at a distance (d1, d2) from the

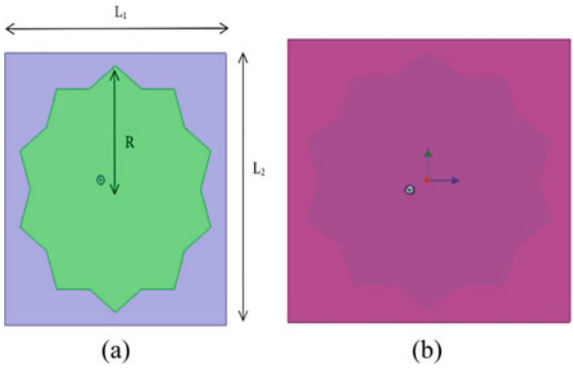

Fig. 1 Microstrip antenna, **a** top and **b** bottom view

feed in order to obtain dual band at the desired resonant frequencies. The coaxial feed is chosen because of the fact it would be easier in the fabrication point of view.

3 Results and Discussion

3.1 Bandwidth Response

The dual band microstrip patch antenna design and analysis is carried out using Ansys HFSS. The return loss characteristics is as shown in Fig. 2.

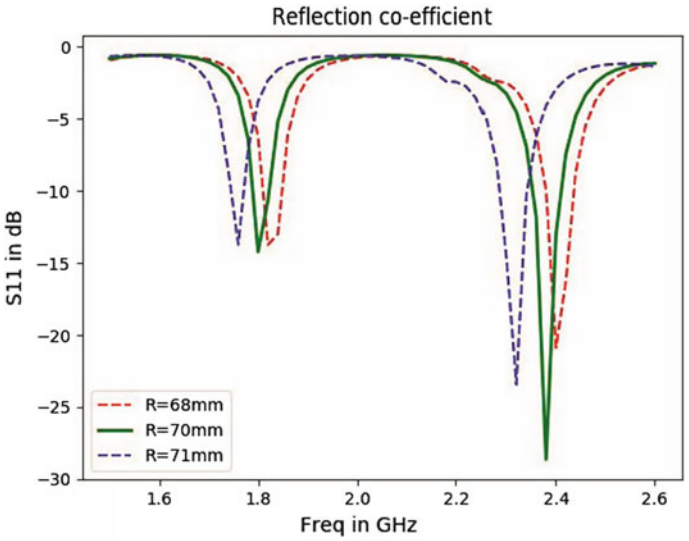

Fig. 2 Return loss response of the proposed antenna for different patch radius

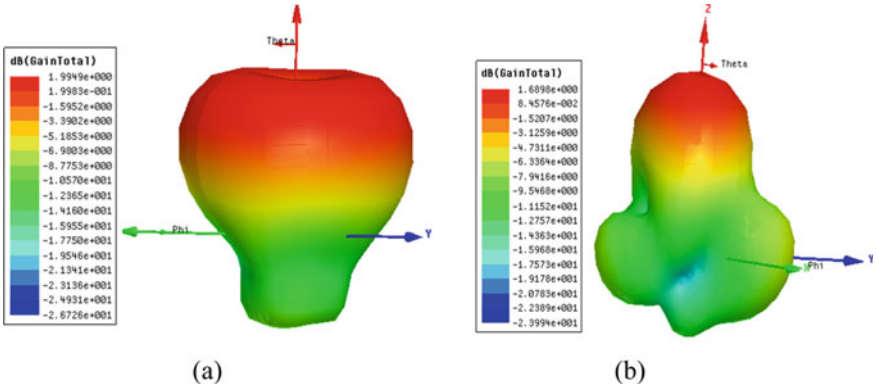

Fig. 3 3D view of radiation pattern with gain at **a** 1.8 GHz, and **b** 2.35 GHz

The return loss value at 1.81 GHz is found to be −14 dBi. The bandwidth around the resonant frequency of 1.81 is given by 0.06 GHz ranging from 1.78 to 1.84 GHz. At the second resonant frequency of 2.37 GHz, the return loss is found to be −26 dBi. The Bandwidth around 2.37 GHz is given by 0.7 GHz from 2.34 to 2.41 GHz.

3.2 Gain and Radiation Pattern Characteristics

The gain of the proposed antenna is found at both the resonant frequencies using the radiation pattern. At 1.81 GHz, the gain is found to 1.8 dBi and at 2.37 GHz, the gain is 2.1 dBi, as shown in Fig. 3a, b, respectively.

The far field radiation pattern for the proposed antenna is simulated for 1.81 GHz and 2.37 GHz and shown in Fig. 4, respectively. Plots for both the E-plane and H-plane are shown. From the radiation pattern obtained, it can be seen that the proposed antenna is a directional antenna.

4 Conclusion

A microstrip antenna for dual band RF energy harvesting applications is presented in this paper. The proposed antenna is fed using a coaxial probe. The antenna resonates at 1.81 GHz and 2.37 GHz with a bandwidth of 1.78 GHz to 1.84 GHz, and 2.34 GHz to 2.41 GHz, respectively. The antenna has a gain of 1.8 dBi and 2.1 dBi at 1.81 2.37 GHz, respectively. The energy obtained from the antenna would be more if energy harvesting is performed in places where the designed bands are widely used.

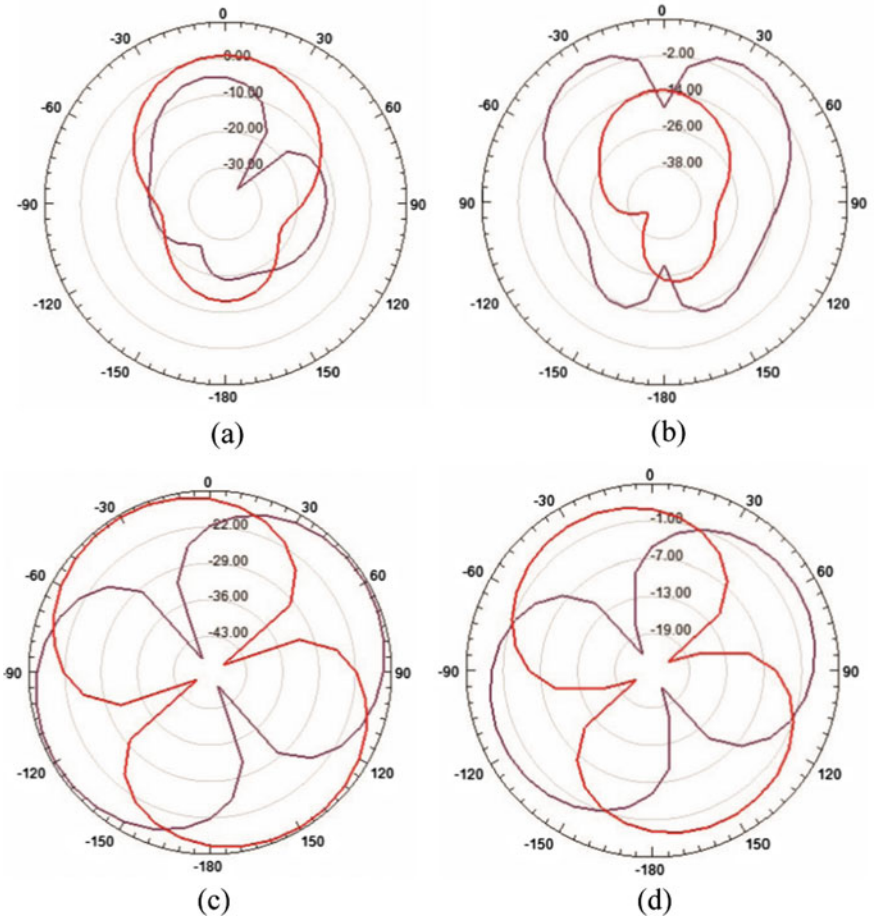

Fig. 4 **a** XY plane radiation pattern at 1.8 GHz, **b** XY plane radiation pattern at 2.4 GHz, **c** YZ plane radiation pattern at 1.8 GHz, and **d** YZ plane radiation pattern at 2.4 GHz

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Restoration of Defocused X-Ray Images with Blind and Nonblind Deconvolution for the Use in Bio-medical Application

Suhasini S. Goilkar and Dinkar M. Yadav

Abstract Prediction of the dieses and accuracy in observations on the basis of X-rays images taken for diagnosis is very important in bio-medical area. Presently the use of images in medical field is more in such areas and it also leads to creation of challenges in terms of high quality of images captured through the systems like X-rays. In addition to that, such improvement of quality of these images captured through X-rays and its associated problems remains a continuous need for medical practitioners. Image restoration of defocused images is one of the challenges in such situations as it sometimes contains blur which is considered as noise while doing the processing of captured images. In this work, removing the blur from the X-rays is considered which is one of the challenges for medical practitioners. This is done by taking the X-rays in the form of digital image and thereafter techniques of deconvolution are utilized to obtained improved quality of defocused image with restoration of X-rays. One of the unaddressed problems of non-availability of point spread function data of X-rays with respect to deconvolution with blind and the non-blind methods is considered here as an additional aspect for study. Another intention behind considering this aspect was that, it will also become helpful in the area of machine learning and medical field. In addition to this work, the analysis is also carried out using the standard parameters of such X-rays through the obtained results after processing of these images. At the end, the comparison of these methods of deconvolution is done with reference to performance parameters of X-rays.

Keywords Defocused X-rays · Deblurring · Image parameters · Restoration of X-rays · Motion and Gaussian blur

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1 Introduction

In the present digital world, use of digital images is increased drastically which is already helping the users to utilize it in many important fields like biomedical applications, security related surveillances etc. The blur as distortion and the noise mostly gets generated and becomes a primary issue in the X-rays obtained because of defocusing or movement of patient during X-ray capturing. Basically, an imaging system consists of a device which coordinates the human eye and image recorder which helps to generate a map from the three-dimensional objects onto a two-dimensional image form [1]. The extensive use of images is done in medical applications with the X-ray images for diagnosis purpose. During such X-ray image capturing process, such three-dimensional object which is a body of a patient is held between the emitting source of X-ray and two-dimensional film of X-rays. These X-rays then passes through the body of a patient and gets absorbed by the body resulting into changes in its intensity as per the body parts and final output X-ray pattern gets recorded in the X-ray film. In such captured X-ray films, distortion in the form of blur and noise remains present which many times becomes very tough to doctors to find disease problems or while ensuring perfect fitment of the medical implants. These distortions occurring during the image capturing process gets created in the form of distortions as Gaussian and motion blur [2, 3]. Hence in medical area for diagnosis purpose it becomes essential to restore and improve the X-rays as efficiently obtained outputs to increase the accuracy of diagnosis. Digitization of such X-ray films can be done and with the help of deblurring, the improved quality X-rays can be used for the diagnosis purposes.

Improvement of image quality only by image enhancement doesn't found sufficient. However, deblurring followed by image restoration is one of the promising techniques that can be used now a days. Distorted images containing blur and noise is one of the fundamental problems that is under study of most of the researchers [3, 4]. The image restoration is therefore also becoming an upcoming area in digital processing which takes a different technique to emphasis more towards improving an original X-rays from a distorted X-rays. Such image processing considers an image in the form of an input signal like photograph, X-ray image, video frames etc. that can be processed and then the reconstructed X-rays can be achieved as set of required features or constrains related to the X- rays under consideration. Distortion in captured X-ray images occurs due to many things which includes the sensor noise, wrong focusing, unwanted motions or displacements of person while capturing X-rays etc. [3, 5]. There are methods like Non-Blind and Blind techniques for image deblurring for quality improvement of images. In case of blind method, restoration of image is achieved without the prior data or information of the X-rays blur as PSF regarding Blind X-rays Deconvolution. Further about non-blind, known prior data or information is available as PSF like other deblurring algorithms takes that in to account. Therefore, such capabilities of blind and non-blind techniques, one can do the image processing as image restoration after deblurring to know the efficiency in

terms of improved quality of X-rays with accurately processed images with more precise usage in applications in the area of medical science [2, 5, 6].

2 Important Aspects of X-Rays Formation

In medical field, X-rays is one of the most popular method used by the doctors to understand the orthopedic damages and to view the positions of implants after surgical procedure. A general set up used for capturing the X-rays is as provided in Fig. 1.

Here the X-ray source emits the X-rays which gets passed through the body of a patient and gets absorbed by the body parts which changes its intensity while passing through the body parts. Such changed intensity of X-rays creates a pattern and gets recorded onto the X-ray film. Further while recording the X-rays, most of the time, the quality of X-ray image gets degraded because of the movement of person (absorber), inappropriately immitted X-rays from source, improper X-ray film holding etc.

In case of X-ray recording, the X-rays obtained gets low quality degraded records because of many reasons as improper setting of lens, improper handling of X-ray source etc. These issues in recordings then gets impregnated in the X-rays as blur [6–8]. Mostly such distortions are known as motion and Gaussian blur, out of focus, atmospheric and average blur etc. Therefore, to resolve these problems, such blur is simulated with Gaussian noise basic model as one of the effective methods [8, 9]. The noise of Gaussian sometimes also considered as normal noise which generally gets elevated from other kinds of sources like manmade and natural [9]. The noise of Gaussian in such case interrupts the gray levels. Basically, this Gaussian noise is a fluctuation in pixel values and it is characterised by random variable. A random variable probability distribution is an equation that links the values of the statistical result with its probability of occurrence. Categorization of noise is based on probability distribution. Gaussian noise that enters in the system is modelled as gaussian or normal distribution [5, 10]. The pdf of gaussian random variable is given as:

$$p(z) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(z-\bar{z})^2}{2\sigma^2}} \tag{1}$$

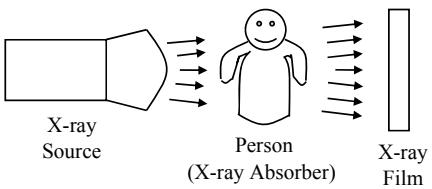

Fig. 1 General set up used to record the X-ray

This equation represents z grey levels, mean of average value of z, standard deviation and variance of z. It can further be realised in the form of probability density function bell shape curve of Gaussian noise having eighty percent approximate degradation of such digital form of X-rays.

3 Adopted Methodology

The main problem in image restoration is image denoising and image deblurring with and without noise. Deconvolution algorithms with number of iterations restores the images and PSF continually to improve them [10–12]. In blind deconvolution method sharp version of the image is restored, without knowing the source of blurring and details of the clear image. Whereas in non-blind deconvolution blurring source and clear image is known while restoring sharp version of image. In practical approach Blind and Non-blind deconvolution is more suitable to restore the image [13–17]. In this work, the steps used in these methods of deblurring are shown in Fig. 2.

This work was carried out with the objective that the evaluation of these X-rays can be done with mean square error, signal to noise and peak signal to noise ratios. In addition to it, the performance with deblurring methods was also intended as the signal to noise ratio is considered as a common metric to understand the performance. It is well recognized that the high values of such signal to noise ratio is a good sign of deblurring [18, 19]. The mathematical expression of it is given as,

$$SNR(dB) = 20 \log \frac{RMS\,signal}{RMS\,noise} \tag{2}$$

Further the expression to get the mean square error can be considered which gives the idea about denoising accuracy. The indication of low values in such case highlights

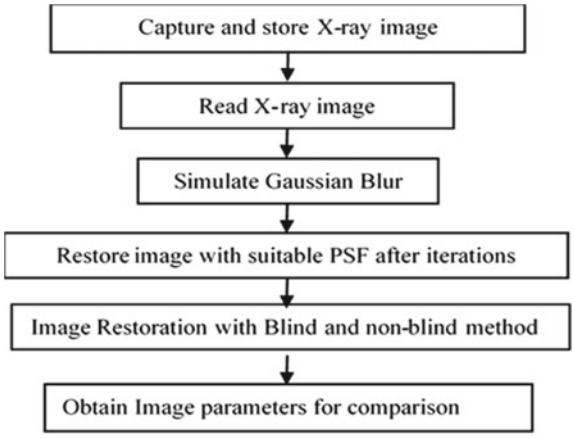

Fig. 2 Steps used for blind and non-blind deconvolution

the fact that the nearness of deblurring signal to original signal and in most of the cases considered as better denoising achievement [19]. The mathematical expression for it is given as,

$$MSE(dB) = \frac{1}{mn} \sum_{i=0}^{m-1} \sum_{j=0}^{n-1} [I(i-j) - k(i-j)]^2 \tag{3}$$

In addition to that, peak signal to noise ratio matric alike signal to noise ratio having high values also shows the sign of more precise denoising. The mathematical expression in this case is given as,

$$PSNR(dB) = 10 \log_{10} \left(\frac{\max j^2}{MSE} \right) \tag{4}$$

4 Implementation Details

This work under consideration is done by adopting the methodology which is used for denoising the blurred X-rays with non-blind and blind methods. Performance of the proposed method is compared with considering the constant and space varying gaussian blur. First the X-ray images are captured and thereafter the X-rays in digital image form are transformed in the grayscales and resizing process is performed as the major restrictions are the size and blur in the image at the time of deblurring [10, 20–22]. In this process the original X-ray image is resized in pixel size of 255 × 255. Constant blur with variance as 2.3 is used and image parameters are obtained as shown in Table 1.

The restored images after applying blind and non-blind deconvolution with constant blur variance value 2.3 are shown in Fig. 3 and comparison parameters are shown in Fig. 4.

In the similar manner, other image is taken and image parameters are obtained as shown in Table 2.

The restored images after applying blind and non-blind deconvolution with space varying blur, variance varies from 1.1 to 3.4 are shown in Fig. 5 and comparison parameters are shown in Fig. 6.

Table 1 Image parameters (Hip Joint A) in decibels with deblurring methods

Image Type	PSNR	MSE	SNR
Original X-ray image	38.183	20.28	16.559
Constant Gaussian Blur	36.066	23.269	14.483
After blind deconvolution	34.006	13.231	18.129
After non-blind deconvolution	33.976	18.530	15.132

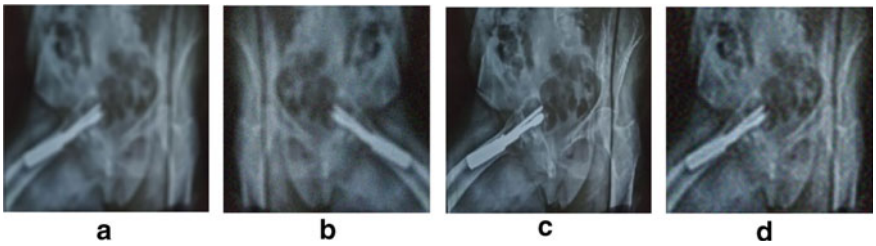

Fig. 3 **a** Original digital X-ray (Hip Joint A), **b** Blurred X-ray, **c** Blind X-ray, **d** Non blind X-ray

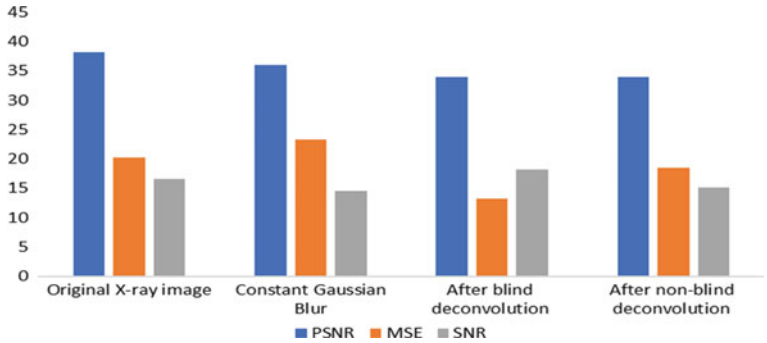

Fig. 4 Comparison of standard parameters with X-ray (Hip Joint A) images

Table 2 Image parameters (Hip Joint B) in decibels with deblurring methods

Image Type	PSNR	MSE	SNR
Original X-ray image	39.103	19.210	16.237
Space varying Gaussian Blur	37.061	22.212	13.783
After blind deconvolution	34.906	14.631	17.729
After non-blind deconvolution	34.006	17.053	14.624

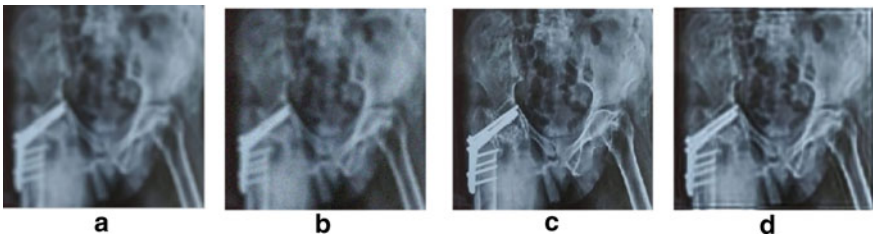

Fig. 5 **a** Original digital X-ray (Hip Joint B), **b** Blurred X-ray, **c** Blind X-ray, **d** Non blind X-ray

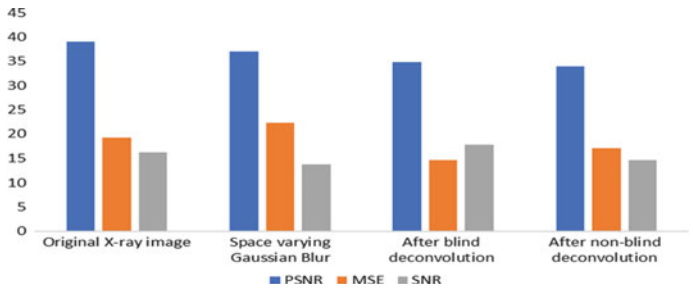

Fig. 6 Comparison of standard parameters with X-ray (Hip Joint B) images

5 Results and Discussion

For this research work and study, as an input, these defocused X-ray Hip Joint images are considered for reconstruction. Additionally, the Gaussian filter with constant and space varying variance is used to blur the original X-ray Hip Joint images. With the flowchart given above, the deconvolutions as blind and non-blind are implemented individually. Thereafter, standard parameters for performance are calculated in decibel and these are provided in the tabulated form and also given in the graphical form for more understanding of the performance. The results of this study reveal that the signal to noise and peak signal to noise ratio in blind case is higher than non-blind case. Further the mean square error is lower in blind case which is an indication of minimum error.

6 Conclusion

To eliminate the blur from the X-rays is the main aim in this implementation which is achieved with the help of restoration of blurred X-ray Hip Joint images using the deblurring methods. The output images obtained with these methods reveals that the blind case is more promising for experimental work and simulations. In addition, it has been observed that blind case gives good results towards restoration of X-rays from the blurred X-rays. The calculated standard parameters with space varying blur and constant are explored and provided in the tabulated and graphical form which gives better understanding of obtained results.

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Smart Intrusion Detection System Using Deep Neural Network Gated Recurrent Unit Technique

Sugandh Seth, Gurwinder Singh, and Kuljit Kaur

Abstract *Background*: The advanced cyber-attacks have led to the dire need for developing smart Intrusion Detection Systems. The existing approaches have not considered the temporal relationship within traffic into account, resulting in poor performance, particularly when low-frequency attacks happen. *Aims*: This paper emphasizes techniques and strategies to enhance network IDS (Intrusion Detection System) performance. *Method*: Considering time-related intrusion characteristics, this paper proposes a novel approach comprising a Deep Neural network with Gated Recurrent Units that can capture the abstracted time series of events from the underlying network. For experiments, the latest CIC-IDS 2018 dataset is used. *Results*: CIC-IDS 2018 dataset gave 96.3% overall accuracy rate and recall rate of 97.8%. Comparing it with the existing systems, GRU is an effective and simple upgrade to Long Short-Term Memory (LSTM).

Keywords Please intrusion detection system · Deep learning · Gated recurrent unit

1 Introduction

The rise of connected lifestyles has exponentially increased computer networks across the globe. These networks are prone to network intrusion and attacks by hackers trying to bypass the security mechanism for breaking into the system. Intrusion detection is the precise recognition of several such threats that may damage or undermine an information system. So, an Intrusion Detection System is deployed to prevent any such attack. The key aim of an IDS is to identify any unusual behavior in the system immediately [1, p. 68]. Based on the detection criterion, IDS are categorized as signature-based or anomaly-based. Anomaly-based IDS defines network

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intrusions by scrutinizing and classifying activities as either normal or malicious. In contrast, a signature-based Intrusion detection system classifies the traffic by comparing it with known attack patterns [2, p. 98]. With the increasing complexity of today's network structures, complications and diversification in intrusion methods make accurate detection by IDSs more challenging. Artificial intelligence using machine learning and deep learning techniques has been used to devise advanced detection technologies to tackle this. Significant research is proposed based on machine learning and deep learning techniques like Support Vector Machine, K Nearest Neighbor, Random Forest, ANN (Artificial Neural Networks), and Deep learning methods for IDSs. Mora-Gimeno et al. [3] proposed a novel IDS that integrates multiple detection techniques or partial views using a deep MLP neural network. Rathore et al. [4, p. 3497] proposed a real-time Intrusion detection system consisting of four layers: capturing layer, filtration, and load balancing layer, Hadoop layer, and decision-making layer. Pradeep Mohan [5] proposed hybrid-based intrusion detection system using genetic algorithm and fuzzy classifier. But the existing approaches do not take the temporal relationship within traffic into account, failing to classify traffic distribution correctly and resulting in reduced detection performance and higher false alarm rates in existing models, particularly when low-frequency attacks happen.

This paper proposes a deep learning-based IDS using the Gated Recurrent Units technique to enhance an intrusion detection system's learning and detection ability. The significant contributions by the paper are as follows:

- An IDS based on a deep neural network with GRUs as main memory units and Multilayer perceptron for network intrusion identification.
- A Detailed performance analysis of the proposed framework using the new CIC-IDS 2018 dataset.
- The proposed method using GRU outperforms methods using LSTM (Long Short-Term Memory) as a component for RNN's memory unit.

The rest paper is divided into the following sections for easy organization and understanding. Section 2 covers the studies related to our work. Section 3 discusses the research methodology used for experimentation. Section 4 discusses the results obtained, and Sect. 5 concludes the paper with a summary.

2 Related Work

Zhou et al. [6], proposed CFS-BA ensemble-based model. The ensemble combined the results from c4.5 classifier, Random Forest (RF) classifier, and Forest by Penalizing Attributes (Forest PA) using the Average of Probabilities (AOP) rule. They claimed to have achieved 99% accuracy for NSL KDD and CIC-IDS 2017 Dataset.

Kumar et al. [7, p. 1416], proposed rule-based intrusion detection system using the UNSW-NB15 data set. They claim that the proposed approach achieved 84.5% MFM, 90.32 ADR, and 2.01% FAR.

Ma et al. [8, p. 1701], proposed a model using spectral clustering and deep neural networks. The model was evaluated using KDD-Cup99, NSL-KDD datasets, and a sensor network. They claim that the proposed approach has better attack detection accuracy in comparison to backpropagation neural network (BPNN), support vector machine (SVM), random forest (RF), and Bayes tree models.

Jin et al. [9, p. 101984], proposed IDS using the time efficient LightGBM classifier by Microsoft. The model was evaluated on three datasets, namely KDD99, NSL-KDD, and CICIDS2017. The proposed approach achieved time efficiency using parallel mechanisms and simplification of preprocessing.

Zhong et al. [10, p. 187], proposed Big Data-based Hierarchical Deep Learning System (BDHDLS) that used behavioral and content features to understand both network traffic characteristics and the information stored in the payload. This strategy increased the detection rate of intrusive attacks in comparison to the previous learning approaches.

All the existing approaches do not consider the time-related intrusion characteristics, resulting in a reduced attack detection rate in present models. To overcome the above gap in research, we propose a recurrent neural network with gated units that can effectively capture the underlying series of events during an attack.

3 Research Methodology

The study follows the traditional machine learning protocol. (1) data collection, (2) data preparation, and (3) training the model (4) evaluating the model performance.

3.1 Data Collection

The latest CIC-IDS 2018 was used for the experiments. CIC-IDS 2018 dataset is published by Canadian Institute for Cybersecurity and by Communications Security Establishment. The dataset is massive, and it reflects traffic for 14 modern-day attacks. CIC-IDS dataset has approximately 16.2 million records and 80 features [11, p. 643].

3.2 Data Preparation

In this phase, the dataset was pre-processed for further processing. The null values were dropped, reducing the dataset to 16.1 million rows. The CIC-IDS 2018 dataset comprises 14 modern-day attacks, were relabeled into two categories: Benign and Attack. As CIC-IDS 2018 is an imbalanced dataset with 2,746,934 attacks and

Table 1 Attack and benign samples before and after pre-processing of data

	Before pre-processing	After pre-processing
Attack	2,746,934	2,746,934
Benign	13,390,235	2,746,934

13,390,235 benign samples, the normal traffic samples are under-sampled to decrease the imbalance ratio to an acceptable level, as given in Table 1.

3.3 Training the Model

Geoffrey Hinton in 2013 introduced the deep learning concept, and since then, it has been widely studied and used. Researchers have achieved successful results in weather forecasting, image recognition, disease detection, and natural language processing using deep learning methods. With high levels of non-linear structure, deep learning-based models possess exceptional learning ability when processing complex data. The rapid technology and parallel computing development have also paved the way for a stronger hardware foundation to support deep learning algorithms. There are numerous deep learning approaches [12] used in cybersecurity, namely: deep neural network, convolutional neural network, recurrent neural network (RNN), deep autoencoders, restricted Boltzmann machine.

Developments in deep learning theory brought a rapid development phase for RNN. RNN is now successfully used in many spheres like speech, security, handwriting recognition etc. The use of a hidden layer for circulating information is RNN's primary feature. It allows the system to remember and recall previously processed data when required, transforming into a structural advantage in time-series information processing. Since many intrusion activities can be linked to events from a particular time series of the concerned network, RNN is considered the right fit for IDS.

Recurrent Neural Network

Traditional neural networks feature a unidirectional data flow, wherein data moves from the input to the output layer while passing through the hidden layer. But RNN works with a different principle. It remembers and uses the information processed at a particular time for calculating values at other instances. For example, it uses data for time t to calculate for time $t + 1$, $t + 2$, and others. In an RNN, the input data to the hidden layer combines the upper layer's output and the same layer's output at the last point of time.

The basic architecture of the recurrent neural network is given in Fig. 1. By unfolding in time, RNN can be used to form a complete network with {i0, i1, i2, …, $it - 1$, it, $it + 2$, …} as the input set, and {O0, O1, O2, …, $Ot - 1$, Ot, $Ot + 2$…} as the output set. Similarly, {hi0, hi1, hi2….$ht - 1$, ht, $ht + 1$, …} is used as input set and {ho0, ho1, ho2, … $hot - 1$, hot, $hot + 1$, …} is used as output set for the hidden

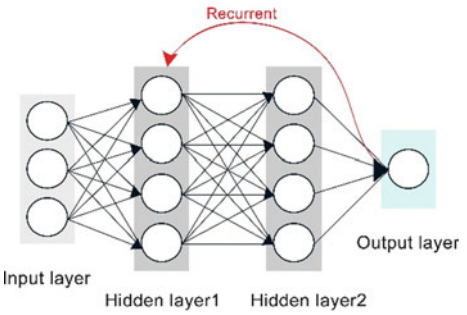

Fig. 1 The architecture of recurrent neural network

layer. W1, w2 denotes weight matrices from input to hidden layer, hidden to the output layer, W3 within the hidden layer, respectively [13, p. 48704]. In Recurrent Neural Network, the most vital jobs are completed by the hidden units. Data flows unidirectionally from the input to the hidden layer. Then, the interconnected and self-connected hidden nodes allow for complete information exchange.

Recurrent Neural Network with Gated Recurrent Units A novel memory cell, GRU has been effectively proposed for and used in numerous applications. This unit is a simplified and improved form of Long Short Term Memory (LSTM) and provides performance comparable to the latter. LSTM is widely used to model chronological sequences.

The hidden unit of an RNN is its most crucial part as it makes the job of forgetting or remembering specific information. Hochreiter and Schmidhuber proposed LSTM that offered a good implementation with numerous improved variants. Figure 2 shows a common LSTM and GRU structure. GRU, in comparison to LSTM, has a simplified approach. GRU has lesser gates than LSTM because of no cell state. Also, it combines forget and input gates into the update gate. This accounts for a simpler GRU structure than LSTM with lesser parameters that allow for better convergence and performance. Based on this, GRU showed great benefits in the following experiments.

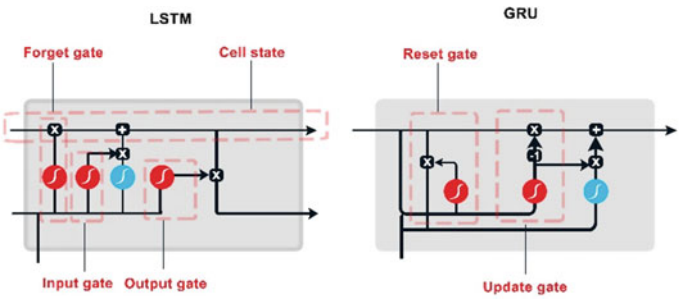

Fig. 2 Structure of LSTM and GRU

4 Results and Discussions

CIC-IDS 2018 dataset was used for all the experimentation. A 10-fold cross validation was used to decrease the variability of the outcome due to random generation of training and test samples. The proposed system was implemented using keras library in python programming. The experiments were performed on the AWS cloud. The configuration used for the AWS instance is given in Table 2.

CIC-IDS 2018 is a realistic dataset with latest attack samples. Large number of attacks and the skewness of the dataset makes it quite challenging to be classified correctly. Thus, the evaluation of the proposed method is done using various optimizing metric considering Accuracy, Recall, Precision, and F-Measure. These metrics are calculated using the following Eqs. (1–5)

TP—True positive

TN—True Negative

FP—False Positive

FN—False Negative

$$Accuracy = \frac{TP + TN}{TP + FN + TN + FP} \tag{1}$$

Accuracy is the percentage of samples correctly predicted as benign and attack.

$$Percision = \frac{TP}{TP + FP} \tag{2}$$

Precision is the percentage of correctly classified samples of attacks out of all the samples classified as attacks.

$$Recall = \frac{TP}{TP + FN} \tag{3}$$

Recall is the percentage of samples correctly classified as attacks out of all the attack samples.

Table 2 AWS instance configuration used for experimentation

Hardware	Properties
VCPU	32
Platform	Amazon Linux (Version 31.0)
Memory	256 GB
Internal storage	24 * 1980 GB
Network performance	25 GB

$$\text{Specificity} = \frac{TN}{TN + FP} \tag{4}$$

Specificity is the percentage of samples correctly classified as benign out of all the benign samples.

$$F - Measure = 2 * \frac{Precision * Senstivity}{Precision + Senstivity} \tag{5}$$

In the experiment the hyperparameters used are: Number of Layers, Model, Batch Size, Sequence Length, Number of Epochs and Learning Rate. The optimal values of the hyperparameters are given in Table 3.

The proposed deep neural network's performance is given in Table 4. As evident from the given results the performance of the classifier is good. The precision and recall rate hit a realistic value of as much as 97.78% and 96.37%, respectively. Further evaluating our proposed system's performance, a comparison is made between our proposed model using recurrent neural network with gated recurrent units and recent work [14] using a deep neural network with Long Short-Term Memory (LSTM) is done in Table 5.

It is evident from the above results in the table that our proposed model outperforms the existing model using LSTM. Further, the methodology used in both approaches is compared in Table 6.

Table 3 Hyperparameters used for RNN with GRU

Name	Value
Number of layers for RNN	3
Model of RNN	GRU
Batch size	32
Sequence length	25
Number of epochs	200
Learning rate	0.001

Table 4 Evaluation metrics for the proposed model

Model	Accuracy	Recall	Precision	Specificity	F-Measure
RNN with recurrent gated units	96.37%	97.84%	97.78%	95%	96.32%

Table 5 Comparison of proposed RNN with existing deep learning model using LSTM

Models	Sensitivity (%)	Accuracy (%)
Deep learning method using LSTM + AM reference	96	96.2
Proposed model Recurrent neural network with gated recurrent unites	97.84	96.37

Table 6 Comparison of the methodology of the proposed approach with an existing approach

	Reference	Proposed
Technique used	Deep learning method using LSTM + AM reference	Deep neural network with gated recurrent units
Dataset used	CIC-IDS 2018	CIC-IDS 2018
No. of samples used	2 million random samples	5.5 million samples
Skewed Dataset	Used SMOTE and under sampling	Used under-sampling of normal traffic

5 Conclusion

In this paper, we have proposed an advanced Intrusion Detection System. The new model employs a deep neural network model, combining GRU and MLP (Multi-layer Perceptron) as a primary memory unit and network intrusion identification unit. CIC-IDS 2018 dataset was used for the model's performance evaluation. The IDS was trained with deep learning method with GRU to capture the underlying sequence of events during an attack effectively. And, using CIC-IDS 2018, well-known dataset, proved the system's better performance over others. The model achieved a 96.3% overall accuracy rate and 97.8% recall rate. For comparison, the paper compares experimentation with GRU and LSTM. As a result, combining MLP with GRUs surpasses the performance of detection methods published recently.

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Efficient Node Placement Approach in Fog Computing Environment Using Machine Learning Model

P. Prakash and V. Sakthivel

Abstract The evolution of fog computing plays a vital role in the field of computing paradigms. The fog computing alone cannot do all the processes so that to be interlinked with cloud computing. One of the significant drawbacks in the fog computing environment is performance degradation, which occurs due to fog device placement. The improper placement of fog nodes leads to delays concerning the execution and response time due to the fog application's critical nature. So, the placement of fog devices plays a vital role in improving the Quality of the Service (QoS) to the user. The proposed method uses a machine learning technique to place the fog node. The paper evaluates the proposed approach using the iFogSim simulation environment and concludes that the proposed method has a better performance ranges from 15 to 50%.

Keywords Fog computing · K-means algorithm · Quality of service (QoS) · Cloud computing

1 Introduction

The growth of computer communication, infrastructure facilities provided by the cloud computing leads to more than 50 billion Internet of Things (IoT) devices in the year 2025. Cloud computing [1] should be used as infrastructure for deploying and hosting the Internet of Things (IoT) applications. A large volume of IoT devices is distributed across various locations, but the cloud environment is geographically integrated, so the problem of, the latency and the congestion of the network in the cloud will increase drastically. Fog computing was introduced to overcome these concerns. Figure 1 depicts fog computing architecture. Fog computing [2] also is a part of distributed computing, where the cloud data centers and the IoT devices are connected in hierarchy manner.

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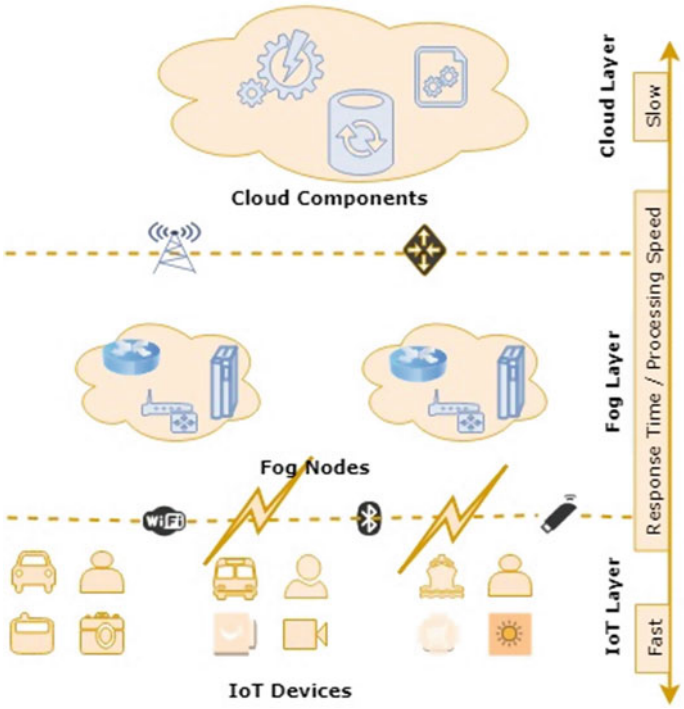

Fig. 1 Fog architecture

Fog architecture pulls the cloud's various services into the edge of the system or the network. The change in the architecture helps to reduce the latency, and the congestion is also reduced drastically which improves the Quality of Service (QoS). Fog nodes are commonly physical devices connected in different hierarchical levels of the Fog computing environment. The networking devices such as gateways, switches, routers, set-top boxes, and proxy servers are furnished with computational services that can act as fog nodes. Fog nodes are resource constraints because of their physical structure and the node deployment. Nodes are heterogeneous due to the capacity of an execution environment. The placement of these fog nodes is challenging because of less guidance and no proven research in the placement strategies. The remaining sections are organized as related works, proposed architecture followed by experimental setup and result analysis.

2 Related Works

The Internet of Things (IoT) needs mobility, location awareness, and low latency. Fog Computing provides an optimal solution for this by connecting the cloud computing

paradigm to the edge of the internet and making the distance lesser. The main problem was determining the fog node sites and the scale of each fog node. The fog node's resource was estimated based on the density peaks [3] by identifying the fog node location sites. The proposed method introduced one feature called time-sensitive, which makes an algorithm more robust and adaptable. Results of the experiments ratify that their algorithms were ineluctable to NP-Hard problems but low time complexity.

Sarkar et al. [4] proposed a fog computing paradigm which involves latency application demands. They mathematically characterized the fog computing network in terms of service latency, cost, power consumption, and putting it in a real-time environment of highly interconnected devices thereby checking its performance. Results were proven that fog computing surpasses cloud computing whenever there is an increase in demand for real-time service applications. But in situations where there are more claims for low-latency arduous applications, fog computing becomes an overhead compared with cloud computing.

Aazam et al. [5] described that the data generated by different devices are of different types with discrete frequencies. Latency sensitive services, such as healthcare and emergency rescue operations, require immediate responses. It is also essential to decide what kind of data can put in the cloud without it being a burden to the core network and the cloud. Fog resembles a bridge between IoT nodes and the cloud. Its principal endeavors involve data filtration, pre-processing, security measures, and management of resources. The fog node deals with mobile nodes and IoTs, which requires different objects and devices with connectivity fluctuations. There is a scope for uncertain abdication since any object or device can quit the utilization of resources at any time. All these factors should be considered and evaluated using CloudSim tool kit.

The design of efficient applications in fog computing is a highly challenging task because of the heterogeneity nature. EmuFog [6] is a framework that has been custom-made for fog computing. It is an extensible simulator that enables the design and implementation of fog computing infrastructure right from scratch. EmuFog empowers its analysts to design a network topology based on the use cases, install fog computing nodes into the existing network topology and run Docker-based applications into EmuFog. It also provides an extensible sub-module to integrate with various network topologies. The efficiency and scalability of EmuFog evaluated with the help of simulated network topologies.

Aazam et al. [7] stated that there is an increase in the importance of the Internet of Things (IoT). The standard storage infrastructures cannot handle the amount of data that is going to be generated by these devices. So, the integration of cloud computing with IoT becomes essential and referred to as a cloud of things. The main challenge was the data storage. The data must be trimmed, filtered, and only the necessary data must be stored. Pre-processing of data should be carried out using a Smart Gateway, accompanied by an Intelligent Fog Network. Authors introduced various components such as delay, jitter, and synchronization delay to test the fog node efficiency.

Mahmud et al. [8] said that fog computing tries to offer cloud-like service at the edge of a network. The challenges for applying the placement in a fog environment

include the distributed, hierarchical and heterogeneous nature of the computational instances. The deployment of applications to their compatible fog instances based on user expectations enhances the Quality of Experience (QoE). They proposed a QoE-aware application placement policy that prioritizes the placement of applications based on the user expectation. It also calculates the capabilities of fog instances concerning its current status. It also places them in such a way that QoE is maximum in resource consumption, service delivery, and utility access. They used iFogSim for the evaluation, and the results suggested a significant improvement in the resource affordability, data processing time, and service quality and network congestion.

Taneja et al. [9] mentioned that Fog computing minimizes the service latency and average response time in applications and that it is an adjunct to cloud computing towards the network edge. They said that fog computing enhances user experience by doing so. Even so, there was uncertainty about where the service should be placed and run to give maximum efficiency. Their motive was to develop a resource-aware placement of a data analytics platform that can adapt to the situation and deploy the analytic platform to either run on the cloud or in the fog. By doing so, it reduces the response time for the user as well as the network costs.

A neural network-based [10] fog computing proposed integrating sparse resources and forming a dynamic pool of resources to improve resource optimization. They used a reward and punishment mechanism for resource allocation from the resource pool. Their method improves the working efficiency and reduces the SLA violation rate in fog computing models.

3 Methodology

The proposed architecture has four different layers, the layers differentiated with respect to the hierarchy of the network model. Figure 2 represents a different layer in the proposed architecture.

Sensor Tier: The Smart Sensor Nodes (SSN) occupy the bottommost layer by forming a mesh network in accordance to the 6LoWPAN protocol. SSN consists of actuators and sensors which sense and transmit environmental data to its immediate upper layer called the edge layer. The upper layer can instruct the actuator to perform an action. There is a random uniform distribution among the SSN. Let us take a smart city example, over there hundreds of network devices belonging to different domains are deployed all across. Networks are coordinated with the help of Coordinating Device (CD). Coordinating Device can act as an Access Point in WiFi networks.

Edge Tier: CDs communicate their data to the Internet to execute the corresponding application, which is taken care by the Task Specific Gateways (TSG) or IoT Gateway (IG). CDs can be connected to at least either one of TSG or IG. A TSG is a wireless device and heterogeneous i.e. it supports multiple technologies of the CDs. A TSG can be interconnected using an IG or a direct interconnection is possible if two TSGs are in range and have a common technology between them.

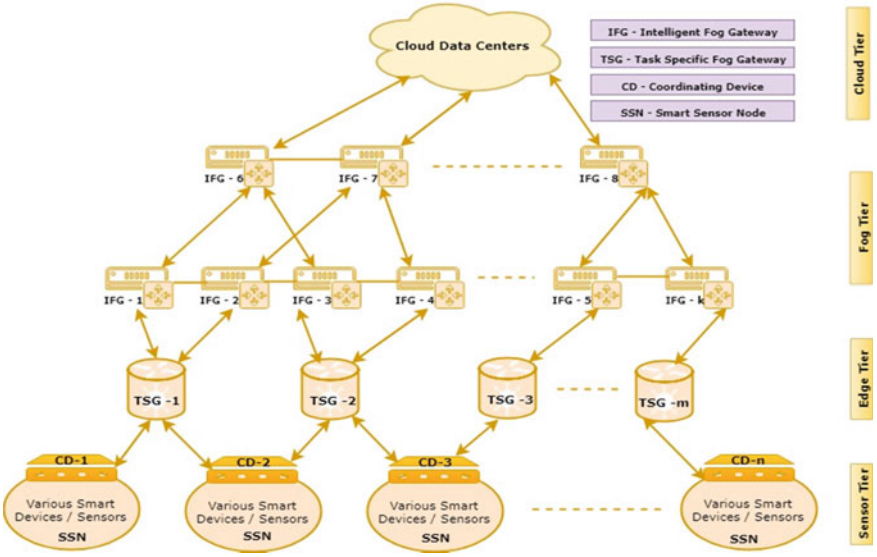

Fig. 2 Proposed architecture

The data given by the CDs are routed to respective IGs. Each IG sends the data to the upper layer.

Fog Tier: This tier is composed of devices which temporarily store the received data, process and analyze it. The devices like switches, routers, access points and gateways are deployed. SSN mobility is supported by these fog computing devices. IFG (Intelligent Fog Gateway) receives data from CDs. Latency based and real time data analysis applications are run on a fog layer. The nodes in the fog are placed within the IG in a geographic specific manner. The IFGs have features like load balancing, resource management and service management of the IGs.

Cloud Tier: Cloud is the top most tier where all the processing of the enormous amount of data takes place with the help of data centres. A data centre has a very powerful connection both in terms of speed and bandwidth to the internet and has multiple physical servers. Each IG has a wired network connection to a cloud data centre.

The proposed method uses gateways to deploy fog nodes. These gateways collect the data from different smart devices, but do not perform any kind of pre-processing or data analytics. So, the gateway is modified as Intelligent Fog Gateway (IFG) which helps to perform the fog node placement. The fog nodes can be placed in a gateway such that it can takes huge amount of data with minimum service delay. Figure 3 shows the workflow of the proposed fog node placement strategy.

The proposed method reduces the network cost because of the minimal number of fog nodes. The Intelligent Fog Gateway takes topology as an input which represents a set of nodes (gateways) and the number of fog nodes. The topology can be represented as a graph G (V, E) where V denotes a set of gateways and E represents a service

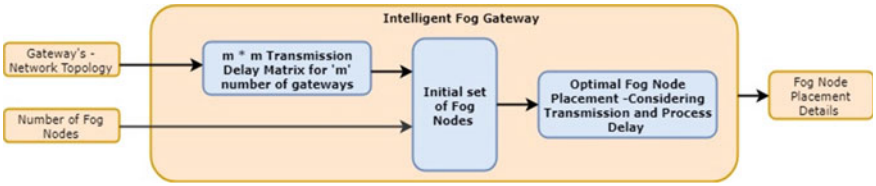

Fig. 3 Fog node placement—workflow proposed

delay. From the topology, a delay matrix can be formed. Based on the delay matrix, the initial set of fog nodes is identified. The delay between each gateway and the fog node will be computed as "1" if the service delay is minimum or else "0". After that, a new centroid will be considered and then the delay will be recomputed again by applying k-means algorithm. Finally, Intelligent Fog Gateway (IFG) IFG finds 'f' number of fog nodes with its location in a network model to improve the Quality of Service (QoS) with respect to the service delay.

Input: List of fog nodes and the transmission delay for each nodes
Output**:** Node placement list
Procedure*:* list FogNodePlacement(list fogNodes,list nodesTransmissionDelay)
Generate list of fog nodes
For each node
Assign transmissionDelay
End for
Randomly group the nodes in to k different cluster (K)
Assume two centroids C1 and C2
For each clusters in list do
For each fog node Fn in the cluster - compute Euclidean distance
If old_value == new_value
Stop the iteration
Else
Add the fog node Fn into the new cluster /update the cluster
End for
End for
For each clusters
Arrange the fog node in descending order associated with transmission delay.
End for

4 Experimental Setup and Result Analysis

The experiments were carried out with the help of the iFogSim simulation tool, on Ubuntu 20. 10 LTS with Intel(R) Core (TM) 10th Generation i9 processor 40 GB RAM server. The various fog computing network-related scenarios [11] were

tested with the iFogSim simulation tool's help. The fog devices' attributes and the transmission delay between the various devices are mentioned in Tables 1 and 2.

The simulation carried three different applications with the configuration mentioned in the previous tables. Each application had its own CPU, the network's capacity, and arrival time of each application into the fog environment. The application configuration was listed in Table 3.

The proposed algorithm was deployed in iFogSim with three different fog computing application configurations which was mentioned in Table 3. The execution time of these three applications was simulated with the mentioned configuration. The traditional algorithm first come first serve execution time was compared with the proposed algorithm and the same was depicted in Fig. 4. The proposed algorithm outperforms the execution of each application.

The response time of each application was simulated and compared with the traditional approach. The proposed algorithm performed well compared to the traditional algorithm called first come and first serve. The same depicted in Fig. 5.

Table 1 Comparison table of different models fog devices attributes

Parameters	Cloud device	Gateway	Mobile device	Sensor
Primary memory—storage in GB	15,000	350	64	0
Secondary memory—RAM in GB	256	32	8	0
Upload bandwidth	10,000	10,000	1000	1000
Download bandwidth	10,000	10,000	1000	1000
CPU (MIPS/GHz)	64,000/140	2400–7000/2.4	1000–2400/1.6	0

Table 2 Transmission delay details

Source device	Destination device	Network link latency in milliseconds
Primary memory—storage in GB	15,000	0
Secondary memory—RAM in GB	256	0
Upload bandwidth	10,000	1000
Download bandwidth	10,000	1000
CPU (MIPS/GHz)	64,000/140	0

Table 3 Application configuration

Application details	MIPS	Network capacity in Kbytes	Arrival time in milliseconds
Fog_Application_1	2000	2	1000
Fog_Application_2	10,000	750	50
Fog_Application_3	50,000	7500	10

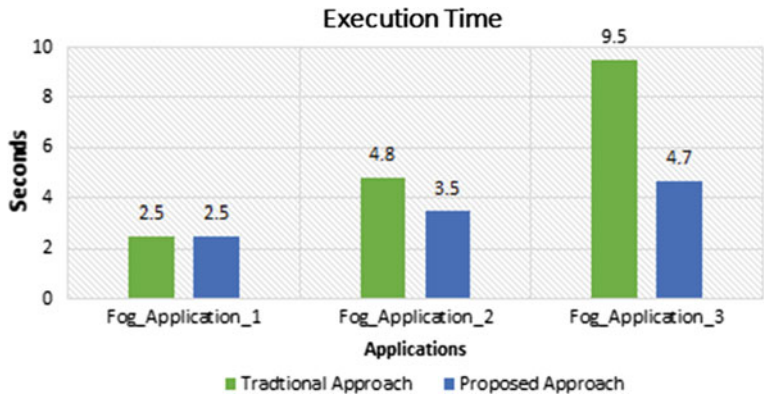

Fig. 4 Execution time

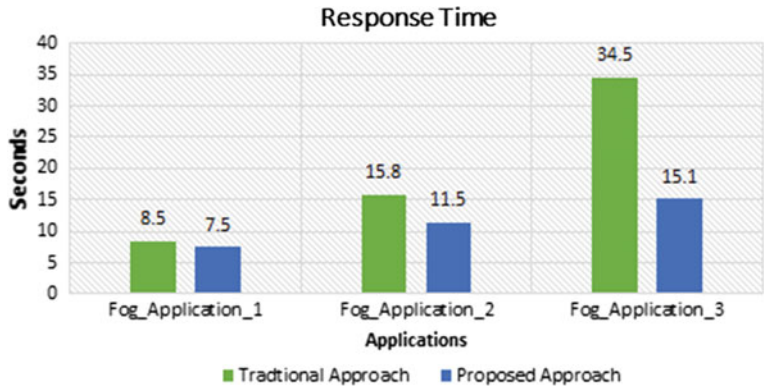

Fig. 5 Response time

5 Conclusion and Future Work

The detailed study on the fog mode placement algorithm was carried out and a novel approach on node placement was proposed. The proposed algorithm was simulated using the iFogSim simulator. The Quality of the Experience (QoE) by means of execution and response time, the proposed model yields better results compared to the traditional approaches. For the small scale applications proposed approach delivers nearly 20% improvement. If you consider large scale applications the proposed method provides a nearly 50% improvement in the execution and response time. In future the same can be deployed over a fog test to get to know the better results. The other parameters such as power and energy efficiency also be observed to improve the Quality of the Experience (QoE).

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Analysis of Efficient Security Using Machine Learning Methods

R. Ganesh Babu, J. Bino, K. Kavin Kumar, and P. Prasanna

Abstract Billions of brilliant gadgets that can speak with each other with insignificant human intercession. It is one of the quickest creating fields throughout the entire existence of processing, with an expected 50 billion gadgets before the finish of 2020. From one viewpoint, IoT advancements assume a critical function in upgrading a few genuine keen applications that can improve life quality. However, the cross-cutting concept of frameworks, as well as the multidisciplinary components associated with their organization, have described security challenges. Actualizing safety efforts, for example, encryption, validation, access control, network security and application security, for the gadgets and their characteristic weaknesses is incapable. In this manner, existing security techniques ought to be improved to make sure about the ML environment adequately. Machine learning (ML) has progressed significantly in the course of the most recent couple of years, and machine insight has changed from research centre interest to commonsense apparatus in a few significant applications.

Keywords Security methods · Machine learning · Network security · Encryption · IoT technology

1 Introduction

Machine learning (ML) has unique strategies for investigation to discover 'typical' as well as 'unusual' behavior as parts and gadgets collaborate in the world [1]. The information within each aspect of the framework could be collected and explored to

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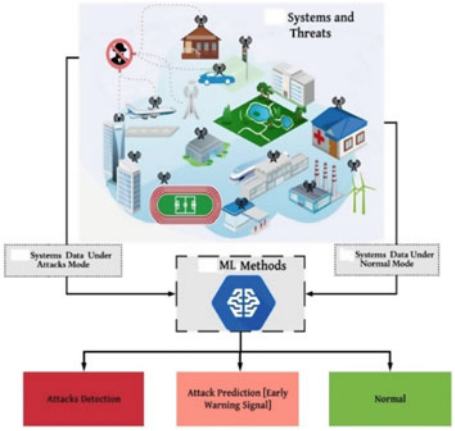

Fig. 1 Rule efficient security in machine learning

determine common topics of connection, thereby differentiating malevolent behavior in the early stages. Furthermore, ML strategies may be useful in anticipating new attacks, that are frequently transformations of previous attacks, because they can accurately predict future obscure attacks by learning from existing systems.

An in-depth feasibility study of the machine is presented here. For robust and secure structures, frameworks should evolve from simply help of sunlight correspondence between many gadgets with protection insight enabled by ML strategies depicted in Fig. 1 [2, 3]. Despite the fact that it is a component with ML, such an paper examines it all in two distinct areas can provide readers with an inside and out audit, comprehensive correlations, and anticipated utilization of both traditional ML techniques for security [4].

2 Literature Review

The rest of the pieces of the paper receive the arrangement introduced on the topical scientific classification. The current study thoroughly audits ML calculations for security, which can provide scientists and engineers with a guide for developing a compelling and end-to-end security strategy based on knowledge [5]. This overview also intends to include an overview of a problems with incorporating ML to ensure the frameworks. It gives a review of general frameworks, yet the reason for such a diagram is to rundowns the technique utilized by the ML model and its qualities for expanding security hazard.

3 Implementation of Machine Learning Method

The current elite of problems, difficulties, as well as future directions for leveraging ML techniques to mitigate security inadequacy frameworks, which also are classified basis of information, learning procedures, circumstances, natural ML Difficulties, opportunities to organize ML with the other technology, supercomputing unpredictability issues, as well as security instead of other concessions requirements [6]. The universally useful of learning calculations is catching the examples from the accessible incomplete preparing dataset and afterwards building a model to classes the new contributions based on the educated. An interrogation to investigate in this cycle is the quantity of trying to prepare the relevant data required to adequately start preparing an educational calculations for such calculations to also be aggregated looking for a bigger participation to a particular region [7, 8]. In terms of ML protection, the major challenge faced by ML in general, and controlled ML strategies in particular, is how to eliminate or create a sensible as well as excellent making preparations dataset contains other potential attacks.

A superior making preparations dataset is a critical fix for precisely preparing a ML calculations [9]. The preparedness datasets should be successful and distinct. Because these preparedness datasets are really the justification for obtaining image data, they should collect details that represents the whole of the processes of actual attacks. This situation has a direct impact on model precision [10]. Figure 2 shows that the frameworks generate massive amounts of information, and that continuing information downloading knowledge management support remains the test. The use of publicly supported techniques besides constructing datasets recognized to IoT risks as well as attacks is an important future exploratory course. Valuable datasets

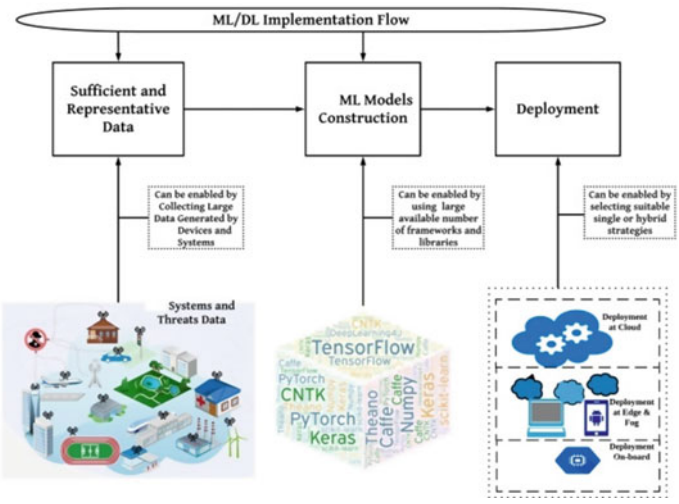

Fig. 2 The enable for machine learning technology tools

containing most assault instances should ideally be generated for planning ML calculations. Furthermore, of that kind datasets can be used to compare the precision of newly proposed estimations to those of current methods for attack detection.

4 Performance Evaluation

Edge figuring has become a fundamental innovation in giving ML administrations. Edge figuring moves administration arrangement from the cloud to the organization edge, which holds a likely arrangement in the ML. Executing ML at the edge for security can limit delays, acknowledge close, constant recognition frameworks, improve energy productivity and upgrade the adaptability of lightweight ML objects. Such execution can offer a viable structure for information handling with diminished organization traffic load. In any case, edge figuring is still at its outset, and a few difficulties join its usage. Further exploration should be directed to investigate and create powerful techniques for executing ML at the edge to give continuous security.

ML is worried about preparing machines to gain from genuine examplesto act independently and keenly. The objective of ML techniques is to permit the machines to become intelligent machines in Fig. 3. The improved meanings of the two advances uncover that a synergic connection can be acquired by consolidating the two innovations to accomplish an utterly practical security framework. Right off the bat, ML may help blockchain innovation in acknowledging shrewd dynamic and improved assessment, sifting and understanding of information and gadgets inside an organization to encourage the roubust execution of blockchain for upgraded trust and security administrations for the frameworks.

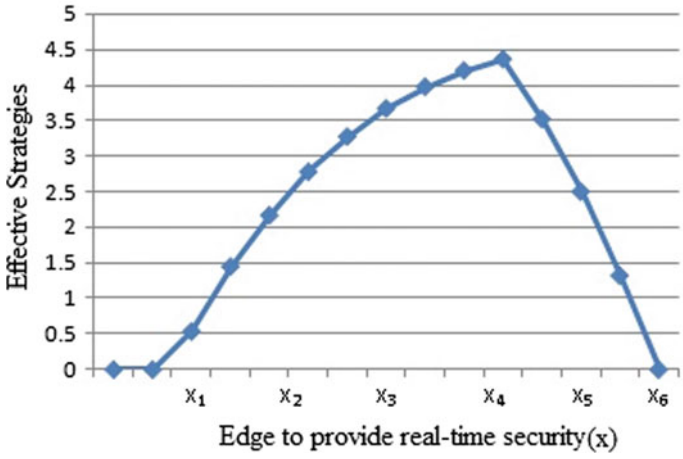

Fig. 3 The samples of training machines from real-world

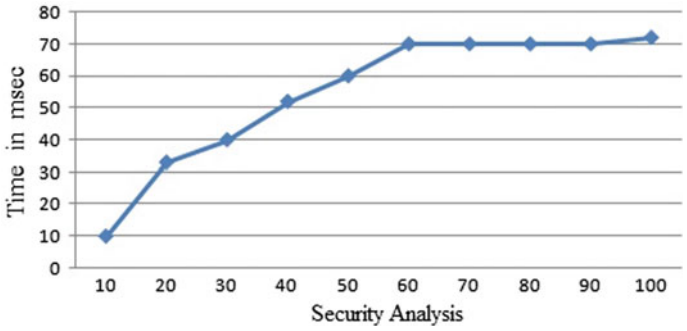

Fig. 4 ML by providing a large volume of data security

Furthermore, blockchain may help ML by giving a massive volume of information because blockchain is a decentralized data set that burdens the significance of information dispersion among a few hubs on a particular organization. The accessibility of enormous information is a primary factor show building up an exact ML-based modelin Fig. 4. Hence, with the expansion in the volume of information to be examined, especially security-related information, the exactness of ML techniques can be significantly expanded and summed up to build up a security model with improved dependability.

5 Conclusion

A comprehensive survey of a likely applications of ML methods through security is provided. These schemes then are considered at the end of each subparagraph in terms with about there benefits, drawbacks, and implementations through security. Following that, the applications of ML techniques besides ensuring the foremost IoT layers (for illustration, observation, organization, and application layers) are examined. Finally, a comprehensive list of issues, difficulties, and future directions identified with the use of ML inadequately ensuring regarding IoT frameworks were also presented as well as characterized by information; teaching techniques; ML besides security with in related, interrelated, as well as intuitive circumstances with IoT frameworks; different security compromises through applications; and synergistic consolidation of ML with ML are presented and described by relevant data; learning techniques; ML for security with in related, interconnected, as well as intuitive conditions of IoT.

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Comparison of Pre and Post Covid Education System and Evaluation of Student Performance

P. Blessy Paul and Maya L. Pai

Abstract India is one of the best countries which follows the conventional education system and forces the student to learn the subjects by attending the classes directly. The normal education system in the country has changed at the starting of February 2020, when the government confirmed the first case of coronavirus infection in India. The schools were suspended suddenly and the situation continued for a few months. But the government found a solution that the students who are not permitted to go to class can pick an online training framework. This research is mainly for comparing the pre and post covid education system and evaluation of the student performance using machine learning techniques such as Artificial Neural Network (ANN), Logistic Regression, and Naïve Bayes. The prediction algorithms are focus on the attributes such as understandability of subject topics, internal assessment, level of concentration, language proficiency, and percentage of marks in the main exam during regular class and online class. The prediction model compares the attributes and predicts either the regular class or the online class increases the student's performance. The dataset for research is collected mainly from graduation and post-graduation students through Google form due to the pandemic. ANN is the model that gave a higher accuracy rate of 0.95.

Keywords Naïve Bayes · ANN · Logistic regression · Covid pandemic

1 Introduction

Education is an inevitable part of nurturing human behavior, characteristics, and attitude. Since the old days, the regular learning strategy is continually developing with time is as yet experiencing various changes inferable from propelling advancements. Rapid changes in the education system affect the students in synchronization with the mode of studies and communication. Schooling foundations will in general follow the customary methods of learning where training is bestowed inside the dividers of the study hall to a gathering of understudies and having the benefit of direct assistance

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by teachers. Be that as it may, with the integration of Information and Communication Technology (ICT), the online class mode is at present countertrend rather than customary study halls. It helps plenty of students across the world to attend the class efficiently. It is possible only if students have sufficient internet availability and digital equipment.

The coronavirus pandemic has significantly disrupted the education system. But, educational institutions decided to continue the regular classes on online platforms such as Google classroom, Zoom, WebEx meet, and Microsoft Teams. Digital tools allow teachers and students to meet and conduct classes over the internet. This research aims to find out which is the effective way of taking the class. The research activities are feature extraction, online data collection (using Google form), data filtration, preprocessing, algorithm creation, coding, evaluation of three prediction models, and finding the best model. ANN uses the percentage of marks in the main exam, understandability of subject topics, and internal assessment score as three parameters to find the solution. Based on the Receiver Operating Characteristic curve (ROC) index, it is not difficult to discover the most exact model. The dataset of student's learning habits during regular class and online class has been collected from various colleges in Kerala.

2 Literature Review

Most of the researches in the education field are related to predicting student performance and career opportunities. Numerous variables influence student performance such as time spent on the computer for reference, mental profile, culture, scholastic advancement, instructive foundation, and Grade Point Average (GPA). According to Shahiri [1], the evaluations across tasks, class tests, lab work and participation, demographic characteristics such as sexual orientation, age, and family foundation, and student's practices such as convictions, inspirations, and learning methodologies, are credits that have been as often as possible utilized by researchers in anticipating student performance. Coates [2] point out that the research, based on a prediction algorithm, utilizes grades from the past semester and two class tests, course execution, lab work, and participation to order and anticipate student's presentation in the end-semester assessment. In the research done by Jiang [3], logistic regression is utilized as a classifier to foresee the likelihood of students who have passed the Massive Open Online Course (MOOC). It predicts the certificate type either it is a distinction or normal. In this research, the average score from four quizzes, the number of peer assessments completed, and the learner's social network degree are used as predictors. The ANN model predicting the kind of certificate with a precision of 92%. On the other hand, Williams [3] says many AI and information mining strategies have been utilized to anticipate the student's exhibition, for example, Decision Tree (DT), Random Forest (RF), Principal Component Analysis (PCA), Naïve Bayes (NB), Neuro-Fuzzy characterization (NF), Linear Regression, Logistic Regression, Decision List (DL), Bayesian Network (BN), Artificial Neural

Network (ANN), K-Nearest Neighbor (KNN), Support Vector Machine (SVM), and Discriminant Analysis (DA).

The time and exertion that students give to exercises connected to desired learning results, for example, dynamic and shared learning, correspondence with scholastic staff and companions, and inclusion in improving instructive encounters, enormously affects scholarly execution, said Ali [4]. Research on the effect of online learning on student performance during the covid pandemic is comparatively less. From the perspective of Basilaia, and Kvavadze [5], there are several types of online learning: Knowledgebase, online support, asynchronous training, synchronous training, and hybrid training. If the subject topics are provided in LMS and giving the instructions to follow the lessons without any direct support is called knowledgebase learning. In online support learning, there will be a discussion board or web forum for providing the learning assistance. Basilaia [5] says, asynchronous training is the one where the exercises don't happen progressively, however, the students are furnished with content regularly through email or other correspondence stages. He additionally characterizes that real-time training with a live educator is called synchronous learning. There is a predefined timetable to go to the online class and members can discuss straightforwardly with the educator and other gathering individuals. Hybrid training is a mix of on the web and in-person communication. In this research, the primary attributes are understandability of subject topics, internal assessment, level of concentration, language proficiency, availability of internet, and percentage of marks in the main exam during regular class and online class. Demographic factors such as gender, age, hometown status (rural or urban), and educational factors such as type of course, subject, learning time during the regular class, and online class are the secondary attributes. Here Grade Point Average (GPA) plays a vital role in predicting the effectiveness of regular class as well as an online class. This research is mainly focused on why students choose regular class rather than online class, and the impact of blended learning through LMS on student performance.

3 Blended Learning System

According to Zacharis [6], the integration of regular class mode and online learning mode is known as a blended learning system. Kalyan Chakravarthi [7] said conventional study room techniques are joined with ICT infrastructure and Internet access, making a mixture instructing system that upholds and takes part in learning associations any time, anyplace. Holmes and Blin [8, 9] introduced the concept of Virtual Learning Environment (VLE) in their research. VLE stores course talks, materials, and appraisal data. Usage of the blackboard, as well as widely used online Learning Management Systems (LMS) such as Moodle, Microsoft Teams, and Linways, are the two aspects of the blended learning system. A blend of these makes conceivable that the creation and sharing of instructive substance, joint effort and correspondence, class observing, and organization. LMS applications give educators the climate to plan notes and tasks, record and transfer address recordings, and valuable

URL joins, make introductions and online tests, put together undertaking groups, and speak with every understudy that needs their assistance, pointed by Krishna [7]. He brings some other concepts in his research related to the same topic as follows. Regardless of whether the guide helping students in defining learning objectives, showing the subjects, and understanding the classes, greater students prefer the traditional class model. By consolidating various devices of learning the board framework, teachers can viably mix and encourage all types of learning, for example, self-coordinated learning, shared learning, issue-based learning, and so on [7]. As per the research, students who follow the traditional learning strategy are fulfilled and inspired by the comfort. As organizations progressively present standard mixed learning alternatives, AI strategies would turn into a ground-breaking help to investigate the expanded measure of understudy accomplishment information and abbreviate the time expected to analyze understudy's shortcomings and requirements. In the examination of Mushtaq [10], to achieve the objectives, they built up a prescient insightful model using AI (ML) calculations. The most fitting ML prescient model was chosen for examining understudy associations in VLE learning exercises and deciding student's degrees of commitment in VLE courses given that an absence of understudy commitment brings about a high dropout rate, by Staikopoulos [11]. Ebner [12] applied a couple of ML figurings as canny learning approaches wanted to predict understudy responsibility during a VLE course and dissected the ensuing execution. ML computations can normally find complex models from features eliminated from existing data, engaging them to make splendid decisions about current data.

4 Data Collection and Feature Extraction

The data sets are collected mostly from graduation and post-graduation students over 15 affiliated colleges under various universities in Kerala. As part of feature Extraction by Ajmi [4], the open dataset is changed by removing a bunch of student highlights identified with their exhibition and correspondence exercises because these highlights are unequivocally identified with the learning limit of the student. Table 1 illustrates the attributes and attributes definition used in the prediction model. There are 600 student responses after filtration. The datasets were mainly collected from woman's colleges so that the 98.3% gender response is from female students. Most of the students have the opinion that regular class has more impact on student's performance than the online class.

Most of the students are from the age range of 17–21. Figure 1 illustrates the age range of students. 76.8% of students are from rural areas and the remaining 23.2% are from urban areas. 88.5% of students are graduate students, out of that 49% of students are from commerce background and 27.3% students are from computer science stream. Figure 2 shows the pie chart representation of home town status, course, and subjects.

Table 1 Student performance data collection

Attribute	Attribute definition
Gender	Male—1, Female—2
Age	17–24 → 1–8
Home town status	Rural—1, Urban—2
Type of course	Graduation—1, Post-graduation—2
Subject	Arta—1, Science—2, Commerce—3
Learning time during regular class	Under 4 h—1 4 to 7 h—2 Over 7 h—3
Learning time during online class	Under 4 h—1 4 to 7 h—2 Over 7 h—3
Self-evaluation of academic performance during regular class	
Understandability of subjects Language proficiency Conduct of exams Progress in internal assessment Interpersonal communication Level of concentration	1—below average 2—average 3—good 4—excellent
Self-evaluation of academic performance during online class	
Understandability of subjects Language proficiency Internet availability Progress in internal assessment Interpersonal communication Level of concentration	1—below average 2—average 3—good 4—excellent
Percentage of marks in main exams during regular class	<50, 50–60, 61–70, 71–80, 81–90, 91–100
Percentage of marks in main exams during online class	<50, 50–60, 61–70, 71–80, 81–90, 91–100

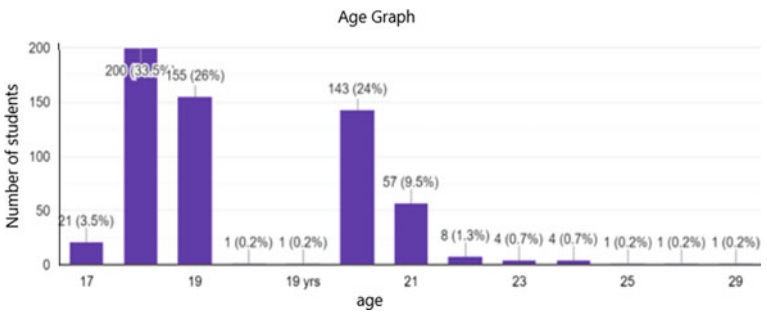

Fig. 1 Bar chart representing range of age

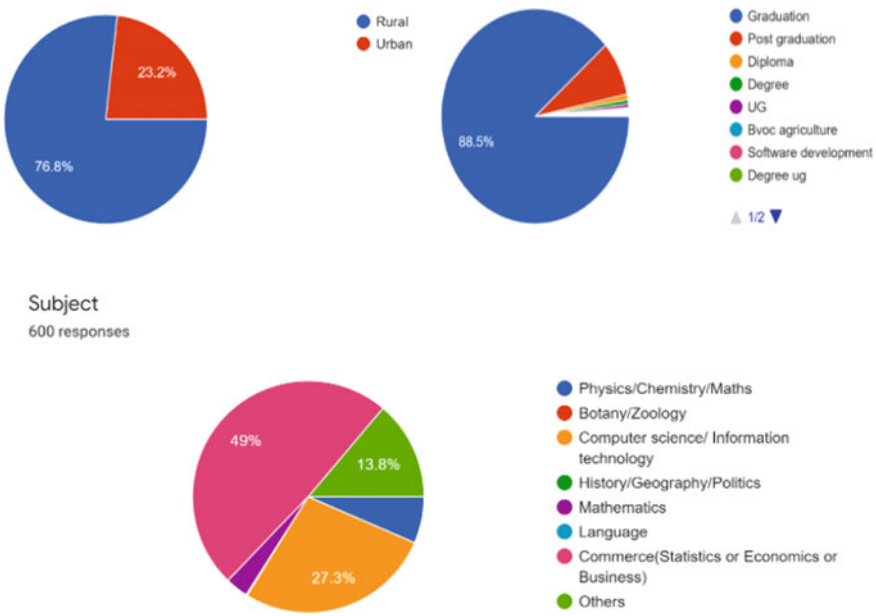

Fig. 2 Pie chart representation of home town status, course, and subjects

5 Methodology

Liyanage [13] attempted to anticipate student learning styles to make singular profiles and suggest learning materials. This exploration is likewise attempting to make an understudy profile that incorporates the solutions for making the online class viable. An exact perspective on the AI strategies utilized in the research is presented in this part.

Figures 3 and 4 illustrate the secondary attributes of regular class and online class in the dataset after feature extraction. The values of these attributes also have to apply in the prediction model to reach the desired output.

5.1 Artificial Neural Networks

ANN addresses extraordinarily energizing and ground-breaking AI-based methods used to take care of some genuine issues. There are some true uses of the ANNs, for example obscured picture and transcribed acknowledgment, discourse acknowledgment, climate estimating, and sickness recognition. ANN is a supervised learning system built of a large number of elements called neurons. It represents the brain system. Instead of passing brain signals, ANN accepts the featured data and converts it into the desired output using a predefined model. Here the primary attributes such

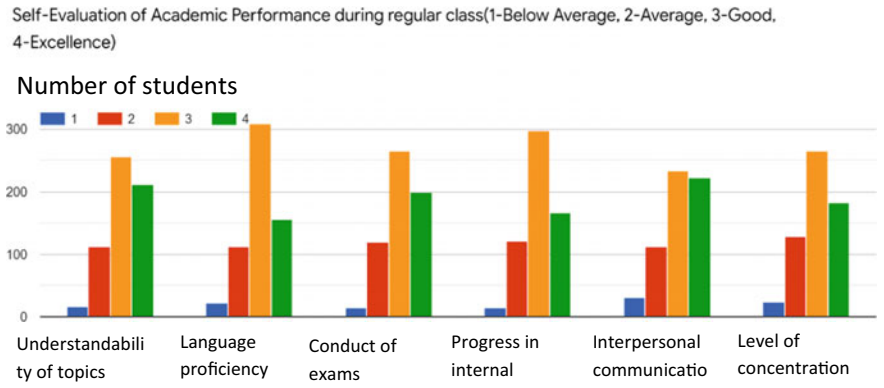

Fig. 3 Academic evaluation during regular class

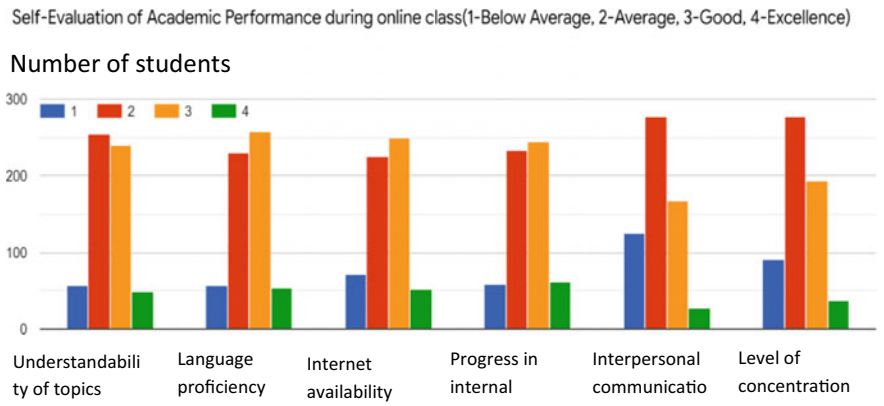

Fig. 4 Academic evaluation during online class

as marks in main exams during regular class and online class, and internal marks are applied to the model. Numerous kinds of ANNs can be ordered dependent on their engineering and plan. One sort is a related ANN in which the association has an information layer; in any event, one covered layers, and the yield layer. Additionally, its associations never return to an information unit or a yield unit situated in the past layer [14].

The ANN administrator has been designed to utilize the Rectifier initiation work and the quantity of concealed layers sizes set to be 7 and 3 continuously. The wide range of various boundaries has been set to the default esteems. In this research, the prediction model used 70% data in the training phase 30% data in the testing phase. The higher accuracy is getting at the ratio 8:2.

5.2 Logistic Regression

Logistic Regression addresses a numerical displaying procedure that depicts the connection between a few autonomous factors and a reliant variable. The strategic model uses the logistic function as a numerical structure having values 0 and 1 for some random information. As per the model, level of understandability, student evaluation on internal assessment and main examination results are the features that predict the best learning platform. The logistic model can apply to genuine issues that may have the estimation of possibly one or zero [15]. Gradient Descent Algorithm is the calculation used to locate the best estimations of the model's boundaries during the preparation stage. The LR administrator has been set to utilize regularization and the streamlining administrator set to locate the best incentive for the solver strategy.

5.3 Naïve Bayes

The Naïve Bayes model is the least complex algorithm in the Bayesian organization. Naïve Bayes model used in this research mainly to classify the students according to the effect of blended learning. Based on the classification result, it is easy to predict the best mode of class. There are 600 student responses. Based on the blended learning-related attribute, we have to classify the students into two groups (regular class/online class). Each variable x in the dataset contains trait esteems x1, x2, … x*i*. The objective function f(x) rises to any incentive from predefined limited set V = (*v*1, *v*2, …, *vj*). For building the Naïve Bayes model, the prediction model has been set to identify the primary attributes for the Laplace remedy. Also, the assessment mode utilizing the credits GPA and internal assessment. It centers on the impact of mixed learning frameworks utilizing LMS.

6 Implementation

6.1 Machine Learning Software and Coding

RapidMiner Studio AI programming has been utilized to prepare and test the models in the examination of Hussei [4]. The dataset is separated into two sets. The ANN model utilized 70% information in the training stage 30% information in the testing face. The learning and testing are executed a few times utilizing the Python programming stage. Here we have used the version python 3.9.0. Python has numerous packages for handling the prediction methodologies. At each crease execution cycle, the AI calculation chooses one set to be the test set and the excess set as the preparation sets. The exactness and the exhibition measures are accumulated over all the cycles

to ascertain the last presentation and the precision of the model [16]. Here is a bit of code that implements labeling, training, and testing in python.

```
    """ Labelling """
    class_label = LabelEncoder()
for column in dataset[["name", "gender", "age",
"hometown", "coursetype", "subject", "learntime_r",
"learntime_o", "understandability_r", "lang_r",
"intexam_r", "internet_o", "communication_r",
"concentration_r", "mainexamresult_r",
"understandability_o", "lang_o",
"intexam_o","communication_o", "concentration_o",
"mainexamresult_o", "mode"]].columns:
     df[column] =
class_label.fit_transform(df[column].values)


    """ RegularMode """
    def regular(confusion_matrices):
        fp = confusion_matrices[0][1]
        tf = confusion_matrices[0][0]
        accuracy_rate = float(fp) / (fp + tf)
        print("Regular mode: ", accuracy_rate)

    """ OnlineMode """
    def online(confusion_matrices):
        ff = confusion_matrices [1][0]
        tp = confusion_matrices [1][1]
       accuracy_rate = float(ff) / (ff + tp)
        print("online mode: ", accuracy_rate)
```

7 Experiment and Performance Measures

The performance measures used in this research are accuracy, recall, precision, and F score. The ROC index (the area under the bend) has been utilized to assess the presence of the prediction models. As per Brian [16], this measure is a notable measure that is depending on the ROC curve and it is determined by utilizing the

forecast scores. The accuracy rate shows the rightness of the model in foreseeing the ideal yield. The recall measure is a metric that measures the quantity of right certain expectations made out of all sure forecasts that might have been made. Not at all like accuracy that solitary remarks on the true positive forecasts out of every certain expectation, recall demonstrates of missed positive forecasts. For building up the training model, the Optimize Parameters and operator have been set to locate the best estimation of the splitting criteria and the negligible size for split properties. The Logistic Regression administrator has been set to utilize regularization and for building the Naïve Bayes model, the optimization operator has been set to locate the best values for the Laplace amendment. So, the accuracy rate can be calculated by:

$$Accuracy = (TP + TN) \div (TP + TN + FP + FN) \tag{1}$$

Precision indicates the number of correctly predicted cases turned out to be positive.

$$Precision = TP \div (TP + FP) \tag{2}$$

The recall represents the number of actual positive cases we were able to predict correctly with the ANN model.

$$Recall = TP \div (TP + FN) \tag{3}$$

F1-score is a harmonic mean of Precision and Recall. It gives an integrated result of these two metrics.

$$F1 - Score = 2 \div ((1 \div \text{Re}call) + (1 \div Precision)) \tag{4}$$

8 Results

Three prediction models have been created and tested using three machine learning techniques like ANN, Naïve Bayes, and Logistic Regression. ANN has predicted the result with higher accuracy. The following results show the accuracy, performance measures, and confusion matrices for ANN. Analysis of featured data results that 35% of students strongly agree with regular class encourages their learning speed and overall performance. 41.4% of students agree with the same opinion. 20.8% of students have the suggestion that online mode and regular mode make the same impact in their studies. It means that they have utilized the positive aspect of the blended learning system through LMS. It can clearly understand from Fig. 5.

Performance measures can be calculated only after drawing the confusion matrices. Following is the confusion matrices of 600 filtrated responses after feature extraction.

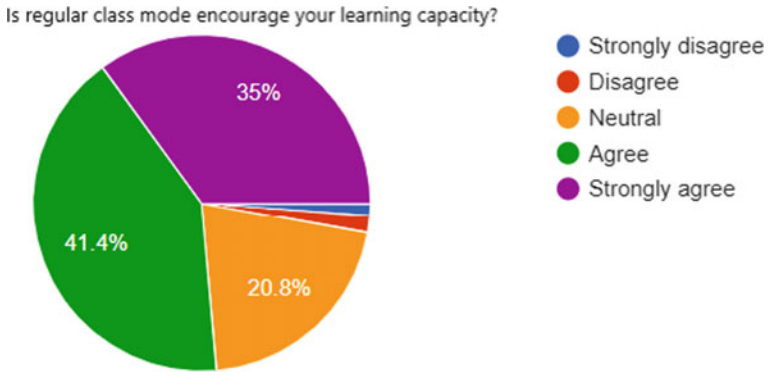

Fig. 5 Pie chart represents the effect of regular class

Predicted values	Actual values	
	Positive	Negative
Positive	TP(530)	FP(20)
Negative	FN(10)	TN(40)

Table 2 shows the calculated performance measures accuracy, performance measures, and confusion matrices for ANN, Naïve Bayes, and logistic regression. From the table, it is clear that the logistic regression algorithm has more accuracy than the Naïve Bayes algorithm.

Table 2 Confusion matrices and performance measures of ANN, logistic regression, and Naïve Bayes algorithm

Model	TP	TN	FP	FN	Accuracy	Precision	Recall	F-Score	ROC
ANN	530	40	20	10	**0.95**	0.96	0.98	0.97	0.95
Logistic regression	515	35	28	22	0.91	0.948	0.95	0.95	0.90
Naïve Bayes	500	30	40	30	0.88	0.925	0.94	0.93	0.88

Bolded number in the table shows the highest accuracy rate.

ANN has the highest accuracy rate of 0.95 which is indicated in bold letters in Table 2. A ROC curve has been drawn for showing the performance of an ANN model. Figure 6 illustrates the area under the curve (AUROC) represents the efficiency of the ANN algorithm as 0.95. Figures 7 and 8 are the ROC curve representations of the logistic regression model and Naïve Bayes model respectively.

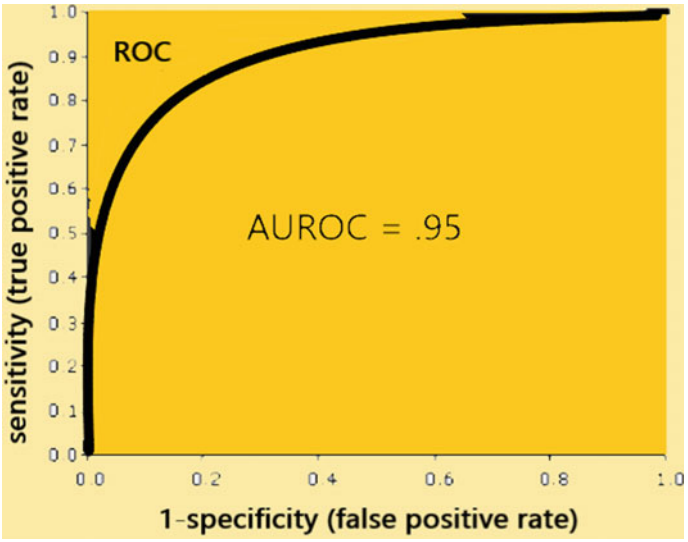

Fig. 6 ROC curve represents ANN model

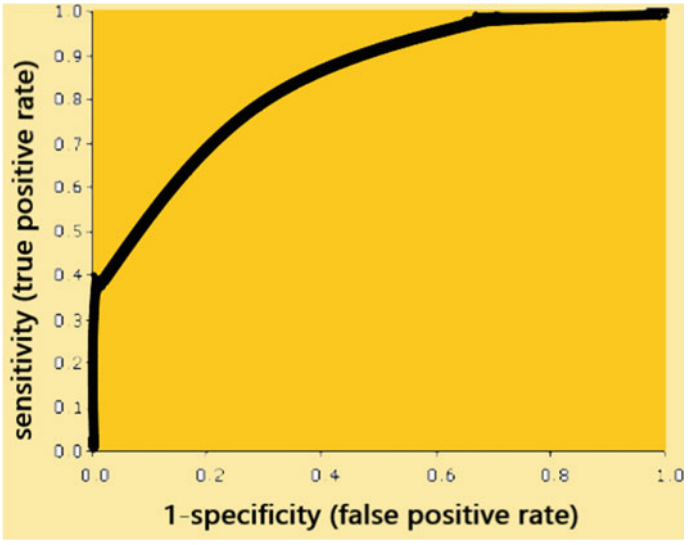

Fig. 7 ROC curve represents logistic regression

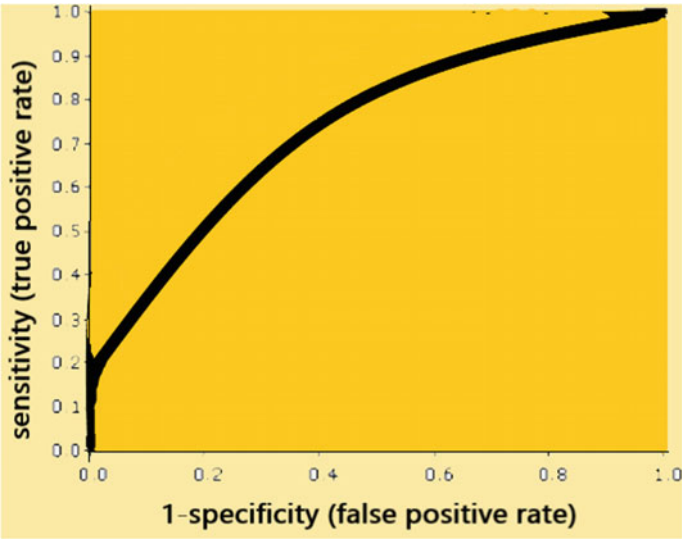

Fig. 8 ROC curve represents Naïve Bayes

9 Conclusion

The Covid pandemic causes a situation for moving from a traditional classroom atmosphere to an online learning environment. The objective of the research is to find out which is the best mode of the education system (regular/online). Besides, there is one more aim that to evaluate student performance during both learning platform. This research used machine learning techniques such as ANN, logistic regression, and Naïve Bayes. As per the model created according to these algorithms, the regular mode learning system impacts students with a higher rate compared to online learning. ANN is the best model that gave a higher accuracy rate of 0.95 with the attributes, marks in main exams, and internal assessment.

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Analyzing Random Forest, Naive Bayes, and SVM to Filter Spam Emails Across Multiple Datasets

Gopika Mohanan, Deepika Menon Padmanabhan, and G. S. Anisha

Abstract As Emails are one of the most growing and important modes of communication, it is more vulnerable to be exploited. This paper addresses the several types of machine learning classification models for filtering spam emails using multiple email datasets, such as Random Forest, Naive Bayes, and SVM algorithms that are implemented in python with Scikit-learn library. Email Dataset, Enron Dataset, and Ling Spam Dataset are the datasets used for classifying emails into spam (indicated as 1) or ham (indicated as 0). The result shows that Random Forest and Naive Bayes does extremely well than Support Vector Machine.

Keywords Data mining · Spam emails · Random forest · Naive Bayes · Support vector machine · Scikit-learn

1 Introduction

The email system is among the most efficient and frequently used ways of communication. The cause for the recognition of the email system resides in the frugal and swift nature of communication. But, it is getting exposed to spam emails. One of the most critical issues on the internet, the world is spam emails. The actual email user is not only financially affected by spam emails, but it also enrages the individual email user. Spam emails also charge extra money among dial-up connection users and can expose teenagers to inappropriate content. Spam-Mails are mostly commercial and may also carry malicious content. Spam mails are more of a nuisance than dangerous. To detect potential spam messages, researchers use several spam detection methods and data mining approaches to eliminate this problem. The research goals are (i) implementation of Random Forest, Naive Bayes, and Support Vector Machine to detect email spam on multiple datasets, (ii) evaluation of Random Forest, Naive

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Bayes, and Support Vector Machine to filter spam mails on the selected datasets to determine the finest classifier among them.

2 Related Works

2.1 Machine Learning-Based Spam Email Detection

A hybrid system (Sharma and Bhardwaj [1]) is designed using a combination of both Naive Bayes and J48, and is found that the efficiency of J48 alone is more efficient than the hybrid system. The idea of boosting strategy is proposed for future work for further enhancement of the system, as it will substitute the poor classifier learning features with the efficient classifier features and thereby improve the performance of the overall system.

2.2 Hybrid Spam Filtration Method Using Machine Learning Techniques

A hybrid model (Jancy Sickory Daisy and Rijwana Begum [2]) is designed in such a way that firstly the data collected is preprocessed, then Naive Bayes algorithm is applied further Markov Random Field technique is implemented on the resultant classifier. Hybrid model is found to be more efficient than individual Naive Bayes or Markov Random Field. To eliminate problems such as decreased bandwidth and low performance on a Mail Server and Client, the proposed hybrid approach can be used.

2.3 Email Spam Detection: A Method of Meta Classifiers Stacking

Different hybrid models [3] are compared, firstly a hybrid system of J48 with information gain, chi-square and gain ratio are compared. Secondly, various hybrid models such as SMO + Naive Bayes, SMO + J48, J48 + Naive Bayes with Meta Classifiers as SMO, Naive Bayes, SMO, J48, Naive Bayes are considered respectively. J48 with "Chi-Square" is regarded to be the ideal hybrid model for this study when compared between the two results. Thus we come to know that hybrid models perform well compared to a single classifier. Clustering and prediction techniques can be used in the future for extending this research.

2.4 Spam Mail Detection Through Data Mining a Comparative Performance Analysis

The analysis (Rathi and Pareek [4]) is done to find the best algorithm and to also find the efficiency of applying feature selection algorithm before the application of algorithms (classifiers). Here, the data is preprocessed. Two experiments are conducted. In the first experiment classifiers such as Random Tree, Function Tree, J48, Simple Cart, SVM, Random Forest, Naive Bayes, and Bayesian Net are directly applied one after the other without using a feature selection algorithm. In the 2nd experiment, the Feature Selection method is being applied and then classification models are introduced to a diminished data set. Therefore, when feature selection algorithms is included first, it is seen that tree-like models work well and accuracy has enhanced remarkably.

2.5 Analysis of Naive Bayes Algorithm for Email Spam Filtering Across Multiple Datasets

In this study (Rusland et al. [5]), the Naive Bayes classifier to filter spam emails on 2 datasets is evaluated and its results are validated. The Naive Bayes classifier's level of output is also dependent on the datasets used. The data set that has few instances of emails and characteristics will produce good results for the Naive Bayes classification. So, when the SPAMBASE dataset is used, the output of Naive Bayes is better.

3 Methodology

We use three datasets which are divided into training and test sets, where training datasets contain 80% and test datasets contain 20% of the original data set. The methods for classifying email spam is executed in Python using Sci-kit Learn. The proposed system follows certain steps for better results.

1. Data Collection: The Enron dataset, Email dataset, and Ling Spam dataset are the three datasets used in this research.
2. Data Preprocessing: It is the most crucial stage as the information consists of bugs, ambiguities, redundancies that need to be cleaned up beforehand.
3. Feature Selection: Using sci-kit learn, we apply the feature selection after the preprocessing step [6].
4. Data Transformation: Converts the data into lower cases and adjusts the data types as per the algorithm needs, generally for text classification.
5. Classification System: Sci-kit learn classifiers classify the data into junk or legitimate based on the identified attributes.

3.1 Naive Bayes

The Naive Bayes Classifier is formulated on the conditional probability as per Bayes Theorem. It is also dependent on the datasets selected.

3.2 Multinomial Naive Bayes

Data are expressed in this classifier in the form of word vector counts. For each y class, the parameterized distribution of vectors θy = (θy1, …, θyn) for class y each, in which n denotes characteristics and θy1 is the likelihood P(xi y) of the characteristic i of y class [7].

$$\hat{\theta}_{yi} = \frac{N_{yi} + \alpha}{N_y + \alpha n} \tag{1}$$

Equation (1) demonstrates Multinomial Naive Bayes Model mathematically [8].

3.3 Random Forest

Random Forest is a supervised learning classifier that constructs a forest to determine outcomes. Random forest classifier generates decision trees from the bootstrap dataset using chosen random data samples, thereby predicting values of each tree, and then picks the obvious solution by using the voting technique [9].

3.4 Support Vector Machine

SVM being a supervised machine learning algorithm can be used for classification and regression problems. The individual observations are Support Vectors. We construct a hyperplane with support vectors in the n-dimension plane such that it differentiates the inputted classes well. A boundary that better separates the two groups (hyper-plane/line) [10] is the SVM classifier.

Email message xi is represented as a vector of n-dimensional characteristics that can be marked in n-dimensional space. It explains the features of your email content in numerical form (e.g. word count, connection count, etc.). Each vector of the feature is labeled with a yi class. yi class can be either a +ve or a −ve (example: spam = 1, not-spam = −1). The algorithm determines a hyperplane using this dataset (or decision boundary). It establishes a separation between examples of a maximum margin between two classes [11].

4 Experiment and Result Analysis

4.1 Confusion Matrix

A matrix which is used to depict the effectiveness of the algorithm or classifier on a test data set considered to be true values [12].

4.2 Dataset

The datasets we use in this paper are collected from Kaggle and are as follows:

1. Dataset 1-Emails Dataset It is a public dataset, that was first described in "Spam Filtering with Naive Bayes—Which Naive Bayes?" the 2006 conference paper [13]. It comprises 5728 emails. The non-spam (ham) messages are taken from one of the Enron Corpus inboxes. Other sources of spam messages are from the Spam Assassin Corpus and the Internet users. A project that collects spam messages to detect spammers contributed to the remaining spam messages.
2. Dataset 2-Ling-spam Dataset The ling spam dataset is a collection of 2893 spam and ham emails. A collective of legitimate/spam emails from a linguistic list.
3. Dataset 3-Enron Email Corpus The dataset is a public set of emails from former company Enron. It is a collection of 5171 spam and ham emails. The dataset is from the enron1 folder of spam dataset from public Enron Email Corpus (Tables 1, 2, 3 and 4; Fig. 1).

The experimental result on implementing Random Forest, Naive Bayes, Support Vector Machine algorithm in Python using Scikit-learn is addressed in this section. The models are applied based on the percentage of spam and ham emails rightly detected, the percentage of accurate spam email messages, the percentage of spam emails managed to be blocked, and the weighted average precision and recall across multiple datasets. In the Email Dataset, the Random Forest, Naive Bayes, SVM yields

Table 1 Experimental result of Naïve Bayes, support vector machine, random forest algorithms in Dataset 1

Parameters	Naive Bayes	SVM	Random forest
Precision (0)	1.00	0.96	1.00
Precision (1)	0.97	0.98	1.00
Recall (0)	0.99	0.99	1.00
Recall (1)	1.00	0.86	1.00
F1-score (0)	0.99	0.98	1.00
F1-score (1)	0.98	0.91	1.00
Support (0)	870	870	560
Support (1)	269	269	579

Table 2 Experimental result of Naïve Bayes, support vector machine, random forest algorithms in Dataset 2

Parameters	Naive Bayes	SVM	Random forest
Precision (0)	1.00	0.94	1.00
Precision (1)	0.91	1.00	1.00
Recall (0)	0.98	1.00	1.00
Recall (1)	0.98	0.70	1.00
F1-score (0)	0.99	0.97	1.00
F1-score (1)	0.94	0.82	1.00
Support (0)	480	480	293
Support (1)	92	92	279

Table 3 Experimental result of Naïve Bayes, support vector machine, random forest algorithms in Dataset 3

Parameters	Naive Bayes	SVM	Random forest
Precision (0)	0.98	0.99	1.00
Precision (1)	0.95	0.92	1.00
Recall (0)	0.98	0.97	1.00
Recall (1)	0.96	0.97	1.00
F1-score (0)	0.98	0.98	1.00
F1-score (1)	0.96	0.94	1.00
Support (0)	722	722	494
Support (1)	277	277	505

Table 4 Confusion matrix of Naïve Bayes, support vector machine, random forest algorithms across multiple datasets

Datasets	Parameters	Naive Bayes	SVM	Random forest
Dataset 1	TP	862	865	560
	FP	8	5	0
	FN	1	38	2
	TN	268	231	577
Dataset 2	TP	471	480	292
	FP	9	0	1
	FN	2	28	0
	TN	90	64	279
Dataset 3	TP	709	697	493
	FP	13	25	1
	FN	11	7	0
	TN	266	270	505

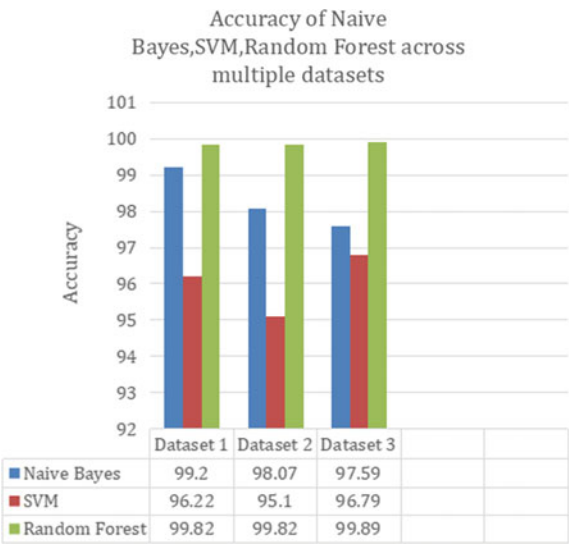

Fig. 1 Accuracy comparison

an accuracy rate of 99.82%, 99.2%, 96.22%, respectively. In Ling-spam Dataset, the Random Forest, Naive Bayes, SVM yields an accuracy rate of 99.82%, 98.07%, 95.10% respectively. In the Enron dataset, the Random Forest, Naive Bayes, SVM yield an accuracy rate of 99.89%, 97.59%, 96.79% respectively. Random Forest fetches accurate results for recall, precision, etc. across multiple datasets followed by Naive Bayes and then SVM. It is observed that the machine learning classifiers in dataset 1 with 5728 spam and ham emails performed exceptionally well when compared with the rest. Although requiring little configuration in packages, Random Forest produces accurate predictions over a broad range of data. The random forest retains its accuracy well, despite the absence of some data. Thus, Random Forest is an effective algorithm for email spam filtering irrespective of the datasets used.

5 Conclusion

In this paper, as per the algorithms such as Random Forest, Naive Bayes, and SVM, the finest classifier for email spam filtering is found. The datasets that we used in our research are composed of two variables each. The email data content is the first variable and the second variable is the output variable. Random Forest provides excellent performance for email spam classification in contrast with other classification algorithms in terms of various performance measures like recall, precision, accuracy, etc. This represents the high accuracy of 99.8% throughout the three datasets. Random Forest runs efficiently on larger datasets [7]. It is an optimal way to measure missing values and also retains the accuracy well. Compared to SVM, Random Forest and

Naive Bayes had an incredibly good score [14]. In the future, we can use various classifiers to evaluate efficiency. A hybrid model of the above classifiers can be generated and can be evaluated on several datasets.

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Intelligent and Adaptive Learning Management System Technology (LMST) Using Data Mining and Artificial Intelligence

Bagam Laxmaiah, Banothu Ramji, and Attuluri Uday Kiran

Abstract Artificial Intelligence called it as Intelligent Machines deals with the development of smart machines capable of executing tasks like human thinking. In future, most of the areas are developed by using Artificial Intelligence (AI). Artificial Intelligence is the most important feature for research, innovation and development. It is also useful for developing adaptive learning-based E-Learning Management System Technology (ELMST). In current scenario, learns can convert from blockboard to E-Learning System. In these days, the uses of technology in education system are huge quantities of students and prefer different methodologies. Using ELMST to enhance the methods of teaching and learning processes including graphical representation, using animations, digital content, and other related videos. The Data Mining is used to categorize the way of learns using clusters mechanism. The Artificial Intelligence is identifying the students based on the learning skills.

Keywords Learning management system · Artificial intelligence · Data mining · E-learning

1 Introduction

Most of the institutions are switched from the conventional classroom delivery to E-Learning Management Systems [1], where e-learning technologies are growing day-to-day which includes electronic media like multimedia, satellite disks, Mobile phones and many. In these days, everyone can have mobile phones and they can learn through Internet. Many institutions can support E-Learning Management System Technologies in many ways including real time experiences (case studies), increasing practical knowledge [2], will encourage team work etc. In teaching—learning, new innovations are constantly evolving and have the ability for teaching and learning

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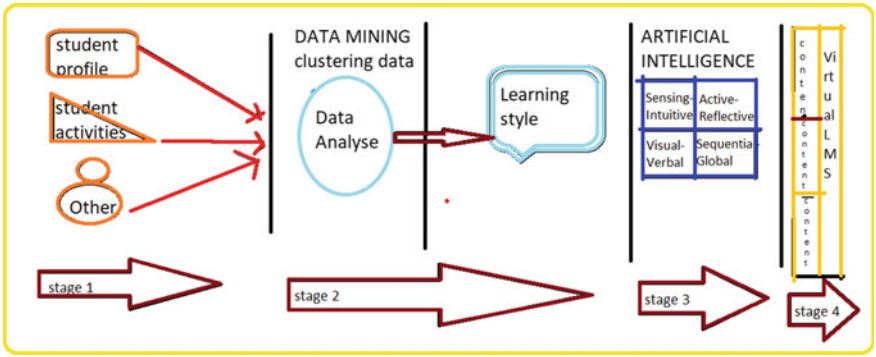

Fig. 1 E-learning management system

to play an important part. It offers new opportunities for conventional curriculum—based learning as well as beyond the classroom for lifelong learning (Fig. 1).

Educational programs under the development of methods and the beginning of emerging technology face the difficulty of the knowledge of professionals who can plan, building, manage new techniques and use progressive technologies. In the last decade, the availability of web technologies and the Internet, learning methodologies are also changed from traditional to emerging learning systems includes easy to learn, understand and analyse the things which are very easy to know the ability to gain the knowledge [3]. The review of applied modes of education indicates that hybrid learning has benefits over formal learning and e-learning [4]. Now way days the students are learn with some graphical representations or some kind of animations. In this E-Learning Management system, the students are learning in free time at college or home and any place and so many online courses are available in these days. So obviously students can learn emerging technologies apart from academics and gain more knowledge. Every decade, many areas are changed by the technological revolutions int that education system have been affected by this technological revolution [5]. These technologies are affected not only how we live, but also the traditional teaching and learning context.

2 E-Learning Management System

Easy HTML websites, as well as complex systems with greater flexibility, present e-learning software in the educational software industry. These include the learning management system (LMS) [1, 6] and the information management system for learning, used in organizational networks (Learning Content Management System, or LCMS). More specifically, an LMS is a software framework designed to organize, record, log and report training activities, classroom and virtual activities, e-learning services, and material for training. Most of the organizations have maintained their

own LMS system, which is useful to provide well understanding content and not to educate workers along with the operating process. The key goal of LMS is to simplify the administrative aspects of education and the content control of "learning objects" is the subject of LCMS. Currently, the most popular are two kinds of e-learning systems. Systems of the first type have the opportunity to plan training courses and assess students, whereas systems of the second type allow all instructional processes to be structured in a supportive manner. In addition to the simple features for designing training classes, Moodle and Sakai both have such functions as monitoring training statistics, accounting students, and the ability to configure them. In the Web Tutor framework, such tasks as maintenance and moderation of forums are carried out. Although these systems can be used for the introduction of blended learning, all open-source learning systems have common drawbacks: the sophistication of e-learning programs and assistance, the absence or difficulties of technical documentation. Technologies for e-learning will become essential instruments for arranging blended learning. In order to take full advantage of the e-learning system's ability in the blended learning process, it should provide a complete range of functions required for highly skilled experts to be qualitatively educated.

From last decades, students or customers are ability to learn online (E-learn) courses individually from their native places. Even though university aspirants [3, 7] are also interesting to E-Learning courses. Most of the top companies are also provides e-learning courses for their employees to up-to-date with emerging technologies and gain latest knowledge in competitive business environment. Some of the examples of large companies like TCS, Wipro, CISCO and HP developed a Videos based web training that have adapted e-learning solutions for their corporate training (Fig. 2).

Artificial Intelligence is a fantastic direction in which to promote staff preparation, by having the technological help your company wants to be forward looking in the learning process. AI-powered learning management systems (LMS) are systems that

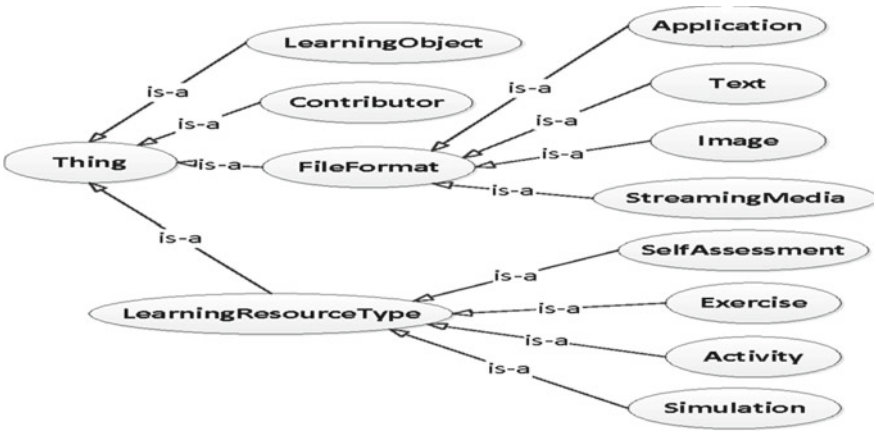

Fig. 2 Different types of E-learning resources

work to streamline the way content is delivered to learners, facilitating personalised business learning in the most streamlined way possible. AI Learning Management Systems (LMS) help learning and growth managers to define the areas of expertise need to be integrated, allowing the optimization of critical information. AI allows you to make more efficient and knowledgeable decisions on how to present and curate information compatible correctly with the needs and desires of individual users.

It easy to bring together a new media centre with information technology and, in particular, information training programs, allowing us the ability to accomplish our goals in an instructional process, in a manner that acknowledges individual attributes of each and to offer opportunities for continued education. Over the past decade, several developments have taken place that have enabled teachers and in general the education sector to incorporate technology in the classroom. A research by Martin, F and Parker, M. A. showed that several online classes are offered, but faculty are also beginning to implement synchronous virtual classrooms where students and teachers can talk with each other in real time [8].

3 Methodology

If this is a successful introductory step for branding brand by extensions over the Internet into pedagogy relies on the multiple variables of a widespread implementation across the Internet. This study of the university at large determines the factors that affect the implementation of a learning management system in one large, multi-campus local university. It is widely agreed that balancing the learning pattern of a pupil with the required type of educational intervention has a substantial effect on the student's success and achievement of learning outcomes [9]. It is now commonly accepted that personality qualities have a significant effect on academic achievement. What is not yet understood is the role of cognitive patterns and personality characteristics in an instructional sense on the success of gamification. Does gamifying the learning environment, for instance, have a stronger effect on the academic participation or success of students who choose to consciously process knowledge than others who are more reflective? Can gamification impact visual learners in a separate way than verbally driven learners? Do extraverts respond to a gamified world in a better way than introverts? It is important to know how the attributes of people affect the effectiveness of gamification to inform its successful use. It enables the incorporation of gamification as a feature in the teachers' suite of pedagogical interventions. It will direct the creation of holistic learning experiences that use gamification to ensure that all learners have a meaningful experience.

The use of IT and, in particular, of learning management systems enhances the possibilities for teachers and students to accomplish their instructional objectives [4]. These programs offer learning materials, help coordinate and document instruction, gather data on success and take care of each user's unique characteristics. Actually, all paying and free devices are physically located on all college computers and in the cloud, providing various feature sets with distinct licensing schemes and prices, with

a large inventory. This introduces the dilemma of the right system being selected. The lack of a detailed definition of such systems is partly due to this problem. Study of more than 30 of the most popular now-automated learning management systems has demonstrated that it is important to identify those systems according to such requirements by which the same type of system can be considered. The classification characteristics provided by the author include: cost, flexibility, modularity, consumer needs, material alignment, device physical location, adaptability training. Under these classifications, taking into account the learning management system and the latest developments in their development, it is possible to define the key specifications for them: functionality, usability, ease of use, low cost, SCORM standard or Tin Can API support, modularity and adaptability. That an analysis needed to be made compile a model that gathered architectural data, that architectures of a commodity will be in the data, and that there could be statistical indicators (LMSs).

To be able to evaluate the variables that affect efficiency, precision, and correlation, we first plugged the factors that other researchers had historically used, then using independent models, including the Anxiety–Innovation (AI), Value and Usage (UU), Tool Learning (TL), System Factors (SF), Access Methods (AS), Virtual Library (VL), and Smartphone Use [10, 11]. Then we took in the language through our background model. The study was performed over one year, split into nine classes. One of the key considerations was the LMS Classroom core characteristics in terms of design and structure. It had the greatest results in both dimensions and was ranked number one on both of these categories. The site offers you access to a lot of knowledge inside, which makes it easy to navigate and understand. When LMS (Learning Management System) is involved, the Institute for Electrical and Electronics Engineers (IEEE) has proposed that publishers of scholarly services have metadata (metadata) for products in the same ways. Learning Object that contains Metadata (LOM) [11].

In the same line of study, a number of research laboratories have presented their results at conferences using various LMSs:

- **Edmodo**: It's a social learning site that helps its users to determine how much they have learned through the elements that the social media platform creator adds to their platform [11].
- **Schoology**: The purpose of this website is to establish an instructional approach to encourage students to learn and to enable the students to motivate learning. On this website, teachers and students are able to build classes and classes, manage services, set courses generated as public or private, incorporate resources from other sites, create various tools for assessments, report on success of students, and more [12].
- **Classroom**: The author knows how beneficial the method is in the classroom. It is also ideal in terms of both within and outside class. It is a free online education platform, for teachers, students, and anyone else who wants to learn, that provides users to capture, store, and convert video, PDF, and photographs, and provides a platform for collaboration between professors and students when teaching the same or separate classes; another purpose is for teachers to organize and exchange ideas with students and others in the same class, or different classes. The author

Table 1 Web-based learning system

S. No.	Element	Value space
1.	Text	Document, hypertext
2.	Image	Photo, map, graph, image, presentation
3.	Streaming media	Audio recording, animation, self-running presentation, video, web cast
4.	Application	Interactive software, hyper media application, wiki, presentation

may also integrate the URLs of virtual libraries or external tools into the document [8].

- **Moodle**: Moodle is an open-source web-based learning management framework that helps creators make it exclusive to their organization. In this study, the study concluded that the usage percentage was observed in undergraduate students (Table 1).

The further colleges understand that many of their students are on campuses all over the world, the more they would prefer to use a web-based learning system that encourages students to be able to take classes on campus either at home or on the go. The University of Bogota is one such university that offers this program because they are situated in both the city and in the region. The study showed that healthy adoption environments understanding career goals the test technique used case study methods and purposively picked the sample consisted of creative teaching academics from around the institution, who used web-based approaches to educate both on- and off-campus learners. The results of the analysis were analysed using a hybrid of Rogers' theory of diffusion of technologies and actor network theory, and revealed the degree to which teaching professors are physically and socially chained to the standard tech-importing, educating model that has been in place for years [13]. A significant portion of academics are the product of how the school and its creatives staffs continually appear to mess around with the changing conceptions of what makes a decent university and what is considered right. This essay takes a look at forms and approaches professors and instructors may use to help their students learn about analytics and promote the learning of higher education students in a particular manner, be it by using computers or other technical instruments.

3.1 AI Based LMS

An AI based computing network using complex algorithms to learn and make predictions on data from the iTunes + Netflix model. Although the computerized programs' total flexibility aims to satisfy the learners' interests by planning the content in the most effective manner, it provides the learners with knowledge by editing the information in the most productive way.

3.1.1 AI Cantered Learn Management System—Instruction, Study, Learning and Self and Self Education

An AI-powered learning management system (LMS) would offer the most efficient translation of the knowledge to your workers. The desire to personalise learning, is vital to a learner's ability in having the most use of their time and energy. Since the material is important and useful, students can progress through the course material more quickly since they are solving problems relevant to their needs. Classroom and in the workplace (after all a number of open remote schools already exist and many more are being planned), and need to constantly adapt learning to how people want to learn.

3.1.2 AI-Based LMS—Intelligent Knowledge Transformation

Content transformation and metadata collections are an important aspect of the digital marketing and publishing process in order to provide a strategic edge in a rapidly evolving learning climate. An efficient authoring tool that ensures that content can be customized to be used on both Android and Apple devices, as well as remaining formatted and have a decent user interface, is necessary for effective transaction and teacher satisfaction. With AI LMS's, it is easy to import material from a website that is placed elsewhere and return back the content in PDF format to rooms. It ensures that you do not need to incorporate any new technology. The LMS does all the interactivity and conversion for you.

3.1.3 We Use AI to Curate and Distribute E-Learning Content

Content curation and dissemination is done by a massive file set packed with a wide variety of ready-made, sensitive and aesthetic models. It was pointed out that educational simulations (courseware) are available in the prototype format. It was also noted that further simulations can be added to suit the needs and desires of the particular student. Material is curated in an immersive and stimulating manner that is meaningful for learning. Strong Artificial Intelligence (AI) based learning systems provide users with a range of intelligent food monitoring and instructional resources for monitoring learner growth. We will understand how to increase the efficiency of the education system if we invest more time, resources, and money into the observation and appraisal process. The statistics of quizzes (such as having a high-performance ratio), number of correct responses, or high efficiency of topics can be analysed for the continuous development of course content and learner understanding.

4 Results

Step 1: Students demographics data are obtained from the student profile which will be acquired at the time of student's entry, and their success data will be tracked and reported in their profile. The web logs in the Learning management system allow us to get the details about student engagement in the LMS on a particular module. e-learning is a website source which—automatically collects data sent from web servers or client machines; these are large collections of data collected from the websites that are accessed by the users. Students have to provide machine logins and sensors for cameras, webcams, and other tracking methods. The problem of logging is that there are so many systems.

Step 2: A methodology used by specialists to organize data into linked categories without advance.

The community members' meanings may be vague. Grouping the students by their learning techniques would help the teachers to devise the right teaching styles for the targeted children.

Step 3: It is portrayed in a graph that the learning style is found based on the student results.

Step 4: The lists of four learning types as defined by Felder and Silverman (1988), which are: concrete thinkers, logical thinkers, visual thinkers, and trainees.

The human–computer interface strategies would be used to promote the extraction of learners needs bases on variables that affect learners' academic output. What is Artificial Intelligence and how has it always been a subset of computers that can be used to promote intelligent tutoring, judgment support, evaluations of learning outcomes, and hypotheses of teaching in school. One of the main ways that a system can be intelligent is using Artificial Intelligence (AI). And in some cases, using AI can influence the actions of the system itself. Once the learners profile deduces from Data Mining that an integrated E-learning style can be implemented an IMS can be incorporated the instructional design principle into the LMS. Learners will be able to use Interactive LMS as a forum to access the recommended content in learning style by model. Since they will be using this method, the leaners will have a stronger interest in using it.

5 Conclusion

The performance of the electronic learning methods, it was observed that the uses of the tools could be wisely conducted on the learner studying style. Being proposed to use this model to be accurate and efficient in some sort of e-learning platform such as a Learning Management System. This model would empower the learners to learn how to manage the e-learning resources as progress and the in planning

the learning materials, the tutors must be familiar with the characteristics to satisfy the needs of learners. We are recognizing various backgrounds, different learning patterns, different teaching styles, there is also a need for instructional frameworks to have some input and to be able to integrate intelligence. After understanding different backgrounds, learning patterns, different instructional styles, there is a need to integrate intelligent education in the learning management frameworks to improve learner's behaviour. Such techniques such as Fuzzy logic, integrating intelligence, machine learning and trust factors in Information Based Applications and Decision support systems can extensively benefit LMS where deep searching techniques can be used to come up with material that highlights behaviour of a learner.

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Collaborative Security Schemes for Wireless Sensor Networks

Mohammad Sirajuddin and B. Sateesh Kumar

Abstract Information sensing and data aggregation are vital components for technologies like Machine learning, Big data, IoT, and Cloud computing. Providing security to data sensed in WSNs is critical. The risk of destructive security risks has risen as the resources are limited. Encryption, authentication, and firewalls are the first line of defense but not adequate. Collaborative Intrusion prevention and detection approaches complement security as the second line of defense. This review aims to provide insights into solutions to prevent, detect, and mitigate WSN intrusions. This paper provided an outline of WSN at the beginning of this review paper, and then we elaborated and compared a broad range of intrusion detection methodologies to demonstrate their performance. Finally, we concluded the report with an insightful potential course of study into the state-of-the-art fields that enable researchers in this area to assess their work.

Keywords Security · Intrusion detection system · Wireless sensor networks · IDS

1 Introduction

WSN is a potential technology applied to various fields of science. This network of sensors does make out of an enormous number of dispersed sensor nodes. These nodes are used for monitoring ecological qualities, such as sound, movement, vibration, temperature, pressure, smoke, etc. Sensors gathered the information and send the collected data to base stations. In Wireless sensor networks, sensor nodes do generally deployed in uncontrolled regions like the forest and underwater. WSNs struggle with limitations such as inadequate power supply, less bandwidth, and low energy [1].

WSNs conventionally consist of routers and switches, and other networking devices and uses heterogeneous routing protocols. However, the dynamically

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growing nature of WSNs makes monitoring and updating problematic. Innovative ideas and new mechanisms are needed to enhance the overall security of wireless sensor networks. Data security in WSNs is currently facing enormous challenges, which come from the security attacks in various forms; the customary security mechanisms like encryption, verification, and authentication, are not adequate [2]. Thus, we need efficient hybrid solutions for intrusion prevention and detection of WSNs.

The following are the prominent characteristics of WSNs:

- Dynamic topologies
- Fixed infrastructure deficiency
- Routing through multiple hops
- Demand for high bandwidth
- Resources shortage (computation, power, memory)
- Security limitation

During security attacks, attackers are usually concealed, tap the communication line, either for data collection; or destroy network resources. The attacker intercepts and modifies the information in active attacks. Encryption, authentication must be considered as the first line of protection that is not adequate to protect all kinds of security threats. Therefore, a multilayer collaborative security system needs to be developed to improve overall security in WSNs. The multilayer coordinated security system combines the intrusion prevention system, Intrusion identification, and Intrusion mitigation.

IPS (Intrusion Prevention System): This phase is a defense against attack; it is intended to any attack 'prevent' before it happened.

IDS (Intrusion Detection System): If an attacker succeeds in clearing the steps taken in the prevention phase, then it means there is a failure of defense; now, the detection phase needs to identify nodes that are compromised.

IMS (Intrusion Mitigation system): The final layer aims to react to the attack by removing a malicious node, updating the routing tables, and securing the network.

2 Wireless Sensor Networks Security

Due to their infrastructure-less nature, Wireless sensor networks are very prone to security attacks. Security requirements of WSNs depend on protocols used for data transfer. However, few safety measures are defined as follows.

Availability: It is one of the main requirements of WSN security. It maintains the availability of the services offered. Availability also means the nodes in the network remain unaffected despite the DoS attack [3].

Authentication: It is the user validation process; improper authentication in WSNs may lead to incorrect data.

Integrity: It ensures that no third person alters the data from the sensor node to Admin.

Confidentiality: It preserves confidential data from a third person's reach. Information leakage such as military and financial transfers in some systems is dangerous and not recoverable [4].

Privacy: All information related to a single node is referred to as private data, such as passwords, biometrics, and location. Privacy is the safe access by legitimate and critics alike inside and outside the internet to such private information.

Non-repudiation: It means two interacting entities cannot reject one another. It helps to recognize and delete malicious nodes.

WSNs attacks depending on the attacker's position, categorized as internal and external attacks. The intruders stay in the same network in internal attacks, and they are partially legal nodes with network accessibility. They are difficult to classify as a node of an opponent. Nodes outside the network induce an attack in the external attack.

WSNs attacks are of two types based on behavior: Passive attacks and Active attacks. No significant changes may occur during passive attacks. The network is unlawfully observed and inactively eavesdropped without interfering with the network in this form; the attack won't attempt to change the routing paths. In comparison, active attacks actively lead to network damage, destroying information, and altering routing paths.

3 Intrusion Detection System

In a standalone computer network, IDS is responsible for monitoring the activities, analyzing, and identifying conflicting events contrary to the system's safety policy as unauthorized activities by a malicious or permitted entity. When unauthorized behavior is discovered, IDS track network actions and trigger the alert.

The volume editors, usually the program chairs, will be your main points of contact for the preparation of the volume (Fig. 1).

The data collection module is accountable for gathering information from the various nodes of WSNs. The data pre-processor module processes the data using discrete pre-processors and converts the data into the desired form. The intrusion model is the database of already known intrusion profiles, and the response module is responsible for initiating the alarm if any intrusion is detected.

4 Classification of IDSs

The Intrusion detection system's taxonomy is presented in [5] as shown in Fig. 2. IDS are classified into multiple categories depending on different points of view.

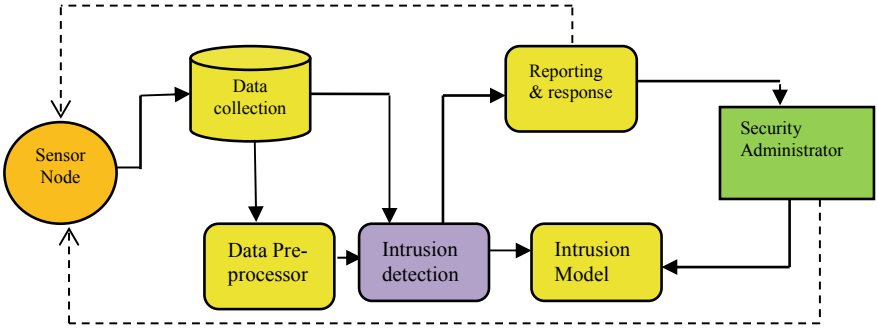

Fig. 1 Architecture of IDS

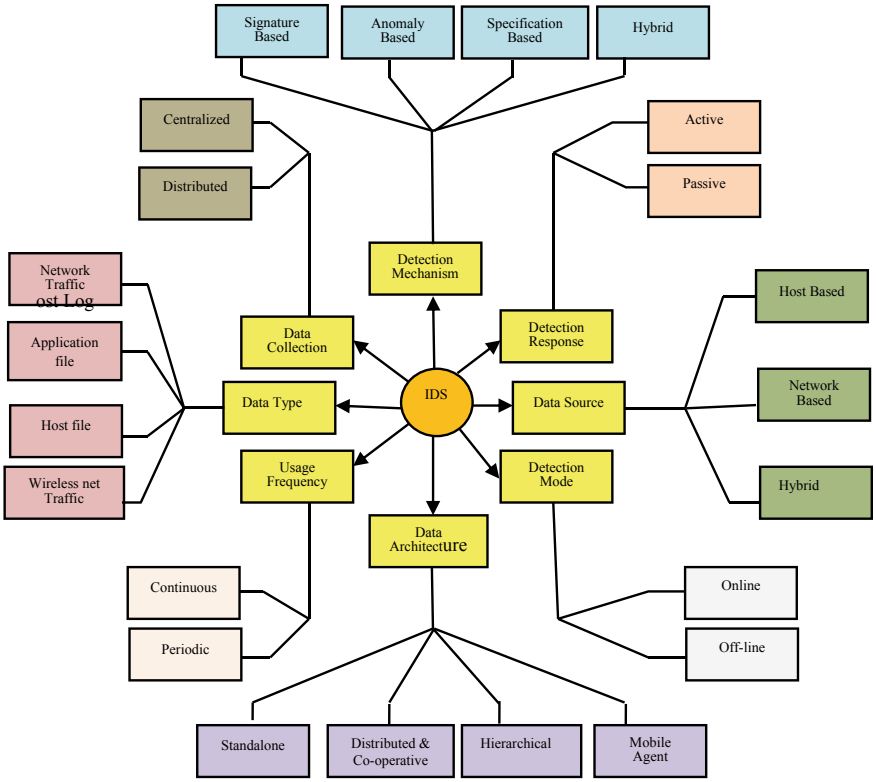

Fig. 2 Taxonomy of the intrusion detection system [5]

In this section, major categories are discussed as follows:

- Behavior-based IDS
- Knowledge-based IDS
- Agent-Based IDS
- Network-Based IDS

Behavior-Based IDS: This model of IDS monitors the actions linked with attack behavior, increasing the possibility of a malicious activity being detected and mitigated before the network is compromised.

Knowledge-Based IDS: It utilizes well-known attack signatures, a database of former attack profiles, and device vulnerabilities to recognize active intrusion attempts.

Agent-Based IDS: It requires tiny computer programs called agents installed on each system. The agents examine the computer operating system and network write data to log files.

Network-Based IDS: It typically includes a network node or sensor, running in promiscuous mode and a separate managing interface with a network interface card (NIC). The IDS is positioned along the section or border of the network and tracks all traffic in it.

4.1 Classification of IDS Methodologies

Machine Learning-Based: In this method, novel approaches based on Machine learning for anomaly identification and prevention are used to identify and avoid security attacks in Wireless sensor networks. Machine learning is used to learn continuously by analyzing information and data to find patterns to detect malware in encrypted traffic. Machine learning-based IDS and IPS approaches are suitable for infrastructure-less and scalable wireless sensor networks due to their continuous learning and data analysis (Fig. 3).

In [6], a systematic approach to avoid intrusion using Machine learning on structured data is proposed [6]. This method suggested the steps: Input, Dataset selection, applying the algorithm on collected input, processing the received input, a final

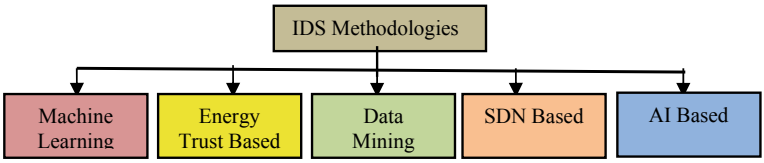

Fig. 3 IDS methodologies

decision can be taken based on output. This technique used the AVISPA [7] tool for verification concerning authentication. It provides a detailed risk monitoring and intrusion modeling on anomaly identification and prevention mechanism that observes the encryption pattern if any change in pattern predicts the intrusion for WSN using a potential security protocol verification tool [6].

The approach [8] uses the restricted Boltzmann machine learning-based cluster intrusion detection system (RBC-IDS), a potential machine learning and deep learning-based IDS approach used for observing the critical infrastructure of a wireless sensor network [8]. This approach proved to achieve a -99.91% accuracy rate and $= 99.12\%$ detection rate with the number of hidden layers are equal to three intrusive actions on the wireless sensor networks tested [8].

Machine learning-based methodology [9] presents an anomaly identification technique that depends on enhanced AdaBoost-RBFSVM for DoS attacks in WSNs [9]. This scheme uses a DoS attack algorithm called Enhanced AdaBoost-RBFSVM [9]. The method proposed is divided into three phases: data gathering, data identification, and data response. The WSN statistical information is used as the data input to evaluate a data set's detection process. Finally, the data response phase executes according to the data detection phase's output. The proposed approach [9] significantly improves overall network performance by identifying and eliminating malicious nodes.

Energy Trust-Based: Energy trust management is another technique for intrusion detection and prevention, which takes node energy prediction into considerations. WSN is facing enormous security challenges coming from internal and external attacks. Energy trust-based schemes are practical approaches for defending and preventing internal attacks. Each sensor node can calculate the trust which neighboring nodes have by interacting with one another in the energy trust model.

Energy trust-based intrusion identification system is proposed in [10]. It depends on predicting and calculating energy utilization to evaluate the nodes' security states [10]. The [10] approach uses an energy consumption prediction algorithm, the trust value of every node calculated by the formula.

$$T_{CH,i}(t) = \left[\left(\frac{10 S_{CH,i}(T, \Delta)}{S_{CH,i}(T, \Delta)\mathrm{d}x + U_{CH,i}(T, \Delta)} \right) \left(\frac{1}{\sqrt{U_{CH,i}(T, \Delta) + 1}} \right) \right] \quad (1)$$

$S_{CH,i}(T, \Delta)$ shows the time of successful communication between cluster head and node 'I' in a time interval Δ. $U_{CH,i}(T, \Delta)$ refers to unsuccessful interaction time, and by simulation proved that the true identification rate for hybrid DoS attacks increased.

The intrusion identification methodology NL-IDS is proposed in the paper [11] is a trust management based anomaly identification mechanism for WSNs network layer to identify the blackhole attacks. The network layer's critical factor determines the sensor node's trust value. This approach uses the wait and sees strategy where a node continually tracks the neighbor by computing an interval-based energy trust value. Finally, the sensor node's cumulative energy trust values are determined by

the values of network metrics. The suggested scheme successfully identifies the malicious node in the blackhole network layer attack to evaluate NL-IDS outcomes, a simulated model MATLAB used, and the result proves that NL-IDS offers improved detection and false alarm rate.

Data Mining Based: Mining of data is the process by which the user extracts data from the data repository. Data Mining includes efficient processing and collection of data. Data Mining is also used to find anomalies, patterns, and correlations within large data sets to predicts and deals with intrusions in WSNs.

A distributed, lightweight, hybrid IDS for WSNs proposed by [12], this approach uses both anomaly and misused-based detection and prevention methods. This method contains a central agent and multiple local agents deployed on WSNs, used for IDS and IPS. On WSN, The central agent is deployed and used for intrusion prevention and detection. The central agent, which is deployed on the server, acts as the WSN base station, assesses the local intrusion detection activities result, and coordinates home agents [12]. Suppose any local agent detects a security threat, an alert message generated and transferred to the central agent, along with data collected locally. The central agent analyzes the contents of the alert message. Based on the central agent's data and possible security information produced by the local agents; If the central agent approves the alert, it will notify all local agents of its decision. The proposed approach in [12] uses an algorithm that consists of two stages: Profiling and Anomaly detection: the proposed IPS and IDS performance considered by using false-negative rate, false-positive rate (Fig. 4).

The investigational results show better detection accuracy while keeping a satisfactory but not ignorable false positive rate.

The approach [13] uses a learning procedure to identify the inter-feature correspondence pattern. The scheme presumed that genuine and malicious activities are subject to various characteristics. The purpose of the scheme was to see unknown

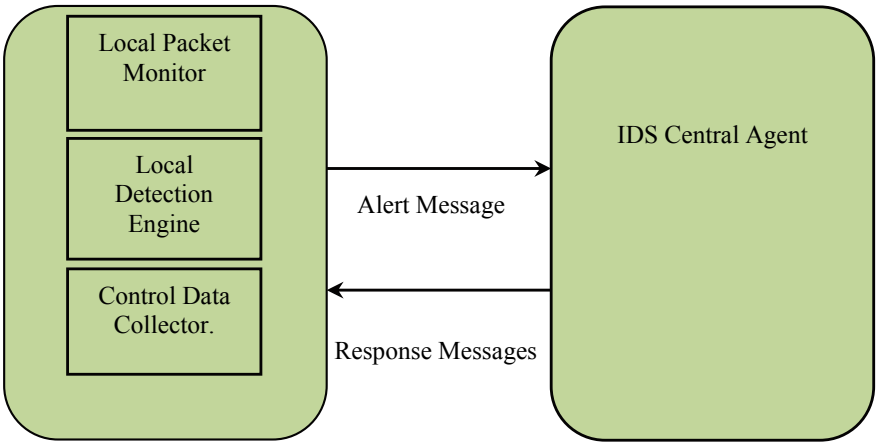

Fig. 4 DM based IDS architecture

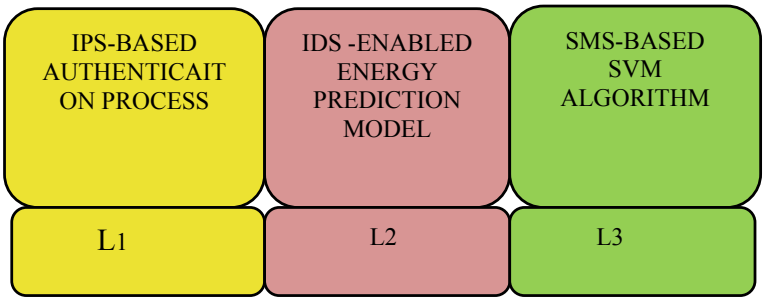

Fig. 5 Layered architecture of SDN based IDS

threats. It also has a high precision of detection. The constraint is that this scheme does not define the source of the attack.

Software-Defined Network Based: As WSNs are very vulnerable to security challenges; they cannot fix or reduce security problems under current security frameworks. SDN is a computing paradigm that emerged to overcome shortcomings of the existing hierarchical network management structure and lack of functionality [14–16]. SDWSN is a network programming technique where network managing becomes simple and allows it to control dynamically.

The paper [17] proposes a software-defined protection scheme that combines intrusion identification, prevention in conjunction with an anomaly mitigation system (Fig. 5).

In the proposed approach, an authentication process that depends on IPS was developed initially, and then a collaborative anomaly identification system leveraged to provide economical IDS, the true- positive alert produced by network nodes. SMS is used in the control plane [17]. The proposed approach combines three security layers, at Layer-1 IPS based authentication, at Layer-2 IDS enhanced energy prediction model, finally at top SMS based algorithm SVM used to improve intrusion identification rate.

In paper [18], the anomaly flow identification algorithm DPTCM-KNN was built under an SDN framework and proposed as an intrusion detection system. The algorithm takes oddity and independence as its dual assessment standard, the loopholes of the TCM-KNN algorithm, and increases the precision of anomaly flow detection. This paper finally carries out algorithm simulations through a framework such as Matlab. The investigational output results show that the DPTCM-KNN algorithm increases the detection rate and the exactness rate of detecting anomaly flow while also reducing the false positive detection rate, thereby offering the algorithm's good efficiency in the SDN context (Table 1).

Artificial Intelligence-Based: In designing the intrusion detection system, AI techniques are used for over two decades. It plays an intelligent role in intrusion detection. It enables the process of threat detection by evaluating data collections, clustering,

Table 1 Summary and comparison of IDS methodologies

Scheme	Approach	Architecture	Attacks resolved	Positives	Challenges
Ref. [10]	Machine learning	Stand alone	DoS attacks	Scalability	Required structural data
Ref. [8]	Machine learning	Stand alone	Node attacks	High detection accuracy	Time-consuming
Ref. [9]	Machine learning	Stand alone	DoS attacks	High detection rate	Energy consumption
Ref. [6]	Energy trust	Stand alone	Hybrid DoS attacks	High detection rate, short computation time	Used for specific purposes
Ref. [11]	Energy trust	Stand alone	Blackhole attack	High detection rate, reduced false-positive rate	Cannot handle flood attacks
Ref. [12]	Data mining	Stand alone	Node attacks	High identification rate	Time-consuming
Ref. [13]	Data mining	Stand alone	Node attacks	High precision of detection	Do not find the source of the attack
Ref. [17]	SDN	Distributive	Malicious node	High accuracy rate	Energy consumption
Ref. [18]	SDN	Stand alone	Malicious node	High detection rate	Time-consuming
Ref. [19]	AI	Cooperative	DoS attacks	High accuracy rate	Cannot detect some attacks

and data classification. In intrusion detection, some problems challenge AI that is considered in the creation of IDS.

A context-adaptive Intrusion detection system (CAIDS) approach is proposed in [19]. According to the node's elements, this methodology has been inferred by an intelligent IDS controller. These components consist of node residual energy and network security attacks. The CAIDS may accept the state of on/off by looking at qualitative knowledge contributing to the low resource use in WSNs. The scheme has provided a balance between detection accuracy and resource utilization. The system is minimal and vulnerable to distributed attacks.

5 Discussion

A computer or application software that monitors a network for malicious action or policy violations is IDS. Using a safety mechanism and event managing system,

any malicious activity or breach does usually recorded or collected centrally. Several surveys have been suggested from the very beginning to clarify different facets of IDS. Some of the surveys provided an analysis of IDS. Other surveys discuss different IDS strategies based on different approaches. In our review, we have tried to give WSNs all relative IDS knowledge. This is also sought to cover most structures in sensor networks using different methodologies found in IDS. Several proposals are summarized in tables with influential writings, including scheme architecture, fixed attacks, tracking methods, strong points, and weak points.

6 Future Directions and Open Research Issues

Controlling False Positive Alarms: Present IDS/IPS cannot solve False positive alarms efficiently; in some situations, the regular action is assumed as an abnormality and initiates false alarms, which downgrades the overall network performance, though these false-positive alarms need restriction.

Multiple Attacks: Normally, only a few attacks were taken into the report by the existing IDS/IPS approaches. Shortly, the variety of IDS attacks that must consider in the monitoring process is a good idea.

Reducing Resource Consumption: Current IDS schemes are robust and use heavy modules that may consume resources more; using effective lightweight to be robust schemes is today's need.

Ensure Safe Synchronization Between IDS: IDS interacts with each other for correct intrusion finding decisions in most hybrid intrusion detection systems. However, it is essential to protect such correspondence. By taking into account cryptographic methods, we can improve the security of this correspondence.

Delay in Intrusion Detection: Many of the IDS schemes discussed in this review has more considerable detection delays not acceptable as it decreases the performance of underlying networks.

7 Conclusion

In this review, we briefly discussed the security threats faced by WSNs. their security requirements. We also studied and elaborated on various Intrusion detection and prevention systems, their modules of work, challenges, and needs in WSNs. This review classified the IDS approaches based on multiple technologies and explain the approaches developed. This paper also contains listed IDS and IPS schemes and their comparisons, and detailed tables make the distinction more apparent. Based

on the study and analysis, we highlighted some open research problems and offered potential research Instructions to support IDS and IPS researchers in WSNs.

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Risk Factor of Diabetes with Comorbidity Using Machine Learning Techniques

Vadthe Narasimha and M. Dhanalakshmi

Abstract This paper is proposed to find the diabetes types using machine learning model classification and classifier accuracy using Support Vector Machine (SVM) for classification of whether patient have diabetes or not and classifier accuracy implemented using random forest algorithm as well as for best result XGboost algorithm. Diabetes Mellitus patient may suffer with comorbidity of either kidney, heart stroke or retinopathy or Covid-19 then how the diabetes will effect on more and how much dangerous cases in this pandemic situation. The dataset is collected from standard open source Kaggle this dataset is benchmark. Patient have multiple chronic conditions, screening, conscious and treatment need to take care far exceed time available cases how effect will increase in the various ages.

Keywords Diabetes mellitus · Comorbidity · SVM · Random forest · XGboost · Covid-19

1 Introduction

As per the WHO acknowledge 10 out of 6 members are facing with different types of diseases within that one of the most dangerous disease is diabetic disease. When sugar level increase in body diabetes is occurred to one person may have the face the stages of type1 and later if it can go very saviors with food taking care or any other carrying of type1 level can't control that disease it can goes to the another level of the disease called type2 diabetes these type of disease may suffer most of the aged people only [1]. Sometime if age also less but fat level increase in the body then also attacked by the type2 diabetes mellitus.

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Most of the research article are described diabetes, among other commonly related diseases, such as obesity, hypertension, blood level changes, coronary heart diseases to be a risk factor either for COVID-19 itself or heart stroke or kidney damages or liver damages and eye retinas damage like more effort will go to type2 Diabetes mellitus patients this are the more severe course and mortality [2]. The reason for this remains unclear but risk population pattern is continuous similar to the previous fatal of new disease getting chances are more.

Most of the people are living in very deprived areas had $\geq$2 comorbidities present at the time of diagnosis (75% of female and 65% male) compared to the affiliated areas patient are facing with diabetes mellitus problem but those who are ling in rural area they are less people suffer with diabetes in that areas had $\geq$1 [1].

In 2027, 33% of females and 15% of males diagnosed with T2DM were predicted to be affected by depression. Moderate increases in clustering have been observed, with concordant conditions clustered together and some changes between various segments of society (Fig. 1).

While changing of type1 to type2 diabetes in human body diabetes can effect on various organ. The organ can damage the human main parts (Fig. 2).

Risk factor identification using machine learning models of support vector machine (SVM) and K-mean algorithm.

K-Mean Algorithm is utilized for removing the loud of information and Genetic Algorithm is used for finding the ideal set of highlight with Support Vector Machine (SVM) as classifier for classification [4]. The Pima Indians Diabetes Mellitus from UCI repository to achieve the exactness decreased 98.79% to average achieving.

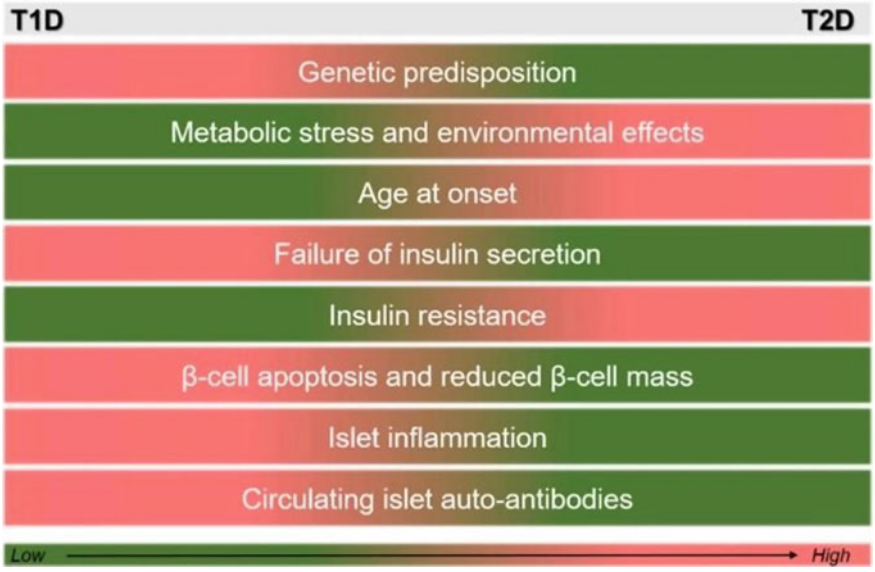


Fig. 1 Variation to changing the diabetic type1 to type2 [2]

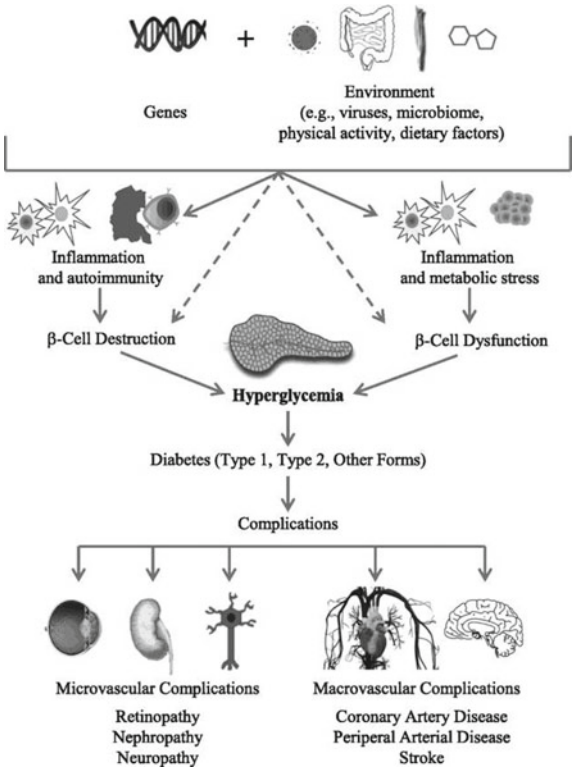


Fig. 2 Comorbidity of diabetes mellitus [3]

2 Literature Survey

Santhanam et al. proposed a technique [5] with k-mean algorithm with SVM classifier and distinctive dataset to enhance the classification accuracy the use of Genetic Algorithm alongside with hybrid mannequin and Hybrid k-mean observed by using naïve bayes and Neural Network [6]. Hemant et al. proposed by means of the k-means clusters to decrease dataset with specific classification algorithm for predicting diabetes. Hybrid model can be integrating a case of information clustering technique and a fuzzy choice tree to classify [7] the liver disordering and bread most cancers dataset. Loannis et al. proposed a desktop mastering algorithm to consider exclusive subset of characteristic and set with nice classification accuracy. for same help to take "machine learning is an identical to the time period "artificial intelligence", given that the opportunity of mastering the primary attribute of an entity referred to as sensible in the broadest sense of the word."

Machine learning tasks can classify into three categories (a) Supervised learning is a series of function which is labeled to train dataset which is input equal to output, (b) Unsupervised learning can learn the system tries to refer the structure of unlabeled

dataset which is trained, and (c) Reinforcement learning which system communicate with autonomous instant environment.

3 Diabetes Mellitus with Machine Learning

Diabetes mellitus (DM) is described as a team of metabolic problems frequently precipitated with the aid of peculiar insulin motion. Diabetes Types1 (T1D) and Type2 Diabetes (T2D) can categorized according to the etiopathology of the disorder. T2D appears to the most common from of diabetes (90% of all diabetes patients only), mainly characterized by insulin resistance [8]. Diabetes programming is strongly linked to several complications is called comorbidity. Comorbidity is the complex of primary disease to any another one or more disease attacking to primary disease [9, 10].

Machine learning can train the function to get the target to find the various trained label data. Using supervised machine learning we can get the classification and classifier accuracy data. Supervised learning classification model is try to conjecture first classes, such as e.g. Blood groups while regressing models predict numerical values. Some of the common technique to find the resultant are Decision Tree (DT), K-Nearest Neighbors (K-NN), Genetic Algorithm (GA), Artificial Neural Network (ANN), Conventional Neural Network (CNN), Role learning, Random Forest Algorithm and SVM. The Machine Learning algorithm evaluate subsequence subset of feature selected the one with the good performance of classification and classifier accuracy [11]. In these case first we train with 10% of data independent assessment on general characterized and another one 90% of data is trained by the machine learning (Fig. 3 and Table 1).

For the classification of diabetes, we are used for SVM and Random forest algorithm used for the accuracy implementation at that move moment it's taken some amount of time and it gives the benchmark data accuracy is 74.56% and using xgboost algorithm is given very efficiency accuracy when compare to random forest algorithm similarity score is 78.65% with best regards.

$$similarity\ Score = \frac{S.R^2}{N + \lambda} \tag{1}$$

Here, S.R is the sum of residuals, N is number of Residuals.

4 Feature Scope

As per WHO record past considers recommend that type of Diabetes and combination of Comorbidity may affect more on diabetic care. Diabetes Patients with combinational both concordant and conflicting conditions with clinically overwhelmed conditions since quiet may have particularly diverse wellbeing care needs and utilizations

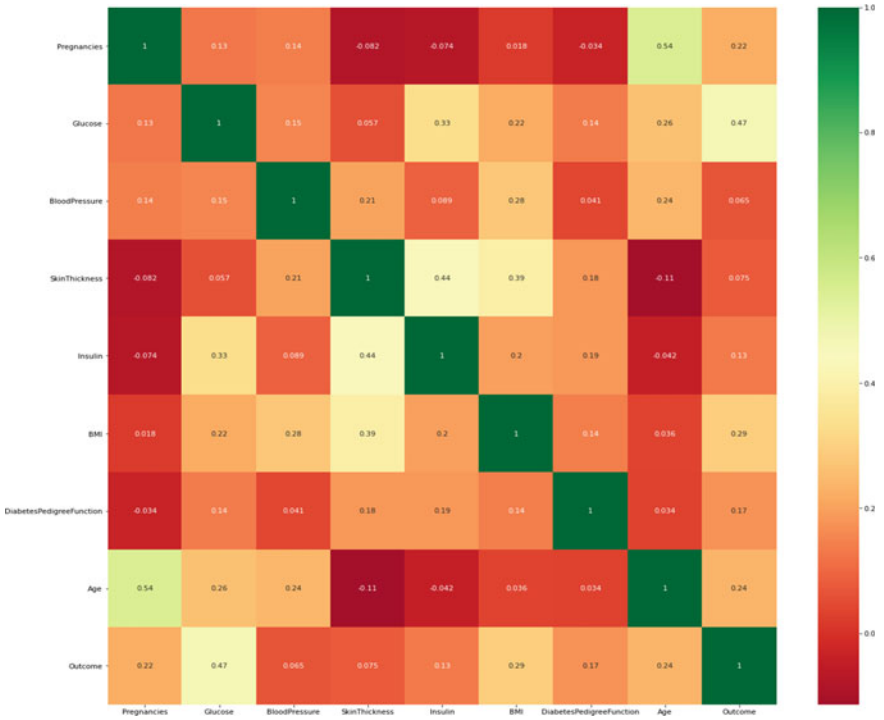


Fig. 3 Plot heat map of diabetes

to diabetes is exceptionally basic to illness management [12]. As per the previous study the seasonal variation of severe hypoglycemia in patients with type1 and type1 diabetes mellitus are having more impact factor on contextual diseases. Several studies have shown that sepsis is also associated with seasons. Neurofibromatosis type1 (NF1) is also multisystem disease of autosomal dominated inheritance, with an incidence of 1 in 3000 people worldwide. H1N1 (Pandemic Influenza virus) infection is more risk factor shows on diabetes with combinational disease in 2009 [1, 3]. This influenza virus is a very small RNA virus that infect many mammals, including human, bird and swine. As per WHO record most of the effected patients H1N1 virus effected with dearth rate high is progeny woman's only because most of the cases they have more chance to effect with diabetes [13–15]. In that same case of pandemic situation SARS-Cov2 disease also wondering the worldwide (Fig. 4).

In India most of the people are living at rural areas they did not go for regular checkup of diagnosis for that case it suddenly increases the type1 to type2 Diabetes Mellitus. And this is the sample bar graph how the Indian people are effected with comorbidity of primary to secondary disease. Based on blood glucose level 5–6% is diabetes type1 and <6% is diabetes type2 classified using Random forest algorithm, and linear regression method (Figs. 5 and 6).

Table 1 Diabetes analysis

	Pregnancies	Glucose	Blood pressure	Skin thickness	Insulin	BMI	Diabetes pedigree function	Age	Outcome
Pregnancies	1.000000	0.129459	0.141282	−0.081672	−0.073535	0.017683	−0.033523	0.544341	0.221898
Glucose	0.129459	1.000000	0.152590	0.057328	0.331357	0.221071	0.137337	0.263514	0.466581
Blood pressure	0.141282	0.152590	1.000000	0.207371	0.088933	0.281805	0.041265	0.239528	0.065068
Skin thickness	−0.081672	0.057328	0.207371	1.000000	0.436783	0.392573	0.183928	−0.113970	0.074752
Insulin	−0.073535	0.331357	0.088933	0.436783	1.000000	0.197859	0.185071	−0.042163	0.130548
BMI	0.017683	0.221071	0.281805	0.392573	0.197859	1.000000	0.140647	0.036242	0.292695
Diabetes pedigree function	−0.033523	0.137337	0.041265	0.183928	0.185071	0.140647	1.000000	0.033561	0.173844
Age	0.544341	0.263514	0.239528	−0.113970	−0.042163	0.036242	0.033561	1.000000	0.238356
Outcome	0.221898	0.466581	0.065068	0.074752	0.130548	0.292695	0.173844	0.238356	1.000000

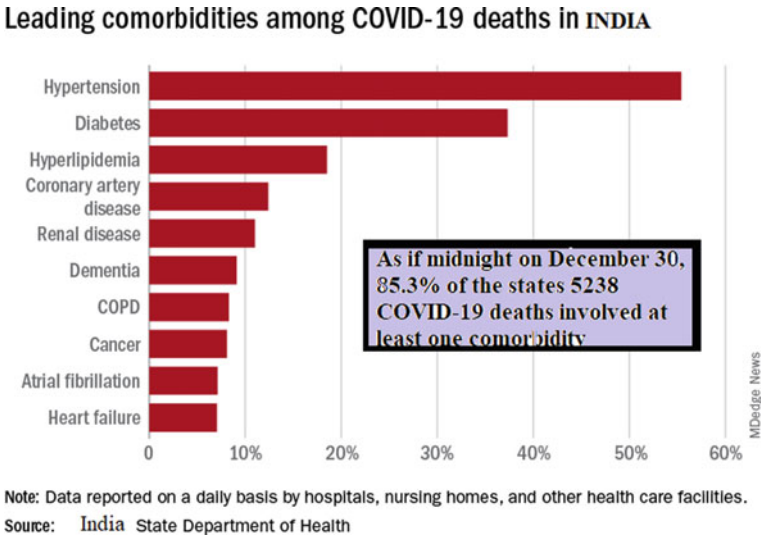
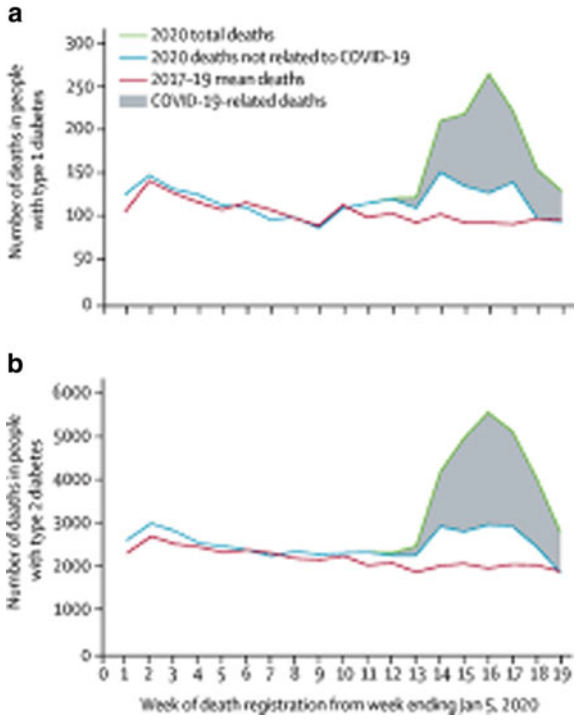


Fig. 4 Comorbidity effect on Covid-19

Fig. 5 Risk of comorbidity graph



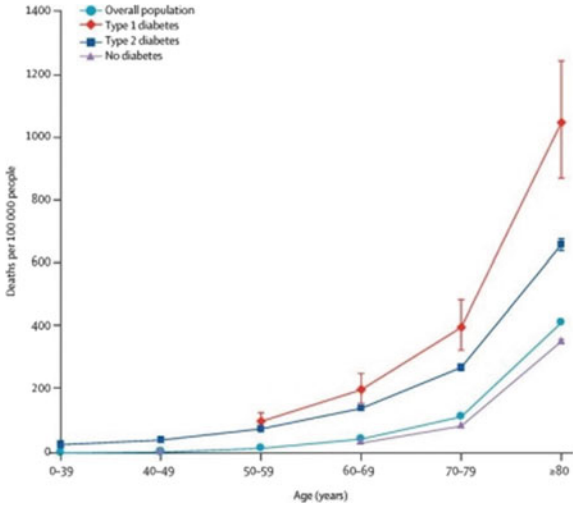


Fig. 6 Diabetes increase in various ages

This two above graphs are representing to how the disease is increase in various ages of basically we divide age is 6 parts first age ≥39, second age ≥49, third ≥59, fourth ≥69, fifth ≥79 and sixth ≥80 plus persons in this case most of them are very heavy to attacked by the comorbidity of type 2 diabetes patients because they are most of them old age people.

5 Conclusion

Diabetes Mellitus (DM) is one of the continuous uncontrollable disease on the world with that any another disease attacked by the patient they have more chance to get dearth rate or unconscious continuous. Comorbidity is the process of a disease which if primary to secondary continuous effecting on the affection. Here this paper is proposed to the concept of comorbidity of diabetic patients either type1 or type2 diabetic may effect with covid-19 then how it increase the dearth rate in India as well as other country. Feature scope is to find the diabetes patient affection with covid-19.

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An Overview of Various Security Issues and Application Challenges of the Attacks in Field of Blockchain Technology

K. Vijaya Babu, Mrutyunjaya S. Yalawar, G. Sumalatha, G. Ramesh Babu, and Ravi Kumar Chandu

Abstract In present world, everyone seems to be specializing in technologies however they're not worrying concerning security. Most users and researchers are giving more attention of the Blockchain applications and technology itself, however less attention towards security. In this paper, we represent overview of the various cyber security challenges and the privacy of various Blockchain applications. From the essential data security and the very effective privacy protection which can make the Blockchain to be used widely in the industries. From the expansion of Blockchain applications many of the security attacks are targeted to the Blockchain. This paper for the most part centers around the security examination of the innovation and uses of the Blockchain, and condenses the vulnerabilities and anticipates potential assaults and furthermore outlines the present status of Blockchain security protection.

Keywords Cyber security · Blockchain technology · Data security · Privacy protection

1 Introduction

As we know that in the present world there is lot of cyber attacks happening more frequently. Even in the rapid growth of companies with huge database systems are the mainly the target of attackers. As We know that the Facebook database was hacked in the year 2018 in the month of October, where the attackers got the personal information of about 30 million customers of facebook. In today situation that to be living in the digital era most of companies need to protect their information in the secured manner. From these examples its very necessary to secure our data like emails, messages, social media data whether in the form of public or it may be private between the users and chats. There are huge kind of information will be collected from customers with the help of social media in this present world. Like as we know

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that in the field of cyber security, information security the Public Key Infrastructure [1] encrypts the kind of messaging applications along with many communication ways. The one of the biggest drawback of PKI is that they rely on third-party certificate authorities where the cybercriminals can target easily. Along with this one of the biggest drawback of Domain Name System as it will be centralized, where the attackers can intrude connection between DNS and the IP. Usually the hackers can combine DNS with DDoS attacks to make the crash down the systems in the period of time. The Internet of things which makes possibilities of life to lead easier but it also makes switches, routers, doorbells, security cameras, smart devices vulnerable [2]. The one of the attack like DDoS Distributed Denial-of-Service which acts as a nightmare for all [3] most all industries who dealing with huge data. From this attack the company can face problems like slowing down services or it may be no access for that specific services, sometimes there may be chance of website which may be compromised. Here the problem in avoiding DDoS attacks which is decentralized of DNS which means hackers can crash the website one after the another by targeting the centralized DNS. If we see all these scenarios, [4–7] cybersecurity plays a vital role by offering the system integrations, advisory services along with the managed security services to provide the support for companies in implementing as well as designing.

Here the most crucial part is about security and safety about the Blockchain which can be a kind of solution between the various platforms like messaging, exchanging all the information in a secured manner. This technology Blockchain ensures the better security which can reduce the vulnerability, number of cyber attacks in the coming future.

1.1 Structure of Blockchain

The Blockchain which can offers a facility to store information, perform functions, execute various transactions along with establishing trust in open environment in many areas. When we have a look from the data management. Blockchain is type of distributed database which can logs list of transaction details into a chain of blocks hierarchically. But when we see from Security point of view, the Blockchain created and maintained like peer to peer overlay of networks in a secured, decentralized [8, 9] and with crowd computing cybersecurity which can provide better security.

From Fig. 1 we can observe that by default provides the solution for the problem of multiparty trust in case of distributed. The Blockchain usually have a result of

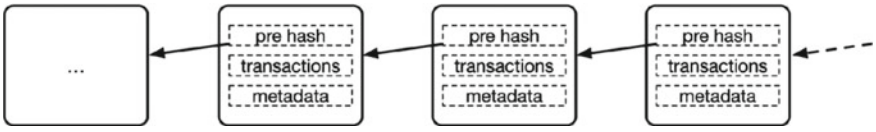

Fig. 1 The blockchain technology

ledger technology in various distributed cases. The Ledger it may be by means of single entry, double entry, digital bookkeeping to distributed level.

The Blockchain technology which has characterized with decentralized, security and the accountability. Because of these characteristics the Blockchain technology can be applied in many fields (Fig. 2).

The Blockchain which can consists of chain of blocks which involves kind of information like kind of database which can be grouped in a peer-to-peer network. It may be combination of computers linked to one another in a decentralized manner. The Blockchain which can allows digital information to the distributed and distributed ledger which can ensures the trust, transparency and data security during the operation (Fig. 3).

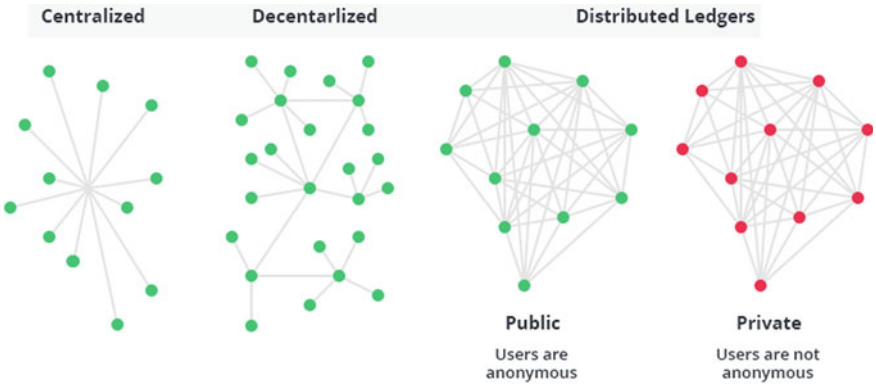

Fig. 2 Centralized, decentralized and distributed ledger

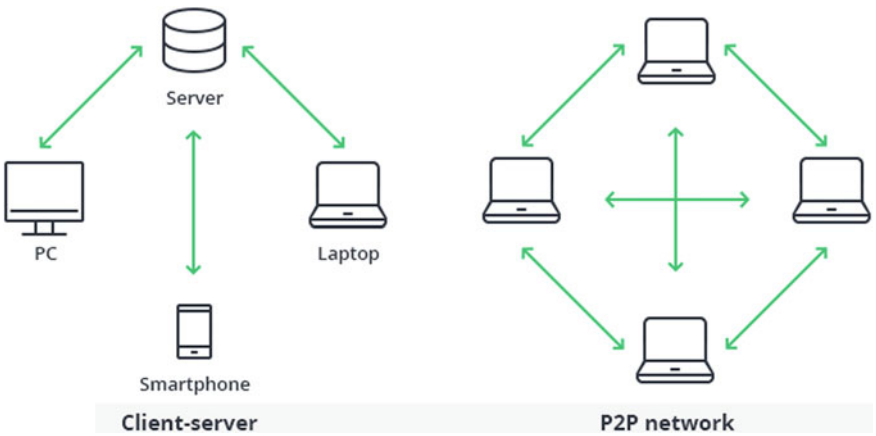

Fig. 3 Shows client server versus peer to peer network

The Blockchain is a kind of decentralized and the distributed ledger of different sorts of transactions arranged into a P2P network where these network consists of the many computers but during a way that the info can't be altered without the consensus of the entire network. Usually the structure of Blockchain technology is represented by an inventory of blocks with transactions during a particular order. The 2 vital data structures utilized in Blockchain include Pointers which keeps the knowledge of location of another variable which is pointing position of that variable. The second one is the Linked list where there is a sequence of blocks which have specific data and links (Fig. 4).

Logically, the first block does not contain the pointer so it is in chain first. At the same time, there is potentially going to be a final block within the Blockchain database that has a pointer with no value.

Basically, Fig. 5 Blockchain sequence diagram is a connected list of records.

Fig. 4 Vital data structures

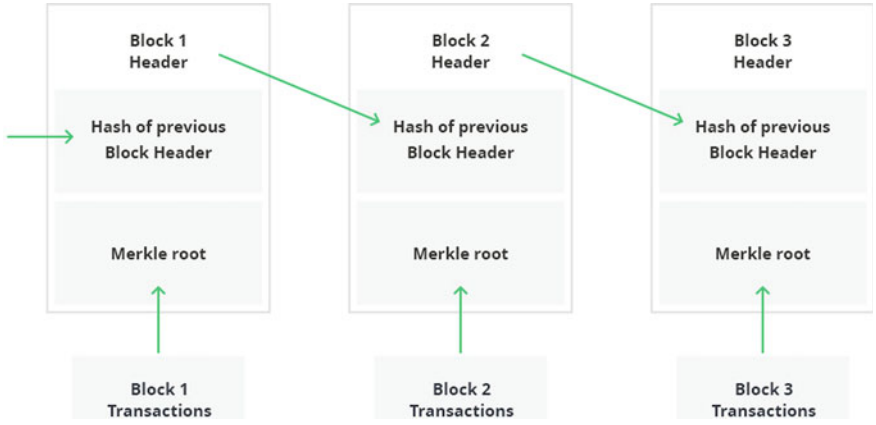

Fig. 5 Sequence diagram

1.2 Classification of Blockchain

The Blockchain is classified into three types like Public, Private and Consortium Blockchain along with main chains and the side chains based on the relationship of chains [10].

1.2.1 Public Blockchain

It is a consensus Blockchain that everybody can get an access where the users in Blockchain topology can send transactions and validated. Usually these Blockchains are generally considered to be "completely decentralized" typical use just like the bitcoin Blockchain [11], during which the knowledge is totally disclosing.

1.2.2 Private Blockchain

The Private Blockchain during which the permission to write down remain in one organization which permission to read are often public or limited to some extent.

1.2.3 Consortium Blockchain

In between Public Chain and personal chain, the Blockchain whose consensus process is controlled by pre-selected nodes. Example like if there's a system of 15 financial institutions where each of which manages one node and a minimum of 10 of which must confirm each block to be recognized as valid and added to the chain. The proper to read the Blockchain are often hospitable the general public or it's going to limited by participants or hybrid. Such chains are often called partially decentralized.

Figure 6 provides a detailed comparison among these three Blockchain systems.

2 Blockchain Technology: The Future of Cyber Security

As we know the technology behind Bitcoin has taken over the world in the present situation. The Blockchain has in every field like from banking sector to Healthcare applications even beyond that. Among these the cybersecurity in a industry plays a very vital role in technology in the coming years. In the Paper Alex Momot's [12], says the removing of human element from various data storage, where the Blockchain have the risk which cause of data breaches. The Blockchain Technology will be used to prevent any type of breaches related to data, identifying the thefts or any kind of cyber attacks in the case of transactions. Hence it provides whatever data which can remains secured and private to the user.

Property	Public Blockchain	Consortium Blockchain	Private Blockchain
Consensus determination	All miners	Selected set of nodes	Within one organization
Read permission	Public	Public or restricted	Public or restricted
Immutability level	Almost impossible to tamper	Could be tampered	Could be tampered
Efficiency (use of resources)	Low	High	High
Centralization	No	Partial	Yes
Consensus process	Permission less	Needs permission	Needs permission

Fig. 6 Comparison of three blockchain systems

2.1 Some of the Features

As we know that like Blockchain even the cybersecurity plays a very important role in every aspect like large investments. The most of the Cybersecurity offers a services, managed security related services and system integration in order to support for industries in field of Cybercrimes in the systems. But the Blockchain which can provides a innovative approach for the cybersecurity as it allows a kind of system designs which is characterized by means of security and have three basic aspects as follows below,

- **Decentralization**

In Blockchain whatever the data available those data are decentralized and its verified so that in case any system is properly distributed, that time concept of single point is avoided or its eliminated. But the hacker can still acquire or do attack on any one of the nodes of that structure which may be more difficult to crack the data which is available.

- **Anti-tampering**

This is one of the fundamental aspects where each block can be added to the make the Blockchain more powerful. Each block consists of cryptographic reference to each previous block which can be modified only on the approval of network nodes. It's very difficult to take the control of block from the hacker as the structure grows rapidly.

- **Zero proof knowledge**

This is kind of data protection where it will verify the identity of the users without using any personal information which can meet some kind of requirements.

Regardless of the DLT type, the Blockchain technology offers numerous security characteristics:

Immutability: Once added to a block, a transaction becomes irremovable.

Auditability: Each block is characterized by cryptographic schemes and secure timestamping offering the capacity to audit each transaction.

Integrity: The SIGHASH function validates the signatures ensuring that any modification will invalidate the transaction.

Authorization: Elliptical Curve Digital Signature Algorithm (ECSDA) is used the links between the blocks.

Fault Tolerance: Many agreement mechanisms are involved to achieve the consensus in DLTs.

Transparency: The transactions are appended into blocks and replicated publicly to the peers.

Availability: Even if peers exit the network, the Blockchain network is continually available.

Consistency: Once the miners agree on the consensus and block arrangement, the distributed ledger is consistent and changes are infeasible.

Privacy: While the distributed ledger is public, keys relatives to each parties are anonymous.

2.2 The Hash Chained Storage

As we know that the Hash pointer and Merkle tree are the two fundamental building blocks for implementing the Blockchain in Bitcoin using the hash chained storage.

2.2.1 Hash Pointer

The Hash pointer is the one where its pointing to the location where the data is stored. Hence, the hash pointer used to check data whether it is tampered or not. Usually the Block chain organized with the help of hash pointers where predecessor data is stored for the operation. Even it can be used by the public to verify the data which is stored that the users can able to get data has not be tampered.

2.2.2 Digital Signature

A well outlined and secure signature algorithmic program ought to have 2 properties. The primary property is valid signatures should be verifiable. The second property is signatures are existentially unforgeable. It implies that associate in Nursing soul World Health Organization has your public key cannot forge signatures on some messages with an amazing chance.

2.3 Applications

The cybersecurity business will enjoy Blockchain's distinctive options, that produce a nearly impenetrable wall between a hacker and your data.

2.3.1 The Cryptocurrencies

First enforced because the operational network behind Bitcoin, Blockchain is currently utilized in over 1000 completely different cryptocurrencies, variety that grows nearly daily. DLT protects the integrity of cryptos through secret writing ways and public info sharing.

2.3.2 Banking

At present, the process once world securities commerce is extremely difficult. throughout the eventualities once multiple banks wish to affix along and wish to share a selective non-public information or the other group action details to taking part banks, this technology offer the flexibility to record transactions from every bank during a method that's visible to the participants, however not the general public. However, to try and do this as a non-public Blockchain (to avoid having to use a chic proof of labor algorithm), every bank takes turns sign language the blocks beneath a distributed accord rule. If there was some major disaster or exception scenario, the banks may coordinate to roll back the Blockchain and write a distinct group action. In addition, the transactions wouldn't be anonymous as a result of a banking ID would be needed to affix.

2.3.3 Energy Industry

One of use cases in energy business of Blockchain usage is in recording certificates in primarily in sensible grids. There are totally different power plants generating energy and making certificates that attest to the number of energy made for ulterior exchange. Currently there are issues like emission certificates are spent doubly likewise because they have to be compelled to address restrictive challenges and supply additional uniform access for everyone within the market. A Blockchain will effectively track the issuing and payment of those energy certificates.

2.3.4 Defense and Military

Innovation within the military and defense sectors has LED to a number of the most important technological breakthroughs within the past century. The U.S. military

pioneered the web to share vital elaborated data with spread teams everywhere the planet, and it created GPS to raised grasp military positioning.

These militaries and defense corporations use Blockchain's encoding and decentralization ways to boost information security and maximize privacy.

3 Attacks

The some of the attacks where play a vital role in blockchain technology like Selfish mining attack, DAO Attack, Border Gateway Protocol hijacking attack, Eclipse attack [13], Liveness attack and Balance attack. To over these we have security enhancements which can be introduced in next session.

4 Security Enhancements

In this section, we have a tendency to summarize security enhancements to Blockchain systems, which might be employed in the event of Blockchain systems.

Blockchain technology itself remains within the initial stage of fast development, and its security is much behind the wants of development. The risks might come [14, 15] from attacks various like SmartPool, quantitative framework, Oyente, Hawk, Town Crier and its process.

5 Conclusion

In this Paper we focused on the various cyber security issues of Blockchain and its applications. Even we made a survey of various real time attacks and analyzed their Vulnerabilities which is exploited in these attacks. At last we summarized the enhancements in the security which can be helpful for the researches to continue their work.

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Analysis of Ensemble Flood Forecasting Using Meta Classifiers and Tree Classifiers

Philomina Sharon, C. V. Sreelakshmi, and G. Deepa

Abstract The changes in climatic conditions begun to impact various regions around the world. Flood forecasting is a fundamentally challenging task because of its uncertain nature. Therefore, flood forecasting has been a key research area in the field of hydrology. This study introduces a machine learning approach that make use of meta classifiers—RandomSubSpace (RSS), LogitBoost (LB) and tree classifiers—RandomForest (RF) and REPTree for prediction. A combined approach of classifiers is selected for the forecasting of flood. The use of Tree classifiers along with Meta classifiers produce a better result to analyse the weather conditions that trigger the flood. The experimental results show that the Error rate can be effectively reduced by formulating the Tree classifiers with Meta classifiers and thereby the forecast accuracy can be improved.

Keywords RandomSubSpace · REPTree · LogitBoost · RandomForest · Meta classifier · Tree classifier

1 Introduction

Disastrous floods are difficult to predict because of their complex non-linear nature and short response time. Flood forecasting and damages caused by flooding has been one of the major environmental issue around the world. Many technologies are available now a days for flash flood forecasting. Advancements in technology contributes to prepare for and mitigate the flood risks. Flood prediction is a vast research area in hydrology. More accurate and timely flood prediction helps to avoid the risk of flood disasters. Rainfall plays an important role in determining precise predictions. The dataset is collected from www.github.com dataset from weather station in Brazil is used for this research. This dataset contains monthly data of air humidity, cloudiness, rainfall, precipitation, maximum temperature, minimum temperature,

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and mean temperature obtained from Brazilian weather station Sao-Paulo. Responsible parameters for this forecasting are cloudiness, precipitation, temperature and humidity.

With the developments in computer technology, Machine Learning (ML) has been widely used in hydrology. The tool used to process the dataset is WEKA. WEKA contain tools for Classification, Clustering, Regression, Visualization etc. various pre-processing steps such as Normalization, Binarization etc. are also available in WEKA. The classifiers we used for prediction are Meta classifiers and tree classifiers. A correlation of meta classifier algorithms—LogitBoost, RandomSubSpace (RSS) and Tree classifiers—RandomForest and RepTree are used for further processing. The factors used for comparison of algorithms are Mean Absolute Error (MAE), Root Mean Square Error (RMSE), forecast accuracy and the time taken to build the model.

2 Literature Review

Paper [1] deals with Rainfall Forecasts at Nagpur Station. Parameters are considered for wind speed, humidity and temperature. In the study, they analysed the Frequent Pattern Growth algorithm and Mean Absolute Error (MAE), Mean Square Error (MSE) and Standard Deviation (SD) features and rainfall tests were checked next year at Nagpur Station. They concluded by saying that FP Growth Algorithm shows a better monthly rate of rain forecast than the Neural Network. In [2], the authors used the FP Growth Algorithm for figuring out weather in Bandung Regency, Indonesia. On the basis of the rules produced, J48 algorithm is used and the performance measure is evaluated. Various performance measures like Accuracy, Precision and Recall are used. In [3], the authors draw up a better method for reducing error rates in J48 and Random Tree algorithm by analysing the outcome of Meta Classifiers—Bagging and AdaBoost on Tree Classifiers—J48 and Random Tree. They concluded that comparing the results shows the error measure in the two Tree classifiers can be narrowed down by using Meta classifiers [4]. Provides a relative study based on Random Forest (RF) as well as J48 algorithms. RF and J48 algorithm were applied to weather data. When compared to J48, RF algorithm had shown lesser MAE and more accuracy. This paper [5], exhibits a comparison of two sub-sample methods of non-parametric methods for constructing time series prediction algorithms from the monthly accumulating rain. Both of these approaches were based upon the artificial feed-forward neural networks (ANNs). Reference [6] deals with presenting the assessment and accuracy of mining techniques algorithms for a variety of decision trees using the WEKA tool. They used seven classification algorithms to obtain weather data test results. Of these 7 algorithms, the Random Tree algorithm exceeds the other algorithms by providing 85.714% accuracy. In paper [7], the authors had evaluated several ways to build classic heterogeneous classifiers by Stacking and have shown that they do the same by choosing the best separator by combining with cross-validation. Paper [8] focuses to differentiate the performance functions

of different machine learning algorithms by using open source dataset. Performance of classifier algorithms were tested for fivefold cross validation tests. For that the authors explored various methods of classification methods like REP, J48, RF, and LMT also found that RF has high accuracy and low error rate. In paper [9], the authors reviewed the effectiveness of decision tree induction classifiers on several medical datasets on the basis of time complexity and accuracy. They studied the frequently used drug filters and various tests have been performed to determine the best diagnosis of Medical Diagnosis. Test results have shown CART as the leading algorithm for medical data classification. It is also evident that CART can also work well with medical datasets with increased size.

3 Proposed System/Material and Methods

3.1 Binarization

The first step is pre-processing. For this we use Binarization. The data we collected from www.github.com was in CSV format and this format is converted to ARFF using Weka. The nominal fields in the dataset is converted into binary because we need binary data to apply classifiers. NominalToBinary option is selected for this process. After this select NumericToBinary option and set the ignore class as true. Apply this option for further processing.

3.2 RandomSubSpace (RSS)

Weka is a data mining tool which contains Machine Learning (ML) algorithms. Weka incorporate tools for Data Pre-processing, Classification, Clustering, Association rules etc. Classification is a data mining process that allocates items in a collection to target classes. RandomSubSpace (RSS) is an efficient classification algorithm that builds a decision tree based classifier that maintains highest accuracy on training data and improves on generalization accuracy as it grows in complexity. Java classes are used to process RandomSubSpace (RSS).

3.3 LogitBoost (LB)

LogitBoost is Machine Learning (ML) algorithm that comes under Meta category in weka. It is an algorithm for performing additive logistic regression. LogitBoost performs Classification using a regression scheme and can handle multiple class problems.

3.4 RandomForest (RF)

RandomForest algorithm is an extension of bagging for decision trees that can be used for Classification or Regression. This tree classifier is made up of a large number of small decision trees, called estimators in which each produce their own prediction. RandomForest combines the multiple output of randomly created decision trees to generate final output. This ensemble classifier produce better prediction results and have good computational performance and scalability. It uses average voting to make prediction.

3.5 REPTree

REPTree is a supervised learning algorithm that constructs a regression tree using information gain as the splitting criterion, and prunes it using reduced error pruning algorithm. This algorithm is based on C4.5 algorithm and can produce discrete or continuous outcome. The decision tree algorithm is easy to understand because we can easily follow the tree structure to see how the decision is made and the pruning procedure is followed to reduce the size of tree based on error pruning algorithm.

4 Experimental Methodology and Result Analysis

In this study, we incorporated Meta Classifiers—RandomSubSpace (RSS) and LogitBoost (LB) with Tree Classifiers—RandomForest (RF) and REPTree and the results are acquired. For simple analysis and testing, simulation results are divided into a few sub-items. In the first section, Meta classification algorithms, RandomSubSpace and LogitBoost are applied individually to the dataset (Tables 1 and 2). Factors considered to confirm results are Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), accuracy measure and time taken for building the model.

Table 1 Applying RandomSubSpace individually

	Cloudiness	Precipitation	Temperature	Humidity	Average
MAE	0.2256	0.173	0.2153	0.1876	0.200375
RMSE	0.353	0.3224	0.3718	0.3354	0.34565

Table 2 Applying LogitBoost individually

	Cloudiness	Precipitation	Temperature	Humidity	Average
MAE	0.221	0.177	0.2394	0.1972	0.20865
RMSE	0.3663	0.3662	0.4256	0.3745	0.38315

In Tables 1 and 2, we tried to find the MAE and RMSE measures for Cloudiness, Precipitation, Temperature and humidity individually and then we have taken the average of these four factors to obtain the final outcome. In Tables 3 and 4, Tree Classifiers—Random Forest and REPTree are applied along with Meta Classifier—RandomSubSpace, and the results are obtained. In Tables 5 and 6, Tree classifiers are applied along with LogitBoost and the results are obtained. Results when (1) Applying RandomSubSpace individually (2) Applying LogitBoost individually (3) RandomForest accompanied with RandomSubSpace (4) REPTree accompanied with RandomSubSpace (5) Random Forest accompanied with LogitBoost (6) REPTree accompanied with LogitBoost is tabulated beneath. Representation of results when applying both Meta classifiers individually and the results after the integration of Tree classifiers with Meta classifiers is also tabulated in Tables 7 and 8 respectively.

Table 3 Results when random forest accompanied with RandomSubSpace

	Cloudiness	Precipitation	Temperature	Humidity	Average
MAE	0.2162	0.1822	0.2039	0.1695	0.19295
RMSE	0.346	0.3448	0.3668	0.3226	0.34755

Table 4 Results when REPTree accompanied with RandomSubSpace

	Cloudiness	Precipitation	Temperature	Humidity	Average
MAE	0.2158	0.1671	0.1156	0.1671	0.1664
RMSE	0.3329	0.294	0.2452	0.294	0.29085

Table 5 Results when Random Forest accompanied with LogitBoost

	Cloudiness	Precipitation	Temperature	Humidity	Average
MAE	0.2073	0.1742	0.1092	0.1815	0.16805
RMSE	0.3441	0.3747	0.318	0.3835	0.355075

Table 6 Results when REPTree accompanied with LogitBoost

	Cloudiness	Precipitation	Temperature	Humidity	Average
MAE	0.2214	0.1659	0.1142	0.1686	0.167525
RMSE	0.3368	0.2931	0.2477	0.2978	0.29385

Table 7 Results when applying RandomSubSpace and LogitBoost alone

	RandomSubSpace	LogitBoost
MAE	0.20865	0.200375
RMSE	0.38315	0.34565

Table 8 Results obtained after the integration of tree classifiers with meta classifiers

	Random Forest + RandomSubSpace	REPTree + RandomSubSpace	Random forest + LogitBoost	REPTree + LogitBoost
MAE	0.19295	0.1664	0.16805	0.167525
RMSE	0.34755	0.29085	0.355075	0.29385

In the second half, the correctly and incorrectly classified instances are categorized by percentage. Graphical representation of the simulation result is shown below (Figs. 1, 2, 3 and 4). Based on the comparisons done over accuracy and error rates, we can see that the highest accuracy is 93.9394% and the lowest is 84.8485%. Also, the highest accuracy is attained by the combination of Meta classifer—RandomSubSpace and Tree classifier—REPTree.

The total time taken to build the model is also a vital parameter in the analysis. In this study, we can say that the combination of RandomSubSpace and REPTree requires the shortest time which is around 0.15 s as compared to others. Table 9 represents the time taken by other classification algorithms.

Figure 5 represents the comparison between the parameters based on MAE, RMSE, and the time consumed for constructing the model. Based on the figure, we can say that by integrating RandomSubSpace and REPTree we can obtain better results for MAE, RMSE, accuracy rate and time taken.

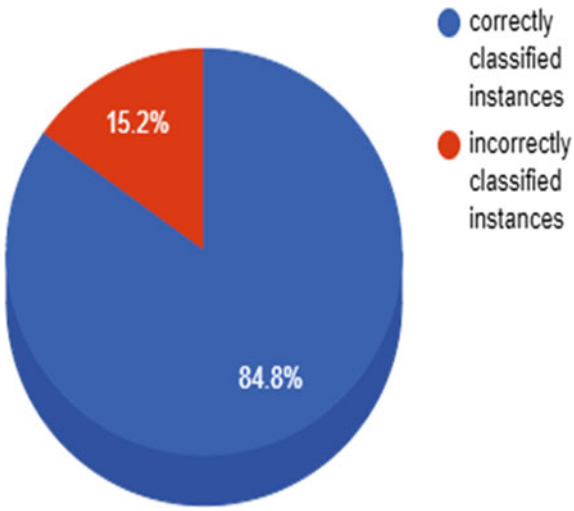

Fig. 1 Random Forest + LogitBoost

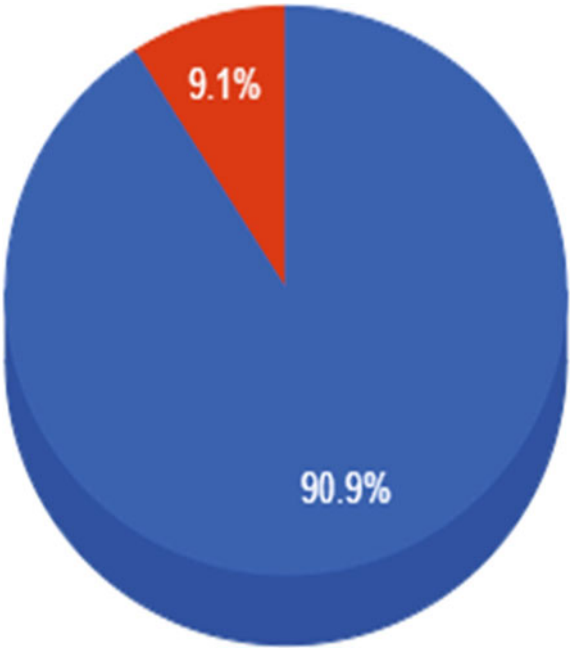

Fig. 2 REPTree + LogitBoost

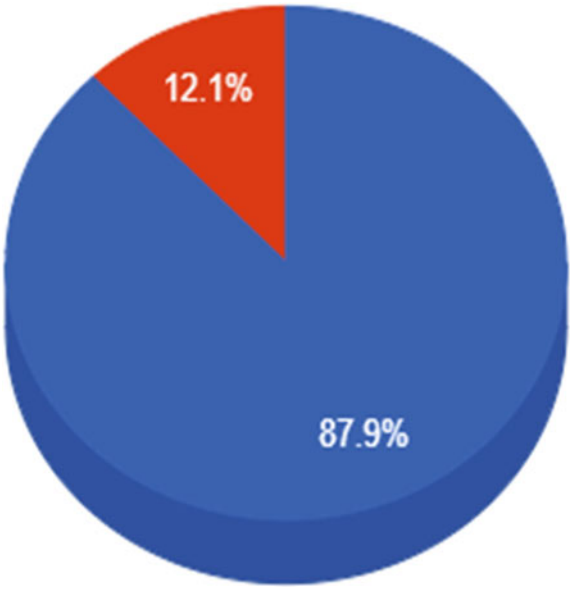

Fig. 3 Random Forest + RandomSubSpace

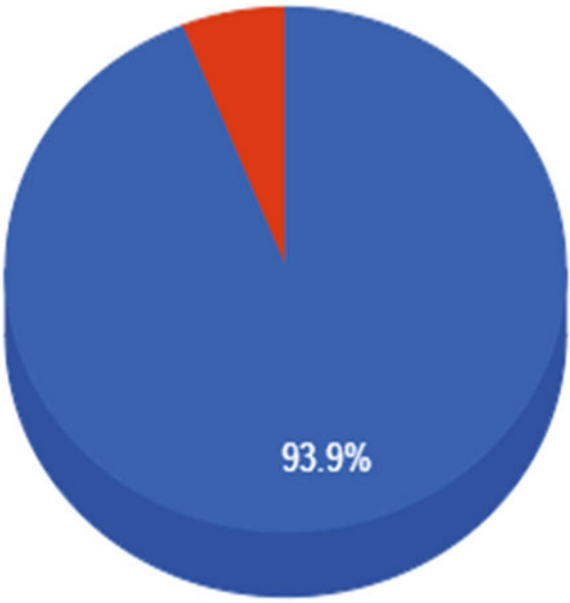

Fig. 4 REPTree + RandomSubSpace

Table 9 Time consumed for constructing the model

Algorithms	Time taken (s)
Random forest + LogitBoost	0.19
REPTree + LogitBoost	0.2
Random forest + RandomSubSpace	0.25
REPTree + RandomSubSpace	0.15

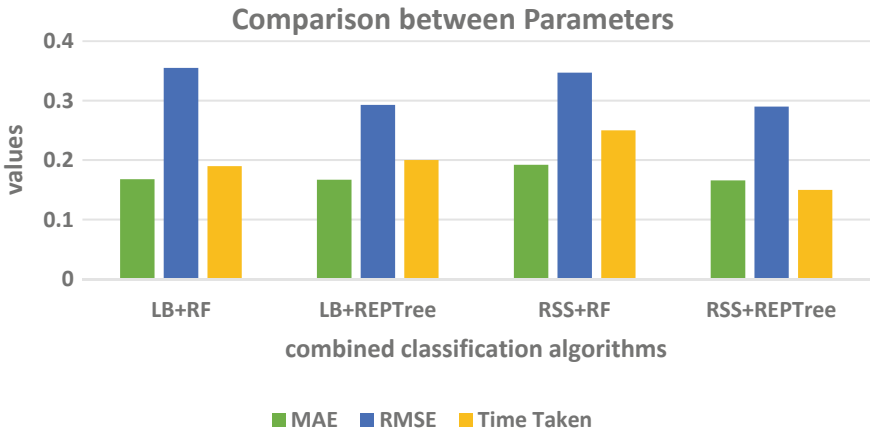

Fig. 5 Comparison between the parameters

5 Conclusion

As a conclusion, we have achieved our goal which is to analyze and investigate algorithms for the Meta and Tree classifiers based on WEKA. The integration of REPTree with RandomSubSpace provides excellent results in weather data with an accuracy rate of 93.9394% and the total time consumed for constructing the model is 0.15 s. Also this combination has a medium error that is very low at 6.0606% compared to the others. These results mean that among the machine learning algorithms tested, the combination of REPTree with RandomSubSpace has the potential to significantly improve the standard classification methods that will be used in Weather data analysis. Subsequent work related with this research work is the use of Meta classifiers formulated Random Forest and REPTree algorithms.

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Implementation and Comparison of Big Data Analysis on Large Dataset Using SPARK and FLINK

Ashim Sharma, Digvijay Puri, Mohit Kumar, and Gaurav Soni

Abstract Various big data challenges are addressed in this paper. We encounter many difficulties in the storage and processing of huge data sets. Various open source and enterprise tools are available for the processing of big data. The choice for the best tool to be used for analysis is very important to make. The tool selected must be able to provide the accurate analysis results and in real time. The advantages and disadvantages of the various tools are also discussed. In the proposed work, a comparison between the two Big Data processing frameworks is made. Big Data deals with two types of processing data i.e. batch data, in which blocks of data are executed with no time constraint, and stream data, in which continuous data input is processed in near real time. In the proposed work, Spark and Flink are used as the processing systems. A parking dataset containing a large number of records is created, which is then processed with these two processing frameworks. Spark due to its batch processing nature shows some lag in the processing of the data, whereas Flink on the other hand, with its stream processing nature certainly has an edge over Spark. To understand the results in a better way, a graphical representation depicting the execution time to process a number of records is also made. This graphical representation clearly helps in visualizing the comparison between the two processing frameworks, due to which a quick judgment can be easily made about which system is better than the other.

Keywords Big data · Hadoop · Map reduce · Spark · Flink

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1 Introduction

The process of data getting generated is ever increasing. Every business, medical and the scientific area is producing huge amounts of valuable data that needs to be stored, processed, managed and analyzed correctly. Traditionally, the data generated from the government and private sectors was easily stored and analyzed by the relational database software installed on the systems but in today's scenario the data has generated tremendously and has evolved into three major type structural, semi-structured and unstructured data. Traditional relational database management software is unable to store and process this huge and disparate data. Therefore, the innovative concept of big data analytics came into existence.

2 Related Literature

Sankari et al. [1] proposed the use of NoSQL technologies for the storage of XML Big Data. The large amount of semi-structured XML data which is not able to be processed by a standalone system forms the XML Big Data. Huge amount of XML data is getting generated every minute from sources like images, videos and audios. All of this data is stored in the shared storage kept aside from the main system. NoSQL database technologies like MarkLogic Server and Clusterpoint Database provide quick search indexes and high speed data storage to overcome any latency problems.

Chawda et al. [2] proposed some big data analytical tools that are necessary for the fast analysis of the big data. The volume, velocity, variety, value and veracity characteristics of the big data are what makes big data difficult to be handled. The IBM InfoSphere BigInsights has built-in analysis capability for the social media data using its social media analyzer. BigSQL uses the structured query language for analyzing the data. Jqal is a declarative query language used for the analysis of structured, semi-structured and unstructured data. BigSheets is a web based analytical tool having the spread sheet type interface similar to that of Excel spreadsheet. The Amazon Big Data Analytics Platform provides the cloud computing environment which provides the utility services to the users. The cloud platform can be easily scaled up or scaled out. Both Hadoop and Hive can be accessed using the Amazon exposed API's.

Al-Shehi et al. [3] proposed a theoretical visual analytical framework for the automation of the visualization graphs produced to easily understand the visualized linked data. Graphical representation of the facts and information gathered is more effective and appeals to the analysts to easily draw conclusions about the problem. The bar chart, pie chart and histogram are the best visualization aids that can be used to represent the results. In some situations the bar chart representation proves more effective and detailed than the pie chart visualization. Therefore, in this paper the effort of automating the visualization process is made possible with the use of a

knowledge base. The knowledge base will help in determining the accurate graphs to be used so as to aid the analysts in the process of analyzing the data.

Dubey et al. [4] proposed the modified version of OASIS (On-Line Access to Project Information System) called the PMSBD (Project Monitoring System for Big Data). The traditional project monitoring system OASIS was unable to monitor the huge amount of data. PMSBD is a web based project monitoring software that uses Hadoop to operate on huge data sets. The analysis, searching and computational processes are supported by the Hadoop MapReduce. This software will act as a powerful decision support system for management. It uses HBase database that can easily handle relational and non-relational data. Hadoop provides batch processing capability which means that the whole dataset will be processed even for the less complex and easy tasks. HBase provides the distributed column oriented database architecture that works on top of the Hadoop framework. The main drawbacks of OASIS are the single point of failure, data sharing with other systems having different built structures and it requires user interaction for generating the report as it can't be done automatically. LDAP (Lightweight Directory Access Protocol) is used for authentication in PMSBD.

Schell [5] discusses the security concern in the storage and accessing of big data. Attackers have found a way to insert their malicious code in the application because the traditional security practices were unable to stop the intrusion. So the big question here is what security technique can be used to effectively secure the data.

Yang et al. [6] proposed a big data framework to solve the congestion problem in the transportation sector and to clearly define the temporal and spatial features required to identify the parking patterns of a parking occupation model. The temporal and spatial inconsistencies in the parking area are addressed by the real time processing of the data. The data sets are fed to the Hadoop system and on top of it the Spark framework is used for the machine learning process. Three modules are explained to identify the parking patterns. The real time parking details along the temporal and spatial information helps in identifying the closest available parking place.

3 Research Methodology

As a research area, Big Data presents numerous fields to work upon, one of them being the comparison between the batch and stream processing data using the frameworks, Spark and Flink. Both these processing engines are the emerging technologies that help to process both batch and stream data. This research work is focused on comparing these two data processing engines and to draw the conclusion that which processing engine performs better than the other. Therefore, this research work requires processing the same dataset with both Spark and Flink. The main points leading to formulation of a problem are:

- To generate a dataset initially containing at least thousand data entries and then to keep increasing the size of the dataset for the comparison.
- To use the advanced data processing systems, Spark and Flink, for the processing of the dataset.
- To compare the two processing systems by analyzing their performance over the same dataset.

Research Scope

- To vividly understand the meaning and dimensions of big data.
- To understand the differences between various tools available for the processing of big data and making the choice of selecting the best one out of them.
- To carry out the research by executing a dataset with two Big Data processing frameworks, Spark and Flink, and to draw a comparison between them.

Objective

There are following objectives of the study:

- The proposed framework will help in solving the congestion problem in the transportation sector.
- Determining the right tool for the real time processing of the parking data to avoid the congestion.
- To do a comparative study between Spark and Flink by evaluating the execution time with respect to numbers of records.
- To clearly distinguish the two processing frameworks used by representing their results in a graphical form (Fig. 1).

The research methodology of the proposed research work would be depicted as follows:

- To start with the research methodology of proposed research work, the first step includes writing a java code that will first write a large number of records to a file and then another code will read the data from the file.
- After writing the code, a dataset will be created that will contain thousands of records. These records will keep increasing to define a proper comparison between Spark and Flink.
- Now this generated dataset is fed to the Spark and Flink processing systems for the batch and stream processing of the data.
- After the processing of the dataset, the next and foremost challenging step of research work is to do a comparative study between Spark and Flink with respect to the execution time.

After the comparative study, the next step of the research work is to generate graphs/results of proposed work that will show how Flink gives better performance when the dataset gets larger.

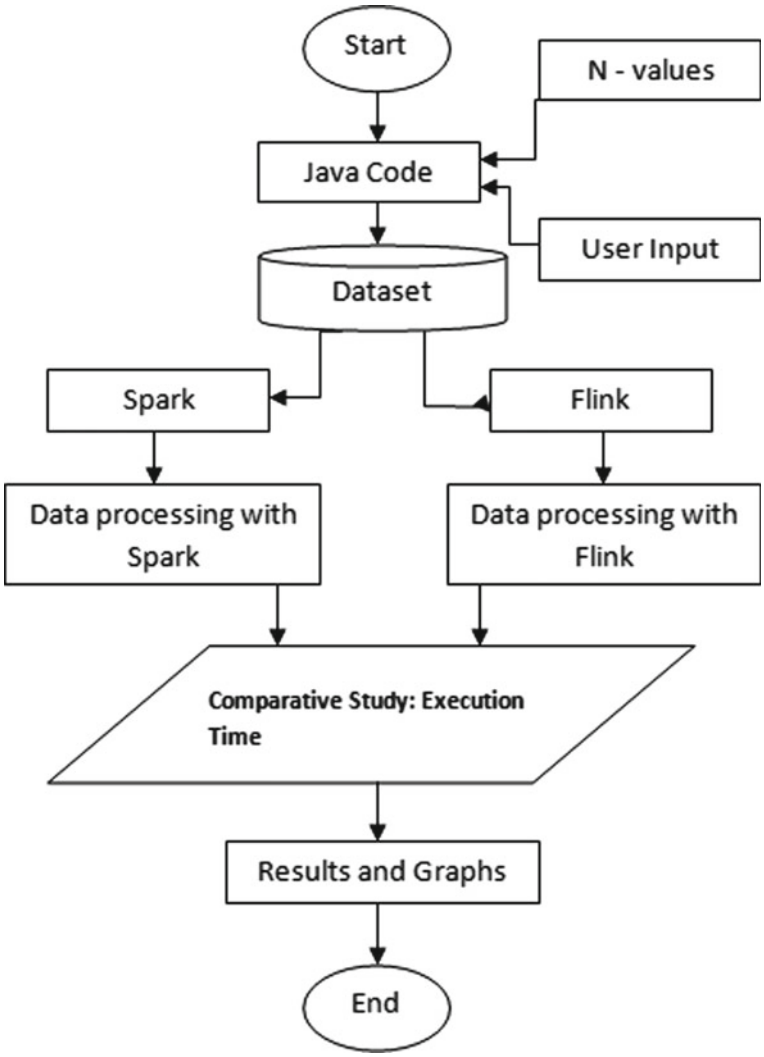

Fig. 1 Flowchart of the methodology adopted

4 Experimentation Setup

In order to implement the proposed research work, our experimental platform mainly consists of configuring and installing Apache Spark and Apache Flink.

Hardware and Software Specifications

Some specifications of the system parameters that are used in the implementation are given in Table 1.

Table 1 Hardware and software specifications

System parameters	Specifications
Operating system	Linux (Ubuntu)
Java	JDK 1.8.0
Programming platform	Eclipse Kepler
Apache Spark	Version 2.1.1
Apache Flink	Version 1.2.1

For carrying out experimental work, we have chosen a java programming platform to do all the coding. In this, first we create our own file that will generate a random set of records. Using this file a complete dataset is created containing N-values of records. To work with Spark and Flink, firstly all their dependencies have to be included into the project. There are numerous jar files of both Spark and Flink that have to be included into the project. For that, we go to the project's properties and in the *build* window we click on the "add external jars" button to add the jar files. Following screenshots shows the setup of the two processing systems that will process the data generated using the java code.

Results

For determining the efficiency of the system in program execution, we have carried out an analysis of data execution with Spark and Flink. To analyze the execution of data with Spark the following observations are made.

Table 2 shows the time observed during the program execution. It shows how much time the proposed system will take to execute the program with Spark. The execution time is observed in microseconds. The main purpose of Spark is to use its internal features that can execute a program hundred times faster than map-reduce.

Hence, following inference has been made which shows that with the increased size of the dataset, the time for data execution has also increased.

Figure 2 shows us a graphical representation of the execution time taken by the processing system when the numbers of records are increased.

To analyze the efficiency of program execution with Flink, the following observations are made.

Table 3 shows the time observed during the program execution. It shows us that how much time the proposed system will take to execute the program with Flink.

Table 2 Observations for data execution with Spark

No. of records (1000–5000)	Execution time in microseconds (Spark)
1000	90,323.2
2000	94,842.2
3000	100,741.4
4000	110,540.6
5000	121,289.8

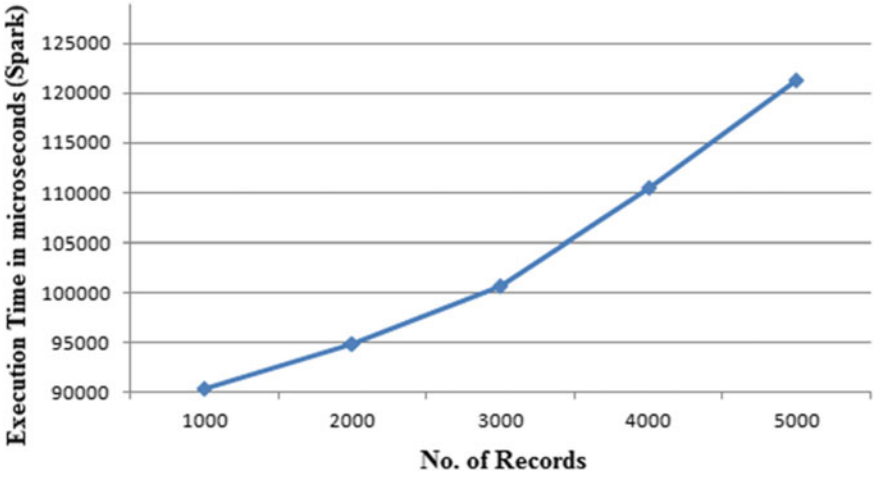

Fig. 2 Data execution with Spark

Table 3 Observations for data execution with Flink

No. of records (1000–5000)	Execution time in microseconds (Flink)
1000	76,312.8
2000	82,560.2
3000	92,980.8
4000	99,740.6
5000	114,273.8

The latency problem is Flink is very less as compared to Spark and therefore, it is sometimes called as the 4G of Big Data.

Hence, following inference has been made which shows that with the increased data set size, the time taken for the execution has also increased but the delay is very less in this.

Figure 3 shows us the graphical representation of the execution time taken by the processing system when the numbers of records are increased.

To analyze the efficiency of the program execution with both Spark and Flink, the given observations are compared.

Table 4 formulates the values observed for data execution with both Spark and Flink. Comparative study of the proposed frameworks will be based upon the detailed analysis of the data execution time.

Figure 4 depicts the comparison between the numbers of records with respect to the execution time by using the proposed frameworks, Spark and Flink. Flink as compared to Spark is not a batch processing system but rather is a stream processing system and hence the execution time with Flink is reduced as compared to Spark.

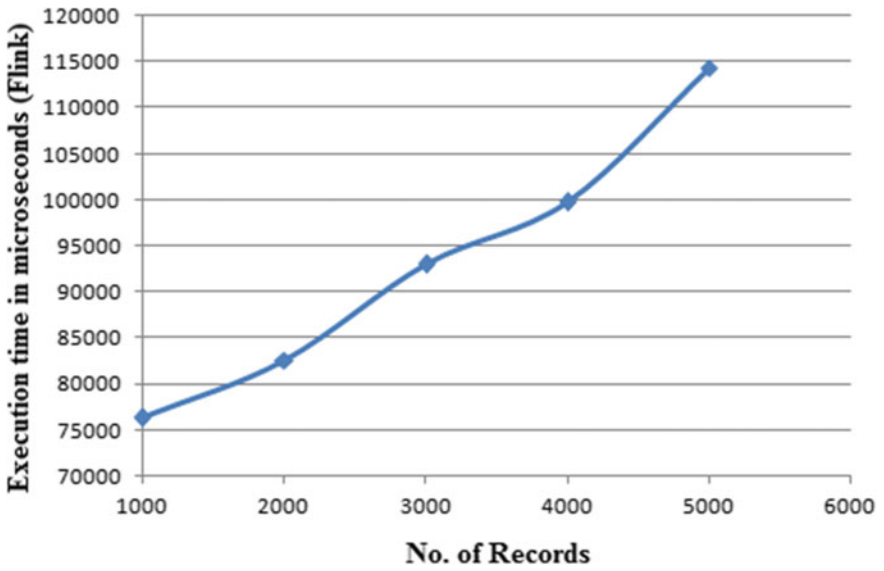

Fig. 3 Data execution with Flink

Table 4 Observations for data execution with Spark and Flink

No. of records	Data execution time (Spark)	Data execution time (Flink)
1000	90,323.2	76,312.8
2000	94,842.2	82,560.2
3000	100,741.4	92,980.8
4000	110,540.6	99,740.6
5000	121,289.8	114,277.8

Hence, it can be concluded that for a given larger dataset Flink performs better than Spark.

5 Summary and Conclusions

Every organization in today's era is concerned about the storage and analysis of the massive amounts of data that they are producing. The analysis of this huge data is very important for the decision making process regarding the sales, purchasing and managing the stocks. The storage and processing of petabytes and zettabytes of data is very hard and therefore proper methodologies must be adopted for this process. In this research work, algorithms have been implemented which executes a dataset with different processing frameworks. We have used Spark and Flink as the two

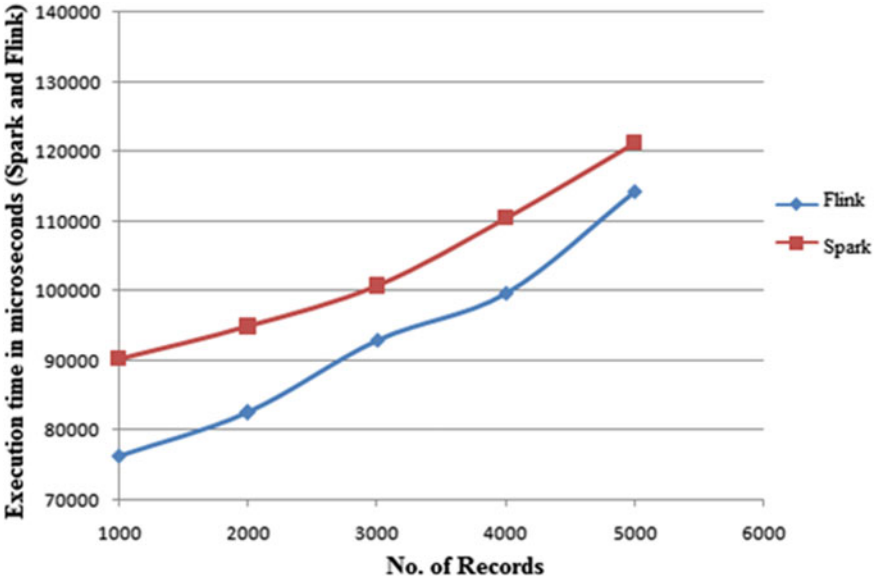

Fig. 4 Comparison between the execution time of Spark and Flink

processing frameworks. The comparative study of both these frameworks has shown that for the dataset execution for both the systems, containing the same number of records, one system outperforms the other. In our study we have concluded that for a larger dataset, Flink performs better than Spark. Transportation helps a lot in the process of urbanization and hence to reduce the congestion problem the real time analysis of the parking data is very crucial. The discussed frameworks will not only help in solving the congestion problem by providing the real time analysis but will also ease the people in determining the perfect parking space by providing the real time statistical details of the car park.

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Data Analytics for Groundwater Solution and App Development

Bathirappan Kalaimathi, Rahamadhulla Farhathulla, Duraisamy Arivan, and Palanisamy Ezhilselvan

Abstract Ground water is the major source of drinking water in every part of India. The agricultural and therefore the industrial sector depends on source of water. The adverse situation is going to happen as the one-third of the world's groundwater aquifers are being rapidly depleted by human consumption. To overcome from this, we have developed a model. The model includes Artificial Neural Networks (ANN's). This system will use the models to provide current and future prediction of groundwater level. The proposed model will provide a set of alarm which is being available to everyone through the mobile application.

Keywords ANN · Mobile application · Groundwater level prediction

1 Introduction

Groundwater contribution to international's water supply is set 20%, that's 0.61% of whole world's water [1, 2], along with frozen ice and oceans. it's far one a number of the primary crucial natural resources that is usually now not identified. there's a finite amount of groundwater on this planet's floor, but the planet's population is hastily growing whilst the range of water we will use stays the equal [3]. the global groundwater consumption fee is double the velocity of populace growth. via 2025 the demand for the beverage are going to be quite a 150% of the to be had deliver. this can leave round 1.8 people dwelling in water-scarce situations [4, 5]. the most offenders of this consumption are unreasonable groundwater siphoning from non-sustainable sources (what we referred to as fossil water) and raised city advancement.

Groundwater depletion can be a rather easy concept with far reaching implications. without a doubt, the amount of freshwater we've got for the sector's populace is reducing. Groundwater depletion is occur in regions experiencing water shortage [6–8]. The complex and interlinked approaches primarily because of human interest,

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from urbanization to pollutants. Two factors that get worse water scarcity are groundwater depletion and saltwater interruption. For a breakdown of these forces, the stairs to be taken. on this challenge to research the facts the idea of machine learning performs an critical function. The measurements pushed model utilized is that the piece of a registering framework intended to reenact the way the human cerebrum investigates and strategies realities.. The records pushed model, artificial Neural network (ANN) may be used to identify the method with out making sure the proper input and output [9, 10]. After making sure all the facts approximately groundwater along with rainfall conditions, weather conditions, intensity of the water stage and so forth we'll be intending with the next step [11]. The mobile utility is evolved and the statistics is being imported and make to be had for the people.

2 Methodology

2.1 Model Techniques

The version includes over records analysis by way of the records driven version specifically, artificial neural network (ANN) which imitates the human brain's way of working. The artificial neural community (ANN) analysis may be a way of expertise analysis, which imitates the human brain's manner of working. The power of ANNs conveys information and yield layers, moreover as (in greatest cases) a secret layer comprising of gadgets that change the contribution to something that the yield layer can utilize. The styles are discovered with the aid of the ANN that are a way too complex or numerous for a human programmer to extract and train the device to understand.

2.2 Process

The first step is installed by means of system gaining knowledge of and process keeps what you need to analyze out of your facts. Subsequent, you compile and clean the information just so they are frequently analyzed. There are numerous varieties of fashions, each one reading the information in a slightly distinctive manner via distinctive algorithms. The algorithms will capable of educate themselves by using assessing the statistics heaps of times whilst searching out styles. As soon as the version recognizes styles, new records are frequently brought there are expecting a final result it really is presently unknown. The predictive electricity of device getting to know has become very famous in our ordinary lives, one of the important vicinities is object reputation device that may fed a series of visual patterns in a picture that continuously correlates with a specific label. So, it would able to discover that the visual sample inside the photo matches the labels. The era additionally

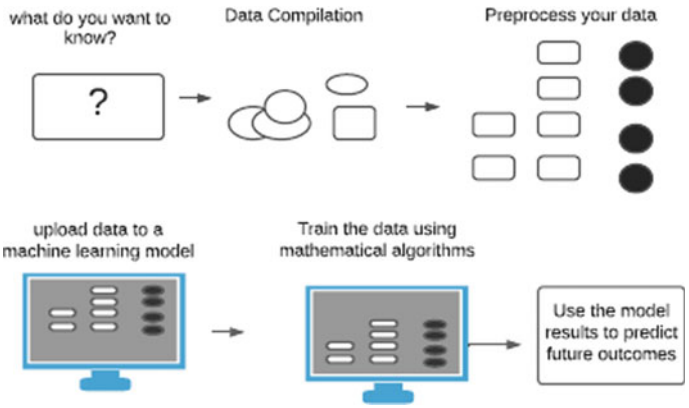

Fig. 1 Prediction process

detects recommends on line advertisements, banking fraud, powers driverless motors, and forecasts medical diagnoses. It is inevitable that system getting to know will extensively utilized in, image and man or woman popularity. The data is transferred to a machine acquiring information on form. There are dozens of styles of fashions, all analyzing the info all through a barely exclusive way thru extraordinary algorithms.

2.3 Overview

The dataset about the groundwater has to be collected using highly equipped instruments and have to deeply examine the data to ensure that the data is error free and it is completely an original one. After examining, the data had to be stored in a database. Then we have to upload the data in our algorithm. The execution depends upon a programming language which will produce better output in minimum lines of code. After that the output should be in a graphical representation so as to have a quick view over the prediction process. And then, the unique application is created using python and the data is being uploaded in the dedicated application (Fig. 1).

3 Study Area and Data

3.1 Study Area

India's groundwater levels according to the areas were calculated by Central Ground Water Board (CGWB). The data has shown that India has facing 54% high to extreme water stress [12]. This has brought about the upward push of troubles associated

with exhaustion of the water device for both agriculture and environmental functions. Consequently, there's a strong need for predictions of the long-term tendencies within the groundwater stages. Particularly, short-term water table forecast is vital for irrigation scheduling during this area, mainly inside the duration when the water consumptive uses of plants are excessive and consequently the surface water is insufficient.

3.2 Data Study

According to beyond research, groundwater level can be impacted through hydrological variables and meteorological variables [13]. The hydrological variables consist of surface circulate-flow, precipitation, etc. The meteorological variables include temperature, evaporation, etc. But, observations records regarding those variables were limited for the have a look at location. Most effective part of hydrological variables became available. With the help of those data we will proceed with prediction process. Before that, the dataset should be cleaned and trained up to the algorithm (Fig. 2).

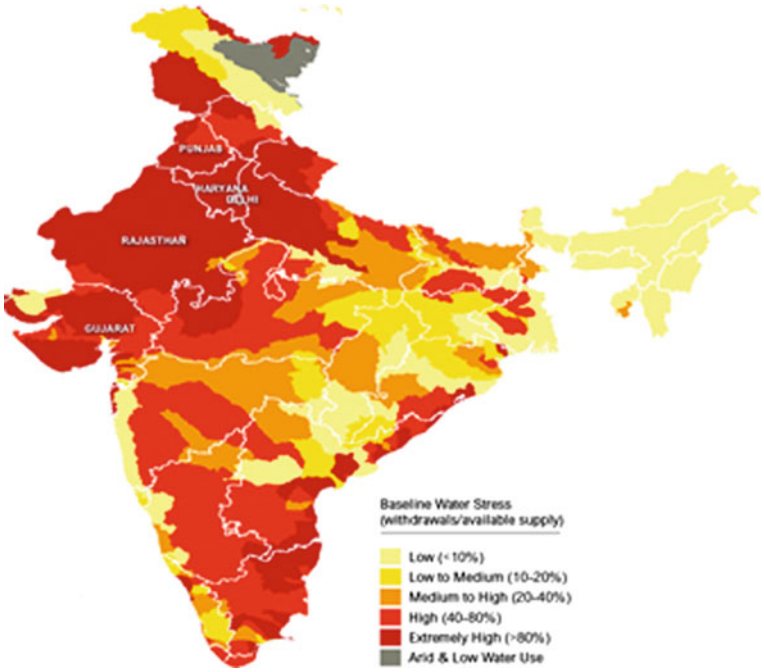

Fig. 2 Study area

4 Model Development

4.1 Determination of Model Structure

The cross-correlation method, which can be the most not unusual analytical technique for choosing appropriate inputs in hydrology, became used to determine the input structure for each studied web sites so that it will pick out the correct series of inputs for the facts-pushed models. For the creation phase, Artificial Neural Networks are chosen because it generates output in a simple graphical format. And then the generated output is intended into the dedicated unique application. The proposed application model would include a series of warning via the smartphone application.

4.2 Model Implementation

The proposed algorithm of version ANN became implemented the usage of python [14]. Python programming language is very a whole lot helpful in generating consequences inside decreased strains of code. two artificial Neural network fashions educated with BP algorithm had been developed for the two have a look at wells. As issues a MLP network, the number of neurons in enter and output layer changed into determined via the enter and output vectors offering to the network, for this reason the trouble of selecting a appropriate architecture for a MLP network depend upon specifying the type of activation characteristic for use and the variety of neurons within the hidden layer. whilst growing the ANN models, the sigmoid beginning characteristic was used for each the hidden and output neurons. The number of neurons inside the hidden layer become optimized through a trial-and-error technique.

The revised codes of LIBSVM written in C# have been used to implement SVM forecasting models [15]. As established by way of many authors, the top-rated of parameters substantially influences the performance of SVM model. The parameters dominating SVM model include the price regular C, the radius of the insensitive tube ε, and kernel features throughout this examine, the form of kernel function was decided on first of all. lots work on using SVM regression model has mounted that RBF kernel outperformed different kernel capabilities. After preliminarily trying out SVM fashions with linear, polynomial, and RBF kernels on all training datasets, RBF was determined to deliver the simplest predictive performance.

The main area of our proposed system is to upload the data to the application which was got from data driven model Artificial Neural Network (ANN). The application is being created by using the python. As python is very much helpful in producing results it is being used. The application is created with python Kivy, creating a natural user Interface or NUI. The concept behind a natural user Interface is that the client can undoubtedly figure out how to utilize the product with next to zero guidance. The application is being available in all the formats of smart phone users (Fig. 3).

Average-Ground Water Level Status Tamil Nadu on Decemeber 2020									
No.	Well Type	Name of the District	Average Water Level in mts below Ground Level			Current Year - Previous Year		Current Month - Previous Month	
			Previous Year (December 2019) in m	Previous Month (November 2020) in m	Current Year (December 2020) in m	Rise	Fall	Rise	Fall
1	Observation Wells	Thiruvallur	5.72	4.5	2.18	1.54		2.12	
2	Observation Wells	Kanchipuram	1.92	3.93	0.84	1.08		3.09	
3	Observation Wells	Thiruvannamalai	3.50	6.67	3.72		0.22	2.95	
4	Observation Wells	Vellore	8.25	9.31	7.46	0.79		1.85	
5	Observation Wells	Dharmapuri	10.58	10.27	10.00	0.58		0.27	
6	Observation Wells	Krishnagiri	8.26	8.91	8.54		0.28	0.37	
7	Observation Wells	Cuddalore	5.95	5.91	4.27		0.32	1.64	
8	Observation Wells	Villupuram	2.26	5.58	2.82		0.56	2.76	
9	Observation Wells	Thanjavur	1.88	2.70	1.54	0.34		1.16	
10	Observation Wells	Thiruvarur	1.89	2.77	1.48	0.41		1.29	
11	Observation Wells	Nagapattinam	1.23	2.22	1.56		0.33	0.66	
12	Observation Wells	Trichy	7.44	8.43	7.21	0.23		1.22	
13	Observation Wells	Karur	5.30	4.68	3.93	1.37		0.75	
14	Observation Wells	Perambalur	7.21	9.30	8.20		0.99	1.10	
15	Observation Wells	Pudukkottai	3.58	5.92	5.47		1.89	0.45	
16	Observation Wells	Ariyalur	2.30	5.13	4.66		2.36	0.47	
17	Observation Wells	Salem	6.20	7.34	6.33		0.13	1.01	
18	Observation Wells	Namakkal	9.35	10.44	10.02		0.67	0.42	
19	Observation Wells	Erode	5.83	7.74	7.37		1.54	0.37	
20	Observation Wells	Coimbatore	10.34	12.29	11.75		1.41	0.54	
21	Observation Wells	Tiruppur	9.40	10.71	9.35	0.05		1.36	
22	Observation Wells	Nilgiris	1.95	2.68	2.66		0.73	0.02	
23	Observation Wells	Dindigul	9.70	10.57	9.37	0.33		1.20	
24	Observation Wells	Madurai	6.07	7.17	5.04	1.03		2.13	
25	Observation Wells	Ramanathapuram	3.38	4.86	4.31		0.93	0.55	
26	Observation Wells	Sivagangai	6.07	5.75	5.34	0.73		0.41	
27	Observation Wells	Theni	8.45	8.47	8.10	0.35		0.37	
28	Observation Wells	Thoothukudi	2.08	5.82	5.10		1.02	2.72	
29	Observation Wells	Tirunelveli	2.48	7.10	5.17		2.69	1.93	
30	Observation Wells	Virudhunagar	7.39	9.83	7.90		0.51	1.93	
31	Observation Wells	Kanyakumari	4.54	5.15	5.32		0.78		0.17
32	Observation Wells	Kallakurich	6.70	8.50	8.09	0.61		2.41	
33	Observation Wells	Tenkasi	4.55	9.00	7.17		2.62	1.83	
34	Observation Wells	Chengalpattu	1.80	4.00	1.15	0.65		2.85	
35	Observation Wells	Ranipet	4.70	5.96	5.11		0.41	0.85	
36	Observation Wells	Tirupathur	7.64	8.56	7.32	0.32		1.24	

Fig. 3 Part of data display in application

In the upcoming years, the predication for many years will be undertaken in according to the past year data and the trained model. The Groundwater forecast for several years will be conducted in the upcoming years according to data from the previous year and the qualified model (Fig. 4).

Plotting the dataset to check the different components of time series by implementing the seasonal dataset according to the various time series of drought and some other conditions. The underground water is also affected by the terms of seasonal conditions. So the seasonal data is very useful in predicting the underground water level in a particular area (Fig. 5).

Water reservoir level in Chennai is being simulated from 2004 to current 2020. From this dataset the future groundwater level is also being simulated by using machine learning Artificial Intelligence (AI) (Fig. 6).

The groundwater level data is simulated and the peak graph is being observed. From this we will predict the future level also using the AR implementation (Fig. 7).

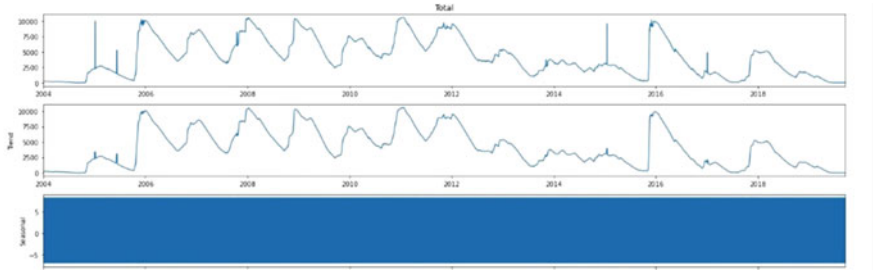

Fig. 4 Seasonal data implementation

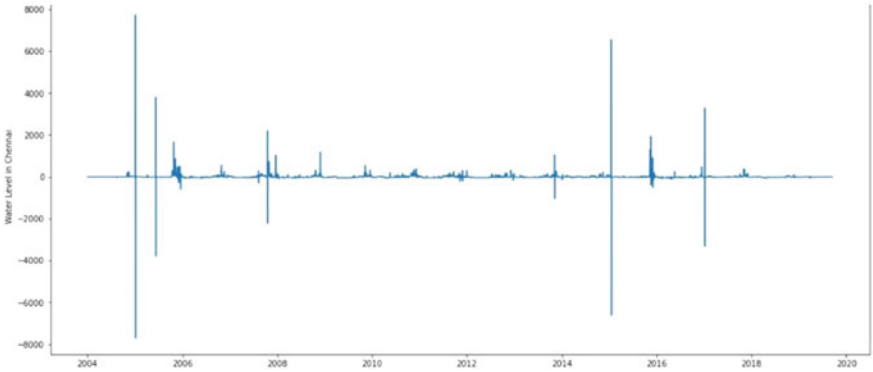

Fig. 5 Preprocessing the dataset

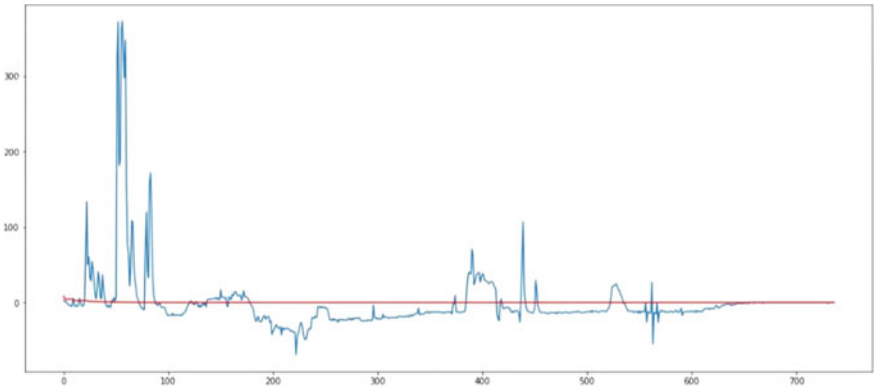

Fig. 6 Dataset implementation

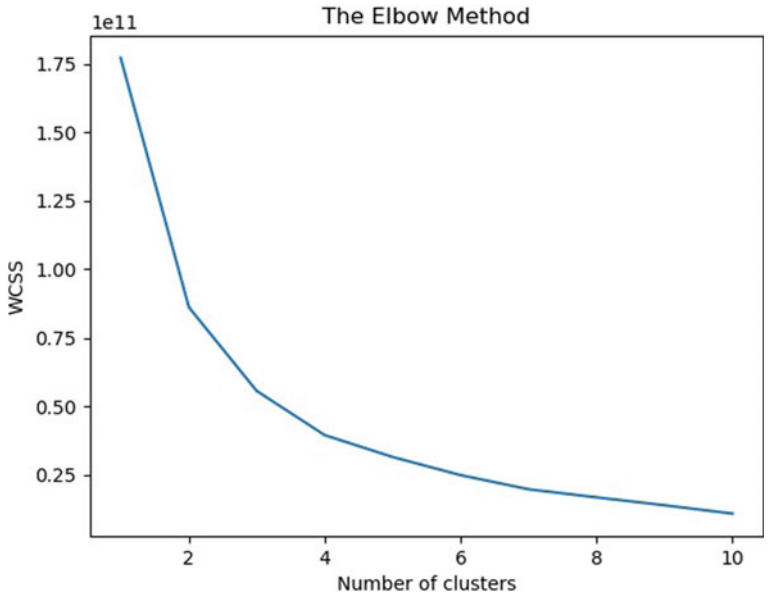

Fig. 7 Underground data info

The underground water data information is being denoted number of clusters versus water info using the elbow method (Fig. 8).

5 Conclusion

In dynamically changing environments tracking groundwater ranges is a crucial trouble. Early prediction of drought or lack of plumage will depend upon the faster reaction of the groundwater researchers. Timely records can be made to be had the use of improvements in Wi-Fi networking infrastructure. To build a whole, correct and sensible way to the real-time groundwater tracking all the components of the machine should be developed and incorporated effectively. The solution mentioned on this paper directly addresses one of the instant needs of the groundwater studies and offers alarm to humans in order that they may be alert and use the groundwater at maximum care.

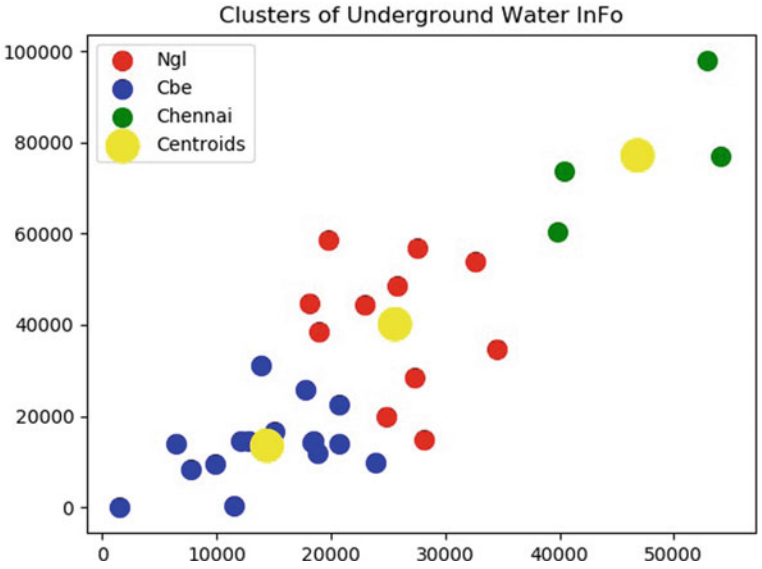

Fig. 8 Groundwater level data info is being denoted in the means of red, blue, green, yellow colours

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Advancement in Cognitive Radio: Game Theoretic Perspective

Manisha A. Dudhedia and Yerram Ravinder

Abstract Cognitive radio (CR) is promising and satisfies the criteria of effective use and demand for high data delivery of available frequency range for next generation technology. The primary user is not utilizing the allocated frequency range to its fullest and thus leaves hole for secondary users to use. Then CR technology is able to tackle the spectrum hole created by primary user. Many researchers are working on CR technology to satisfy the rising demand of bandwidth and hence data rate. In this paper, review of CR based solution as well as game theoretic solutions for spectrum sharing are discussed along with its advantages and limitations. These identified research gap leads to many new research opportunities.

Keywords Cognitive radio · Game theory · Cognitive radio wireless networks · Primary user · Secondary user

1 Introduction

As wireless networking has expanded exponentially, need for spectrum has risen dramatically. The Federal Communications Commission supports radio spectrum competitions, technologies, acquisitions and legislation (FCC). The reserved spectrum is, however, partially used. This inefficient use of bandwidth includes designing dynamic access strategies for the spectrum. The Dynamic Spectrum Access (DSA) permits secondary users (SU's), who do not have a spectrum license, to access the unused license spectrum.

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Priority customers, the primary users (PUs) have precedence in the utilization of the spectrum. SUs must continuously track the approved spectrum that can be used in real time. The SU does not breach the temperature of the intrusion that is the interference temperature. The SUs should know that the PUs will reappear [1].

An ad-hoc network has no central authority and is a self-configuration, multi-hop network. There must also be a full allocation of any element of the set-up and activity of an ad hoc network. In comparison, ad hoc network nodes are also severely limited by resources and power. Many of these features—decentralized operation, self-configuration, and energy perception—are also attractive in evolving wireless networks, including sensor networks, mesh networks [1]. According to the latest analysis and study principle, ad hoc wireless network optimization may be an appropriate technique. The game theory can be used to model the relationship in an ad-hoc network between independent nodes. This article addresses the survey of game theory applied to cognitive radio networks through game formulations.

Complexity of dynamic topology and inconsistent link consistency results in a statistical analysis difficult to extend to wireless adhoc networks. The future research on adhoc network using game theory indicates a great deal of assurance that the complicated interactions between nodes in this highly competitive, distributed and mobile world are understandable. In an ad hoc network, game theory is in an evolving stage for the study of problems in multiple protocol layers, much of the work in recent years being carried out [1].

Cross-layer optimizations for cellular networks are of particular concern. Game theory provides a method for modelling adaptations that can arise on various protocol stack layers and for studying the convergence properties. Recently created games such as potential games are commonly used because of their features, such as life and convergence into a Nash Equilibrium (NE). In comparison, the use of game theory in the modelling of ad hoc network complex environments where nodes have insufficient knowledge has led to often unexplored games such as imperfect surveillance games being used [1].

Ad hoc network security problems were also a justification for evaluating the application of game theory. Game theory also has a robust function in the creation and study of protocols for ad hoc networks fitted with cognitive radios [1].

1.1 CR Architecture

CR is composed of primary as well as secondary networks. More than one PUs and main base stations form a primary network. The PUs have spectrum license and are coordinated by the main stations. Just via the base station PUs interact with each other. The PUs and the major base stations typically do not have CR characteristics. A secondary network is made of more than one SUs and a secondary base station may or may not be used. The secondary central station serves as a wireless access point of the SU network, controls and operates the spectrum access for SU's. The SUs inside the same base station communicates via the base station with each other.

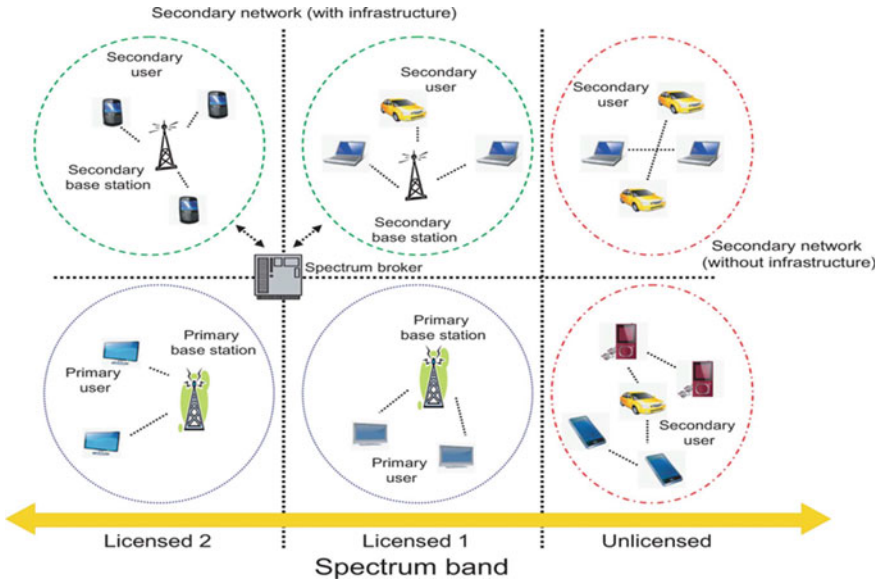

Fig. 1 Cognitive radio architecture [3]

As shown in Fig. 1, spectrum bands consist of both licensed and unlicensed. The SUs are only permitted to use licensed bands while the licensed bands are unused by the PU. The SUs are allowed to transmit when a PU is transmitting provided the interference of the SUs is does not affect the PU else the SU should sense the presence of PU automatically and should not transmit on the same band [2]. The secondary base station provides the SUs with details concerning the available bands as well as occupied bands. The secondary base station shall control the allocation of bands and organize the whole SU network. Whenever an SU hears a PU, it sends it to the secondary base station and then the secondary base station alerts the other SUs of the presence of PU on that track, and orders all SUs to leave that band. If SUs uses an unlicensed band, they will establish an ad hoc network and communicate without a secondary base station.

2 Related Work

In light of the recent research, this paper provides survey of the most recent advances in spectrum sharing in terms of the assumptions made, advantages and disadvantages in each case (Table 1).

Based on the analysis and evaluation of these techniques, the limitations of these techniques as well as the challenges of implementing them have been highlighted here.

Table 1 Comparison in terms of assumptions, advantages and disadvantages

Sr. No.	Author	Assumptions	Advantages	Disadvantages
1	Maghsudi S [4]	Here, the initial information is not available with the players, the existence of an authority is assumed which regularizes the network in favour of the primary agents, and restricted resources are given to the secondary agents	Each D2D user the average accumulated reward in the long run is nothing but the optimal strategy	As the number of players increases the convergence speed reduces and complexity increases
2	Al-Imari et al. [5]	Orthogonal frequency-division multiplexing (OFDM) is considered	This algorithm has a fast convergence rate, with 99% of the equilibrium point with few number of iterations	No global optimization
3	Kousika et al. [6]	Only simulation of the games is done using NS2	Packets are sent without much lag in time, interference power is less, throughput between individuals nodes are higher in game theory model compared to non game theory model. Here, Bayesian signalling game has good packet delivery ratio	Complexity: in terms of sharing information amongst the nodes in the network and the computational complexity to perform the strategy selection
4	Shah et al. [7]	Only basic working has been discussed	Good classification, good figures for basic understanding, good comparison table	No results discussed, may include more papers on new MAC ideas
5	Joshi et al. [8]	No assumption on QOS, different traffic conditions, etc.	Good reference to see how to formulate idea	Mathematical model is missing, analytical result must present for verification

(continued)

Table 1 (continued)

Sr. No.	Author	Assumptions	Advantages	Disadvantages
6	Zhong et al. [9]	Multi-channel assumption, no different conditions	Good reference for numerical model, reference for formulating the problem	Detailed simulation results comparison with other parameters, especially for energy efficiency, etc.
7	Tan et al. [10]	Multiple channel assumption, no different traffic condition, no simulation data	Good mathematical model, may improve the performance, priority and hybrid model is missing	Detailed simulation results are missing, latest results need to study
8	Abdulghfoor et al. [11]	Non-cooperative game and optimal solution	Good definitions and problem definition	Utility function and strategy definition
9	Felegyhazi et al. [12]	Non-cooperative game and optimal solution	Good model and simulation results, good concept	Utility function designing, QOS, traffic analysis
10	Wang et al. [13]	Basics of game theory with few fundamentals	Good classification and few diagrams, some basics	No solution
11	Jang et al. [14]	Require global information	New fully distributed CSMA algorithm proposed	CR radio not considered, single channel MAC protocol, selfish behaviour not answered
12	Parras and Zazo [15]	Only one malicious sensor is considered	Approach is validated via simulations	CR radio not considered, single channel MAC protocol, selfish behaviour not answered

3 Challenges in CR

CR proposes many challenges from PHY to application layer however here the focus is more on MAC layer. The reason is MAC layer improves the performance of a network to a large extend.

A new concept for Spectrum Distribution Leasing is being suggested, dividing primary spectrum into multiple bands of frequencies and developing a game-theoretical frame to model dynamic spectrum sharing. The secondary users prefer a primary system with many different frequency channels. Spectrum sharing in current systems may be found analogous to generic medium access control (MAC) issues.

3.1 Common Control Channel (CCC)

Many options, clustered or dispersed, expect a spectrum sharing CCC [3]. It is apparent that the CCC supports several functions for exchanging bandwidth, such as handshake transmitter receiver, contact with a central entity or exchange of sensor information. Nevertheless, because network subscribers are known as guests to the bandwidth they assign, this channel must be vacated without interruption when the primary user selects a channel. This refers to the CCC as well.

3.2 Dynamic Radio Range

Due to difference in attenuation, the radio spectrum varies with operating frequency. A set range is expected to be independent of the operational range [3] of certain solutions. In Cognitive Radio Wireless Network, though, the neighbours of a node will change as operating frequency is modified when a significant proportion of the wireless spectrum is assumed. The interference profile and routing decisions are impacted by this. In addition, this property involves deliberate judgement to choose a control channel.

3.3 Spectrum Unit

Several algorithms and methods were suggested to pick the right channel to be used in networks effectively. In some programmes, the channel is, however, loosely described as "orthogonal non-interference", 'TDMA, FDMA, CDMA, IEEE 802.11 or a radiation-related logical channel' [3].

3.4 Decision Making

The first important research challenge is, as CR is guided by decision-making, how to determine about what spectrum availability decision is made (e.g. spectrum availability decision, channel selection approach for access or radio output optimization). The first problem relates specifically to the centralization or delivery of the cognitive function. This is more critical not only for cognitive networks where intelligence is distributed more likely, but also for cognitive radios since collaboration between them and other devices could influence the decision-making [3].

3.5 Learning Process

Machine learning research has recently expanded significantly, with substantial success. If the learning is controlled or unattended is an important feature of the learning process. Both methods may be used in the sense of a CR. The first challenge is learning, in the autonomous or unattended learning process, to avoid false decisions before making a workable decision. The second challenge is describing the learning process, its aims and contributions, in the conceptual sense of CR [3].

3.6 Cross-Layers

Whereas inter protocol connectivity is included in the definition of a cognitive network as a way to meet the needs of users as well as of applications, the performance and behavior of applications and networks relying on CR technologies are not subject to any relevant and full review. The design of a self-organized or cognitive network is itself a challenge, particularly the co-ordination of external and internal loops, network interface for the exchanging of information and networking of interface systems for sharing and cooperation [3].

3.7 Security

CR issues include ensuring the proper running of equipment. The compliance of laws is part of protection in this sense [3]. Static device compliance has been questioned by the extent of funding needed to approve equipment, by the demand for evidence of the misuse of the equipment and by the identity of the violator. As the applications become more complex, the amount of theoretically violating encounters increases. In addition, this allows the time of these interactions to be shortened and the special scales. Both these amendments intensify the problems of compliance.

4 Results and Discussion

Based on the literature survey and limitation of existing work, game theoretical modelling of cognitive radio based wireless network is proposed. This network proposes various challenges however; efforts will be more on MAC layer and especially on following issues: Fairness Issues, Global optimization/sub-optimization.

As shown in Fig. 2 we can see the relation between number of nodes and probability of success. As the numbers of nodes are increasing probability of collision also increases. Figure 2 shows the motivation to use CR in network. Using CR nodes can

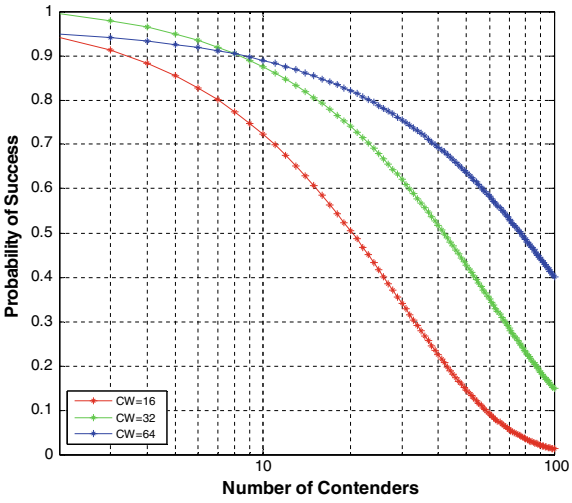

Fig. 2 Performance of probability of success

communicate on various frequencies and hence collision can be avoided. As we can see from Fig. 2 the probability of success also depends on contention window size. A successful transmission occurs when there is only one transmitting node. Higher the contention window size, increases in probability of success to certain extend. However it is a trade-off between QoS, here QoS is defined in terms of delay, energy, and throughput. So Fig. 2 gives intuition to propose CR based on game theory to guarantee the optimum/sub optimum solution for the overall network performance.

5 Conclusions

In this paper, an extensive survey has been done on spectrum allocation methods using the approach of game theory. Research gaps have been identified for dynamic spectrum allocation. In view of the new study, this paper offers a comprehensive survey of the resource allocation advances. Based on the study and assessment, we demonstrate all the assumptions, advantages and disadvantages in each case. Different levels of game theoretic methods have been discussed. Lastly the challenges faced at the MAC layer are listed.

From the above drawbacks it is seen that global optimization is missing and cognitive radio with multiple PUs and SUs have not been considered in many cases, selfish behavior and fairness issues needs to be addressed.

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240 Gbps WDM DPSK Free Space Optical Link for Clear Weather Condition

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Abstract Free space optics (FSO) is a promising technology that can efficiently address the last mile connectivity solution, specifically in urban areas. The key challenge is to operate the FSO link under adverse weather conditions and fulfill the increasing demand for data rate. This paper demonstrates the design of 240 Gbps (60 Gbps × 4 channels) WDM DPSK FSO link working in O, E, L, and U bands under clear weather conditions for a long distance of 150 km. The data rate is enhanced three times than the Mach Zehender modulated WDM FSO link with Q factor 10.59 and BER *1.354e.*

Keywords Bit error rate · Free space optics · Wavelength division multiplexing

1 Introduction

A day's every basic need of humankind is driven by the internet and internet of things (IoT) devices. The backbone of today's ever-increasing demand for bandwidth is an optical fiber. In urban areas, the key challenge is last-mile connectivity with an optical fiber. The challenge is resolved by the evolution of free space optics (FSO) networks. The FSO is a promising technology offering line of sight communication with immense advantages competing for optical fiber communication. A link distance and atmospheric variations limit the performance of FSO. The researchers are working to maximize the FSO link's performance in terms of bandwidth and

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data rate. FSO has also proven its utility in hybrid radiofrequency/free space optic (RF/FSO) links, providing excellent redundancy to RF and optical fiber links Optics (FSO) links to minimize the downtime. The implementation of FSO base stations can fulfill the demand for internet connectivity in moving trains. The design can provide a data rate of 5 Gbps for a distance of 180 m with a bit error rate (BER) of 10–10 [1]. An FSO also facilitates the single-channel indoor communication with a high data rate of 260 Gbps with a distance of 10–100 m [2]. The evolving concept of smart cities is looking for the efficient management of telecommunication backbone. The radiofrequency (RF) backbone is not efficient to fulfill the data rate demand of end-users. The integration of 5G networks with the FSO backbone is more efficient for smart city network architecture. Optical access points (OAP) are implemented with the FSO backbone [3]. In an optical wavelength region, 400–700 nm region is visible. FSO operating in this region is named visible light communication (VLC). VLC addresses the challenge of underwater communication. FSO link over a 15 cm operating at 4.7 Gbps for not return to zero-on-off keying (NRZ-OOK) and 11.9 Gbps for 64 quadrature amplitude modulation—orthogonal frequency division multiplexing (QAM-OFDM) is designed with high pointing accuracy [4]. The FSO system under dense fog conditions has enhanced performance with Coherent Optical OFDM orthogonal Frequency Division Multiplexing (CO OFDM). The link can operate with acceptable BER at a distance of 200 m with a data rate of 10 Gbps. Spatial diversity has improved the received power, leading to a low error rate (BER) [5].

The FSO link's reliability is highly dependent on weather conditions, which attenuates the signal under adverse weather. The link under adverse weather conditions can operate at a data rate of 10 Gbps with a maximum distance of 500 m [6]. The recent advancement has proposed the use of optical links as satellite feeder links. High Throughput Satellites (HTS) systems based on 1550 nm wavelength are used for transmission. The links are modulated with both analog and digital modulation. The digital modulation technique is most effective in low error rate and high optical signal to noise ratio (OSNR) [7]. The FSO system with quadrature amplitude modulation (QAM) and orthogonal frequency division multiplexing (OFDM) can enhance the data rate requirement. It can achieve a data rate of 2×320 Gbps over a distance of 2.2 km with an OSNR of 44 DB [8]. The single input single output (SISO) and multiple-input multiple-output (MIMO) FSO technique can enhance transmission capabilities. It can operate up to a data rate of 10 Gbps for a distance of 1 km with hybrid modulation schemes differential quadrature phase-shift keying (DQPSK), and polarization shift keying (Polsk) [9]. The system parameters, such as operating wavelength, transmitted power, modulation format, transmitter aperture diameter, detector type, beamwidth, etc., are vital for the FSO system's performance. The optimization of these parameters can significantly enhance the performance of the FSO system [10]. The four-channel multistream optimized high-speed wavelength division multiplexed (WDM) link with transmitter operating in O, E, L, and U bands operates at a data rate up to 80 Gbps (20 Gbps $\times$ 4 channels) for the very clear weather condition for a range of 150 km. The observed system performance measure values of the quality factor (Q factor) are 6.44, and the bit error rate (BER) is 5.96e−11 [11–14].

The FSO system performance is also affected by the number of transmitters and receivers and different weather conditions such as clear, haze, and fog. The weather conditions is an essential factor to be considered to avoid the failure of the system. The FSO system with clear weather conditions shows better performance than dense weather conditions [15]. The performance and reliability are the crucial parameters of the FSO links utilized for optical metro networks. The performance of a free-space optical communication system depends on the process of tracking, acquisition, and pointing between the transmitter and the receiver. The optimization of these processes is required to reduce the resources and maintain a particular performance. The pointing process's optimized method is highly related to performance for different weather conditions [16]. The performance of an FSO system is mainly limited by atmospheric turbulence conditions like haze and rain etc. The diversity based MIMO FSO technique for different weather conditions can enhance the FSO system's performance at a data rate of 10 Gbps [17]. The Binary polarization shift keying (BPSK) modulation technique with a data rate of 2.5 Gbps can reduce multipath fading due to turbulence and also proves better performance under exact weather conditions for a link range of 1.5 km [18]. It has been observed that changes in atmospheric condition from clear weather to haze, rain, and fog, link distance range decreases from 3 to 1 km, and among the three modulation formats carrier suppressed return to zero (CSRZ), modified-duobinary (MDRZ) and duobinary return to zero (DRZ) (CSRZ) has the best performance [19]. From the reported literature, we can conclude that the maximum data rate analyzed 260 Gbps for a distance of 100 m. The optimization of different parameters will lead to the enhancement of system performance. This paper has proposed the design of a four-channel WDM system with DPSK modulation operating in the O, E, L, and U band. The DPSK modulation and optimization of multiplexer and demultiplexer bandwidth have enhanced the data rate to 240 Gbps (60 Gbps × 4 channels). DPSK WDM System Design The four-channel WDM DPSK system is designed using Optisystem-17. Figure 1 shows the schematic design, and Table 1 describes design parameters. The system is designed for clear weather conditions. The pseudorandom binary sequence (PRBS)

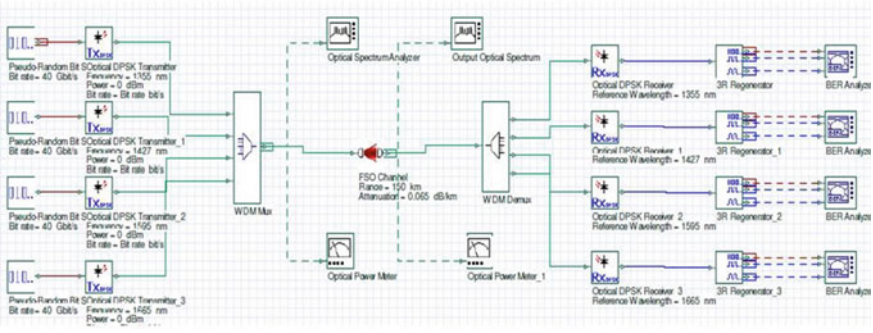

Fig. 1 Four channel WDM DPSK system

Table 1 Design parameters

Parameter	Value
Data rate (Gbps)	40, 60, 80, 100
Source power	0 dBm
Rx type	PIN photodiode
λ1, λ2, λ3, λ4 (nm)	1355, 1427, 1595, 1665
Attenuation (very clear)	0.065 dB/km
Range	150 km

generator is used to generate the binary sequence. The data rate of the PRBS generator is varied for the analysis of a designed system. A received signal's performance is measured using bit error rate (BER), quality factor (Q factor). The DPSK transmitter block consists of an optical source and DPSK modulator. The optical sources at four DPSK transmitters are operating at O, E, L, and U bands; the optical source input is modulated using DPSK modulator with input data and NRZ data format. The output of four different DPSK modulators is combined using a four-port multiplexer. The wavelength of each source is defined, and the multiplexer and demultiplexer. The bandwidth of multiplexer and demultiplexer is set to an optimum value. The output of the multiplexer is fed to the FSO channel with a length of 150 km. The attenuation of an FSO channel is set for exact weather conditions. The optical power meter is used to monitor the input and output optical power variation, and the optical spectrum analyzer analyzes the WDM input–output spectrum. The FSO channel's output is in the multiplexer formed, and it is demultiplexed using a four port demultiplexer. The output of demultiplexer is fed to the DPSK receiver, which consists of a photodetector sensitive for four different transmitted wavelengths in the O, E, L, and U bands. The input to the 3R generators is from the DPSK receiver. The signal strength is reduced, and distortion may get added to the signal while traveling over the channel. 3R generators are used for the proper recovery of the signal. BER analyzer is used to monitor the system performance under variable conditions and data rate.

2 Proposed Work

Free Space Optic (FSO) is a Wireless Optical Communication (WOC) that can be implemented as a backbone for different types of networks. It uses light as a carrier, similar to optical fiber communication. Due to the FSO link's numerous advantages, it is deployed in a variety of applications such as inter-satellite links, inter-aircraft links, terrestrial links, and military applications. As the FSO is used air as a channel and interference of atmospheric turbulence degrades the FSO system's performance. An FSO link's performance should be compatible with optical fiber communication in terms of long-range, low losses, and high data rates. The atmospheric turbulence mainly limits the range and data rate. The research is growing in the direction to

enhance the performance of an FSO system. The optimization of various parameters like operating wavelength, bandwidth, antenna aperture diameter, and transmission power level can improve system performance. The proposed idea of optimizing mux and demux bandwidth and the implementation of DPSK modulation enhances the FSO link range and capacity. The proposed method's underline principle is to improve the channel capacity in terms of data rate and simultaneously boost the range of an FSO link under clear weather conditions.

The proposed work exploits the four-channel WDM system for all operational O, E, L, and U bands. Also, the introduction of WDM has helped improve the channel capacity and expand the number of channels further. Furthermore, the proposed method identifies the maximum operational data rate for an optimum bandwidth of multiplexer and demultiplexer. Implementing the DPSK digital modulation scheme has been determined for performing the analysis and comparative exercise with the implemented Mach Zehender Modulator. Finally, the relationship between Q factor, multiplexer, and demultiplexer has been established to demonstrate the proposed work's importance.

3 Results and Discussion

The free space optic link is a sort of wireless optical communication. The key limiting factor in the FSO link is the environmental conditions. The link is stable in clear weather conditions, leading to the heavy attenuation of the transmitted signal under fog and heavy rain conditions. The system is designed to enhance the operating bit rate and link length. System performance is analyzed with various parameters such as BER, Q factor, and eye diagram. Figure 2 shows the relationship between the Q factor and bandwidth. The optimum values of bandwidth are recorded, at which the

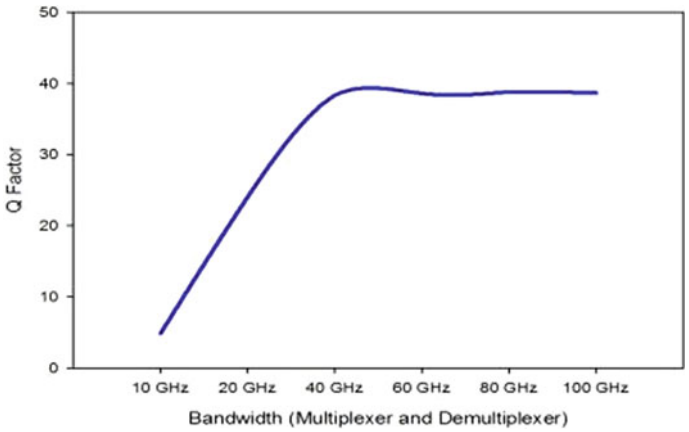

Fig. 2 Relationship between Q factor and bandwidth

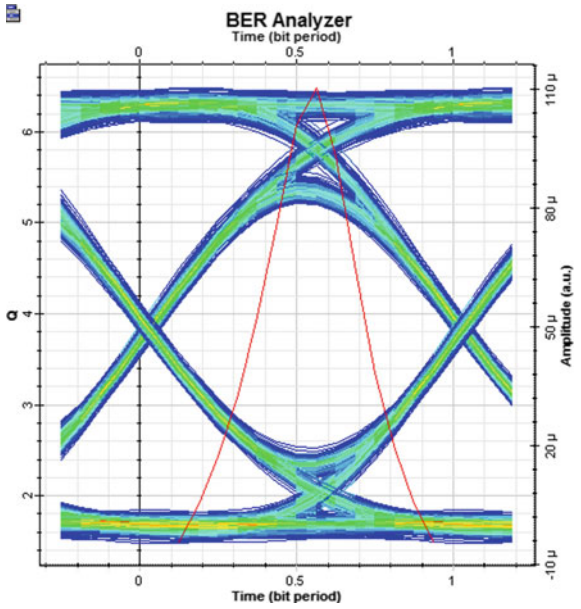

Fig. 3 Eye diagram at 20 Gbps

Q factor value is maximum. The optimum value of bandwidth is calculated with a constant data rate of 10 Gbps and a distance of 150 km.

The multiplexer and demultiplexer bandwidth is varied from 10 to 100 GHz, and the value of the Q factor is recorded. The Q factor values are verified for all possible data rates from 1 to 60 Gbps. A system's performance is compared using two different modulators one is Mach Zehnder modulator, and another one is DPSK modulator. Figure 3 shows the eye diagram at the data rate of 20 Gbps, and Fig. 4 shows the eye diagram at 30 Gbps. The range for 20 and 30 Gbps is 60–100 GHz. The Q factor and bandwidth are proportional up to a bandwidth of 40 GHz, the bandwidth range of 40–100 GHz offers the maximum and constant value of the Q factor. The eye diagram interprets that the system is performing well at the data rate of 20 Gbps with a Q factor of 6.44 and BER value 5.96e−11, whereas at 30 Gbps, the recorded value of Q factor is 2.28 and BER value 0.01104.

The system with Mach Zehnder modulator can perform satisfactorily up to the data rate of 20 Gbps. Furthermore, the WDM system is analyzed with a DPSK modulator. DPSK modulator system has the bandwidth in the range of 60–100 GHz. Figure 5 shows the eye diagram of the DPSK modulated system with a data rate of 40 Gbps. The Q factor at this data rate is 11.20, and BER is 1.84e−28. Figure 6 represents the eye diagram at 60 Gbps. We can interpret that eye-opening is clear and Q factor and BER are 10.59 and 1.354e−58. The system has a satisfactory operation at a high data rate of 60 Gbps. Table 2 shows the competitive analysis of Q factor and BER values at 40, 60, 80, and 100 Gbps. The acceptable minimum value of the Q factor is 6, and BER is 10^{-12}. Table 2 notifies that the system has a satisfactory performance at a data rate of 80 Gbps (Table 3).

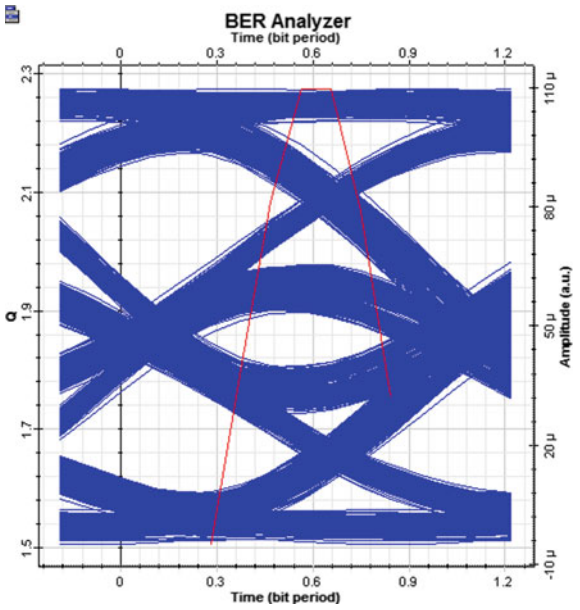

Fig. 4 Eye diagram at 30 Gbps

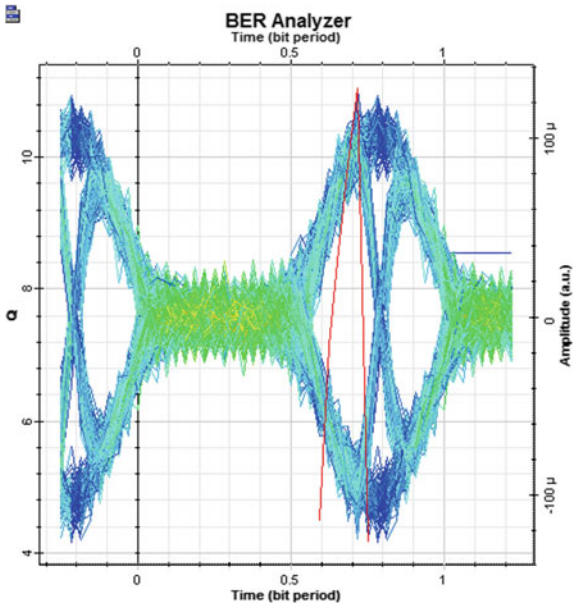

Fig. 5 Eye diagram at 40 Gbps

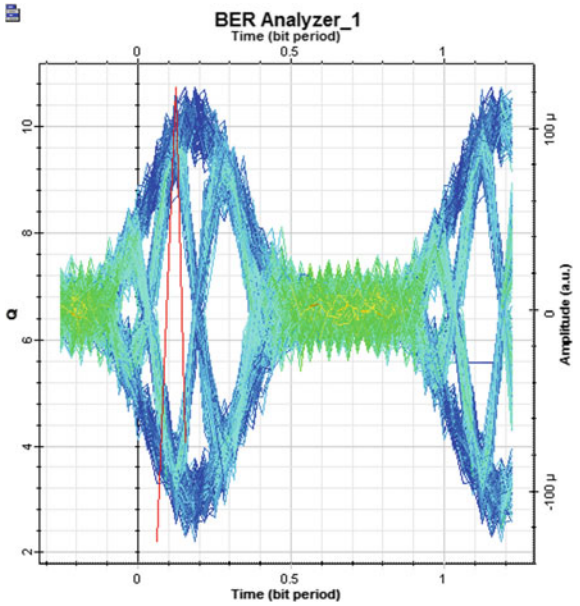

Fig. 6 Eye diagram at 60 Gbps

Table 2 BER and Q factor at various data rates (DPSK modulated)

Data rate (Gbps)	Q factor	BER
40	11.20	1.84e−28
60	10.59	1.354e−58
80	6.48	5.28e−11
100	3.24	0.009

Table 3 BER and Q factor at various data rates (Mach Zehender modulated)

Data rate (Gbps)	Q factor	BER
10	38.69	0
20	6.44	2.38e10
25	3.40	0.0003
30	2.27	0.011

4 Related Work

The implementation of Spectral Amplitude Coding (SAC), Optical Code Division Multiple Access (OCDMA), Orthogonal Frequency Division Multiplexing (OFDM), and Wavelength Division Multiplexing (WDM) has to lead to the performance enhancement of FSO link. With a maximum data rate of 5 Gbps with a distance of 150 km [21]. Various WDM FSO techniques were designed and analyzed under clear weather and haze conditions. The system was optimized to operate a link

for a long distance of 350 km under clear weather conditions with attenuation of 0.065 dB/km and 47 km under haze conditions with attenuation of 2.37 dB/km. However, the system was designed to a maximum data rate of 2.5 Gbps [22]. The impact of attenuation due to different weather conditions is overcome by using WDM/Multistream technique. The use of the multistream FSO technique has almost doubled the operational data rate. The four-channel Dense Wavelength Division Multiplexing (DWDM) FSO link was designed and analyzed for the data rate of 1.25 Gbps for heavy rain conditions (>120 mm/h) with atmospheric loss of 19 dB/km. The satisfactory reduced Bit Error Rate (BER) is achieved for a distance of 1.1 km. In contrast, single-channel links under the heavy rain condition (80 mm/h) operated at a data rate of 0.6 Gbps at a distance of 1.5 km [22]. The Radio over FSO (RoFSO) is a promising emerging technology; the system performs well for the channel spacing of 75 GHz. The RF/FSO hybrid model has also recorded significant marine communication operation, which can be further extended to military communication systems. The FSO system is optimized and simulated for 1, 2, 5, 10, and 15 Gbps for a link range of 50 cm to 1.4 km [23–25].

5 Conclusion

The four channels DPSK modulated FSO WDM system for exact weather condition is proposed operating at O, E, L, and U bands at the data rate of 60 Gbps × 4 channels. The performance of the system is compared with the 4 Channel Mach Zehender WDM system. To maximize the system performance, bandwidth optimization is applied, and the range is chosen between 60 and 100 GHz. In this bandwidth range, the excellent value of the Q factor is observed. Using DPSK modulation in the bandwidth range of 60–100 GHz has proven significant improvement in the data rate. The system can operate at 60 Gbps for clear weather condition with a Q factor of 10.59. In contrast, the system with Mach Zehender modulator can operate at a maximum data rate of 20 Gbps with a Q factor of 6.44. Thus, the proposed DPSK WDM-FSO system can provide a practical enhancement in the data rate to address the last mile problems.

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Effective Classification of Autism Spectrum Disorder Using Adaptive Support Vector Machine

Bindu George and E. Chandra Blessie

Abstract Medical science today produces a great amount of data. Medical field is loaded with rich set of data with evidence and can be helpful in making decision. Autism Spectrum Disorder (ASD) is a category of neurodevelopmental diseases that cannot be cured but are mitigated by early diagnosis and intervention. Early diagnosis and prevention is more critical than cure for people with autism. ASD is present not only with children but also with adults and adolescents. Traditional classification algorithms attempt to give its best performance only with certain dataset that are related to certain diseases. Only very few algorithms available for the prediction of ASD, but it is for predicting ASD among children. Still now there exist no standard classification algorithm for the prediction of ASD among children, adults and adolescents. This research work attempts to find a solution to addressed problem by proposing Adaptive Support Vector Machine (ASVM) algorithm. ASVM is a modified version of SVM algorithm that meets the prediction of ASD more accurately. Tuning method is utilized to enhance the accuracy. To analyze the effective performance of ASVM against previous algorithms it has been tested with three different ASD screening datasets available for adults, children and adolescents. Results are measured using benchmark data mining metrics and it has been found that ASVM has better performance in classifying and predicting ASD in all considered datasets.

Keywords ASD · Autism · Classification · Kalman · SVM

1 Introduction

The number of adults with the Autism Spectrum Disorder (ASD) has been rising dramatically over time and now impacting all age-groups. Early diagnosis of neurological disorders may aid in preservation of mental and physical wellbeing [1]. By using artificial learning, early identification of illness can be accomplished. It helped

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us to create better therapies for Autism spectrum disorders. There is a major difficulty to detect ASD when there are many other psychiatric illnesses whose signs are somewhat similar to those of ASD [1, 2].

Autism is a psychiatric problem. Person diagnosed with ASD face the trouble to interact with others. This medication will have a dramatic impact on the person's health for the rest of their life. A significant finding is that both genetic and environmental factors may cause the development of this disease [3, 4]. And children who have this disorder may spontaneously experience symptoms around three years old, and they may have symptoms for the remainder of their life. It is not possible to effectively avoid this illness, but the symptoms of this sickness may be lessened. The human genome determines the development of the universe. It is believed that weight should be involved in ASD's growth. Getting a low birth weight, having siblings with autism or having older parents often increase the risk of autism [5, 6].

There are many ways of avoiding and treating ASD such as early diagnoses and early preparation. It is difficult to verify whether anyone is diagnosed with autism. ASD is never thought about [7]. Living with autistic children will leave their impressions on their parents and teachers. Autism assessment was administered by a specialist in special education from the classroom [8]. These students advised those who suffer from related symptoms to visit their doctor. In a young adult, autism signs are more subtle than in teenagers. It is easy to predict the behavior of an autistic person who has autism developmental signs at 18 months of age [9, 10].

Machine Learning algorithms are widely applied in healthcare for the prediction of disease and it helps in minimizing medical costs. Currently available machine learning algorithms for the prediction of ASD are facing many issues in terms of classification accuracy. Misclassification can lead to a severe effect on the patient's life.

2 Literature Review

Support Vector Machine [11] algorithm is examined to make an understanding about bipolar disorder patients. Healths of the patients were analyzed using different structural functions. Evaluation of the algorithm was made with significant features using fivefold cross validation. SVM performed poorly due to using minimum number of samples. Computational psychiatry [12] reviewed the approaches used in the medical field of psychiatry that is linked with mental illness treatment. In theoretical driven computing approach, mechanistic models were employed to perform a hypothesis at different analyzing level. Machine learning based data-driven approaches predict psychiatric patients from huge dimensional data. It has been found that machine learning approach have better performance of prediction of psychiatric patients than computing approach. Machine-Learning-based classification [13] proposed to classify post-traumatic stress disorder and major depressive disorder where both come under mental disorder problems. Features of the dataset played a major role towards

making an accurate prediction. 300 features were made to investigate with source-level and sensor-level. The effects of comorbidity are verified with the approach. Meta-Model [14] has been proposed by ensembling different SVM approaches that are trained with local datasets that avoids the sharing of data. Meta-model is validated with schizophrenia patient dataset which used SVM model for classifying. Comparison has been done with joint multicenter data and found that there exist only little variations with existing model.

Deep Neural Generative Model [15] proposed for diagnosing the schizophrenia and bipolar disorders disease among patients. It considers the state of subject by utilizing Bayes' rule. Accuracy of diagnosis is enhanced using connectivity functions, discriminative models and feature extraction algorithms. Deep Generative State-Space Modeling [16] proposed as a temporal model to understand the mechanism that act as a root cause for disorders. Deep learning methodology is utilized as a state space model that overcomes the issues of overfitting and acts better than normal deep-learning classification algorithms. Mental Disorder Screening System [17] proposed as a single-lead ECG system which combines the features of mental oriented tasks. It mainly focused on the varying heart rates. SVM is used classify the somatoform disorders with 24 psychiatric patients. Result of the non-linear classification model makes an indication that it has achieved low accuracy than the existing models. Deep Neural Network [1] has been demonstrated to make a prediction of ASD via speech recordings. It estimates the scores of Autism Diagnostic Observation Schedule assessment and performs the comparison using two different regression models namely (i) support vector regression, (ii) linear regression. Convolutional Neural Network has achieved the better results than other models towards the predictions of ASD.

Recurrent Attention Model [18] proposed as a deep learning technique for classifying ASD. Policy Gradient algorithm plays a major role in this model to experience the Gaussian sampling. Information regarding the error faced in time difference and training are rectified are to increase the accuracy of classification. Machine Learning-Based Model [19] performed a classification among ASD patients. Different classification methods were assessed for identifying the better performance. It was found that SVM, Adaboost and Glmboost algorithms have given better performance in different datasets. Feature selection has major role in the foresaid algorithms. Resting State Networks [20] measured the statistical results of ASD among 295 patient records by utilizing independent component analysis. It attempted to discover the consistent patterns among different websites related to ASD. SVM is used for classification. Area under curve is used to analyze the performance of classification. Gaze-based classification [21] proposed as a method for classifying the different levels of risk present among ASD patients. Feature descriptors were developed incorporate the exact features from the considered dataset where eye gaze plays a major role. Gaze-based classification method compared with existing algorithms to identify the efficient classification of ASD.

3 Adaptive Support Vector Machine

Let the mapping of feature space ϕ:X $\rightarrow$ H, X = ϕ(x) denoted by dot product and indicated using <·, ·>. A linear binary classification f:X $\rightarrow$ R is described as f(x) = $\langle X, W\rangle - b$ and it is required when W $\in$ H, b $\in$ R. Outputs are received as h(x) = sign(f(x)).

Standard formulation of SVM show the way to research problems that are related with prediction is mathematically shown in (1):

$$\min_{W\in\mathcal{H},b\in\mathbb{R}} \frac{1}{2}\|W\|^2 + C\sum_{i=1}^{N}\xi_i \tag{1}$$

$$s.t\begin{cases} \mathcal{Y}_i(\langle X_i, W\rangle - b) + \xi_i \geq 1, \\ \xi_i \geq 0, Z_i \in Z\, i = 1, \ldots, N \end{cases}$$

where slack variables are indicated using ξ_i with the condition $C > 0$ which act as a expression used for regularization.

The answer for the above discussed problem is possible to write as $W_0 = \sum_i \gamma_i \mathcal{Y}_i X_i$, where X_i is equivalent to $\phi(x_i)$ and γ_i is the multipliers variable based on Lagrange for dealing with dual formulation (i.e., the classification) using Eq. (2), with $\sum_i \gamma_i \mathcal{Y}_i$ equivalent to 0. The term b is calculated in a posterior manner, and is represented b_0 which is a bias standard. Hence, the classification is formulated as Eq. (2):

$$f(x) = \sum_{i=1}^{N} \gamma_i \mathcal{Y}_i K(x_i, x) - b_0 = \langle X, W_0\rangle - b_0 \tag{2}$$

where the kernel function ($K : \mathcal{X} \times \mathcal{X} \rightarrow \mathbb{R}$) is described as, $K(x, \mathcal{Y}) = \langle X, Y\rangle = \langle \phi(x), \phi(\mathcal{Y})\rangle$.

Equation (2) adjusts issues in common optimization to integrate information related to penalties that associate with incorrect or invalid predictions for every class issues that are involved in learning. Hence, the two different types of errors are perchance introduced while formulating the issues of learning process that is by utilizing two different regularization parameters is expressed in Eq. (3):

$$\min_{W\in\mathcal{H},b\in\mathbb{R}} \frac{1}{2}\|W\|^2 + C^+ \sum_{i|\mathcal{Y}_2=+1} \xi_i + C^- \sum_{i|\mathcal{Y}_2=-1} \xi_i$$

$$s.t\begin{cases} \mathcal{Y}_i(\langle X_i, W\rangle - b) + \xi_i \geq 1 \\ \xi_i \geq 0, z_i \in Z\, i = 1, \ldots, N \end{cases} \tag{3}$$

where the costs that are associated is indicated using C^+ and C^-. These are the costs that are associated positive class error and negative class error, correspondingly. In

addition, the vector (i.e., related to the solution) is possible to write as like the vector. It is noteworthy that SVM commonly provides good recall result than common SVM. However, there exists a chance for SVM to get fail towards regulating recall. The proposed ASVM attempts to regulate by tuning method.

A notable point in the proposed ASVM is, while obtaining solution vector by utilizing common SVM, bias b is treated as like a parameter. With the agreement of notation, classifier set $F(W_0)$ is mathematically shown in Eq. (3):

$$f_b : \mathcal{X} \to \mathbb{R};\ f_b(\cdot) = \langle \phi(\cdot), W_0 \rangle - b;\ b \in \mathbb{R}$$

The map $\Theta_b : \mathcal{X} \to \{-1, +1\}$ defined as the association of classification, that is $f_b(x) \in F(W_0)$, where x is given as input vector that assigns label using Eq. (4):

$$\Theta_b(x) = sign(f_b(x)) = \begin{cases} +1\, if\ < X, W_0 \geq b \\ -1\, if\ < X, W_0 < b \end{cases} \tag{4}$$

Lets define the function used for calculating the recall, $R_e : \mathbb{R} \to [0, 1]$, as $R_e(b) = R_e(f_b, Z)$ and the specificity function, $S_p : \mathbb{R} \to [0, 1]$, as $S_p(b) = S_p(f_b, Z)$ from Eqs. (5) and (6) where $f_b \in F(W_0)$.

$$R_e(f, \mathcal{D}) = \frac{t_{pstve}}{N_{pstve}} \tag{5}$$

$$S_p(f, \mathcal{D}) = \frac{t_{ngtve}}{N_{ngtve}} \tag{6}$$

Furthermore, let the order

$$Z_{pstve} = \left\{(X_1, +1), \ldots, \left(X_{N_{pstve}}, +1\right)\right\} = \left\{(P_1, +1), \ldots, \left(P_{N_{pstve}}, +1\right)\right\} \tag{7}$$

with $P_i = X_{\sigma^*}(i)$, where σ^* is a permutation of N_{pstve} such that

Let us consider the values $b_i = \langle P_i, W_0 \rangle\ for\ i = 1, \ldots, N_{pstve}$, the following results are assumed to hold:

$R_e(b)$ is a decreasing function of b.

$$R_e(b_i) \geq \frac{N_{pos} - (i-1)}{N_{pos}} \forall_i.$$

Additionally, $if\ b_i \neq b_j\ for\ i \neq j$, then

$$R_e(b_i) = \frac{N_{pos} - (i-1)}{N_{pstve}}$$

$$R_e(b_i) = R_e(b_{i+1}) + 1/N_{pstve} \tag{8}$$

If $b_i < b_{i+1}$, then $R_e(b_i) > R_e(b) = R_e(b_{i+1})$ for any b such that $b_i < b \leq b_{i+1}$.
If $b \leq \beta < b' \leq \beta^* < b^*$, then $\{(R_e(b) = 1) > R_e(b') > 0\} = R_e(b^*)$.
Analogously, let

$$Z_{ngtve} = \{(X_1, -1), \ldots, (X_{N_{ngtve}}, -1)\} = \{(q_1, -1), \ldots, (q_{N_{pstve}}, -1)\} \quad (9)$$

with $q_j = X_{\sigma'}(j)$ where σ' is treated as a permutation of N_{pstve} where $\langle q_1, W_0\rangle \leq \ldots \leq \langle q_j, W_0\rangle \leq \ldots \leq \langle q_{N_{neg}}, W_0\rangle$; for $j = 1, \ldots, N_{neg}$.

Let's consider the values, $\alpha^* = \min_{z_i \in Z_{neg}} \langle X_i, W_0\rangle = \langle q_1, W_0\rangle$ and $\alpha = \max_{z_i \in Z_{neg}} \langle X_i, W_0\rangle = \langle q_{N_{neg}}, W_0\rangle$. Therefore, by assuming the bias $b_{q_j} = \langle q_j, W_0\rangle \; for \; j = 1, \ldots, N_{ngtve}$, it follows that:

$Sp(b)$ is an increasing function of b.

$Sp(b_{q_j}) + \frac{1}{N_{neg}}$. In addition, if $b_{q_i} \neq b_{q_j} \; for \; i \neq j$, then $Sp(b_{q_j}) = j - \frac{1}{N_{ngtve}}$ and $Sp(b_{q_j}) + \frac{1}{N_{ngtve}} = Sp(b_{q_{j+1}})$.

If $b_{q_j} < b_{q_j+1}$, then $Sp(b_{q_j}) < Sp(b) \leq Sp(b_{q_j+1})$ for any b such that $b_{q_j} < b \leq b_{q_j+1}$.

If $b \leq \alpha^* < b' \leq \alpha < b^*$, then $Sp(b) = 0 < Sp(b') < 1 = Sp(b^*)$.

4 Results and Discussion

4.1 About Dataset

In this paper, three different datasets [22–24] are used for analyzing the performance of the proposed classifier towards predicting ASD. Details of the datasets are provided in Table 1 and the details of attributes are provided in Table 2.

Table 2 describes the attributes present in ASD dataset [22–24].

Table 1 ASD dataset

Sl. No.	Name of dataset	Attributes	Instances count	Attribute type
1	ASD screening dataset for adults [22]	21	704	(a) Categorical (b) Continuous (c) Binary
2	ASD screening dataset for children [23]	21	292	(a) Categorical (b) Continuous (c) Binary
3	ASD screening dataset for adolescents [24]	21	104	(a) Categorical (b) Continuous (c) Binary

Table 2 Attributes of ASD dataset

Attribute Id	Description of attribute
1	Age of the patient
2	Gender of the patient
3	Ethnicity of the patient
4	Born with jaundice
5	Family member with pervasive development disorders
6	Who is completing the test
7	Country of residence
8	Whether the screening app used by the user earlier or not?
9	Type of screening method
10–19	Based on the screening method answers of 10 questions

4.2 Performance Metrics

Four different variables that are used in the calculation of performance metrics are:

True Positive (TP): Exact detection of the presence of ASD.

False Positive (FP): Incorrect detection of the presence of ASD.

True Negative (TN): Exact detection of the absence of ASD.

False Negative (FN): Incorrect detection of the absence of ASD.

Above mentioned variables are used in the calculation of performance metrics, which are:

$$Sensitivity = \frac{TP}{TP + FN} \tag{10}$$

$$Specificity = \frac{TN}{TN + FP} \tag{11}$$

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN} \tag{12}$$

$$Precision = \frac{TP}{TP + FP} \tag{13}$$

$$Recall = \frac{TP}{TP + FN} \tag{14}$$

$$F{-}Measure = 2 \times \frac{(Precision \times Recall)}{(Precision + Recall)} \tag{15}$$

4.3 Analysis of Adult Dataset for ASD

In Fig. 1, the variables TP, TN, FP and FN are marked on the x-axis and the y-axis is marked with the count of records. It is very clear to understand that ASVM has better performance against previous algorithms namely SVM [19] and Active Pruning Rules [25]. The prediction phase and the updation phase in ASVM assist better results in predicting ASD.

In Fig. 2, the performnce metrics Sensitivity, Specificity and Accuracy are marked on the x-axis and the percentage of results is marked on the y-axis. From the figure, it has been observed that ASVM has outperformed the other two algorithms namely SVM [19] and Active Pruning Rules [25]. The linear model present in ASVM assists

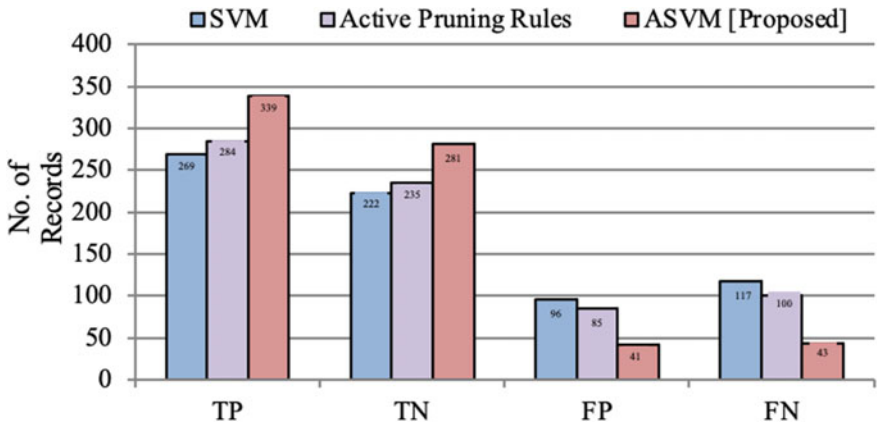

Fig. 1 Adult dataset versus TP, TN, FP, FN

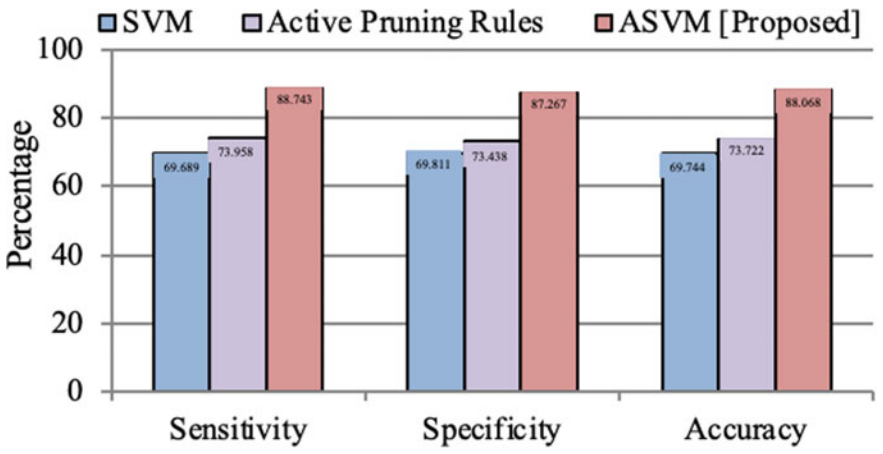

Fig. 2 Adult dataset versus sensitivity, specificity, accuracy

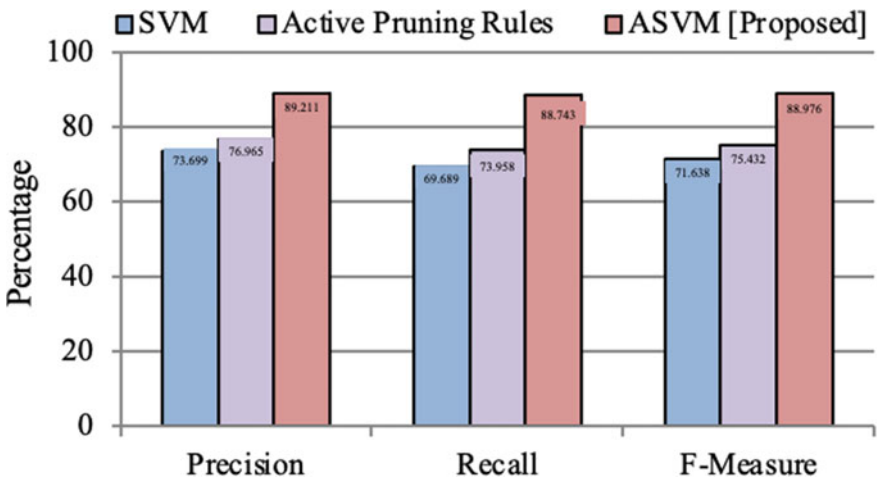

Fig. 3 Adult dataset versus precision, recall, F-measure

the classifier to perform better classification. SVM [19] and Active Pruning Rules [25] would have ignored the significant features and this result in poor classification.

In Fig. 3, the performance metrics Precision, Recall and F-Measure are marked on the x-axis and the percentage of results is marked on the y-axis. From the figure, it is evident that ASVM has better performance in terms of precision, recall and F-measure than SVM [19] and Active Pruning Rules [25]. ASVM applies predicted output as input for estimating the class label and this assists to achieve better results.

4.4 Analysis of Children Dataset for ASD

In Fig. 4, the variables TP, TN, FP and FN are marked on the x-axis and the y-axis is marked with the count of records. It is very clear to understand that ASVM has better performance against previous algorithms namely SVM [19] and Active Pruning Rules [25]. The prediction phase and the updation phase in ASVM assist better results in predicting ASD. While making a notice on FP, it was found that SVM [19] and Active Pruning Rules [25] has the minimum level difference.

In Fig. 5, the performance metrics Sensitivity, Specificity and Accuracy are marked on the x-axis and the percentage of results is marked on the y-axis. From the figure, it has been observed that ASVM has outperformed the other two algorithms namely SVM [19] and Active Pruning Rules [25]. The linear model present in ASVM assists the classifier to perform better classification. SVM [19] and Active Pruning Rules [25] would have ignored the significant features and this result in poor classification.

In Fig. 6, the performance metrics Precision, Recall and F-Measure are marked on the x-axis and the percentage of results is marked on the y-axis. From the figure,

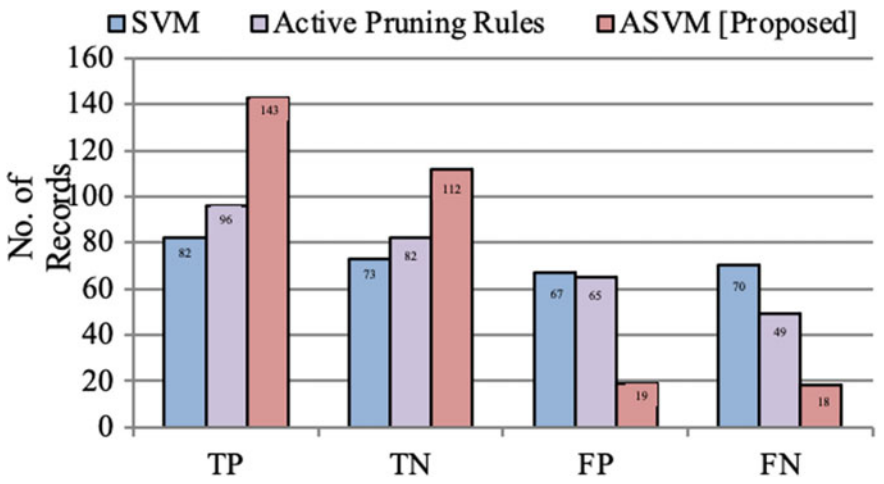

Fig. 4 Children dataset versus TP, TN, FP, FN

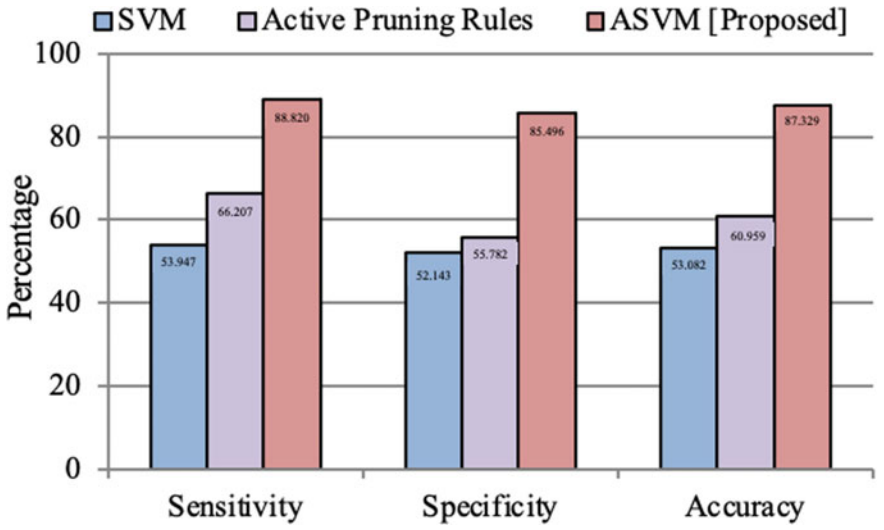

Fig. 5 Children dataset versus sensitivity, specificity, accuracy

it is evident that ASVM has better performance in terms of precision, recall and F-measure than SVM [19] and Active Pruning Rules [25]. ASVM applies predicted output as input for estimating the class label and this assists to achieve better results.

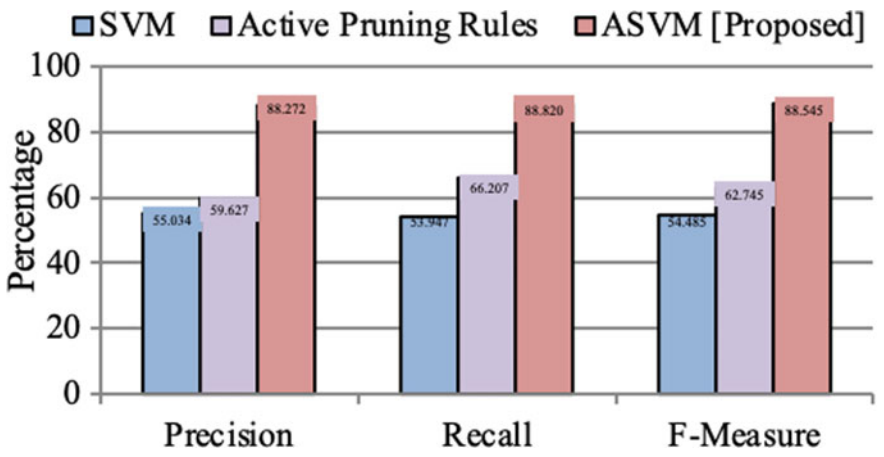

Fig. 6 Children dataset versus precision, recall, F-measure

4.5 Analysis of Adolescent Dataset for ASD

In Fig. 7, the variables TP, TN, FP and FN are marked on the x-axis and the y-axis is marked with the count of records. It is very clear to understand that ASVM has better performance against previous algorithms namely SVM [19] and Active Pruning Rules [25] in terms of TP, FP and FN. But, while noticing TN it is found that Active Pruning Rules [25] has a minor level better performance than ASVM. The prediction phase and the updation phase in ASVM assist better results in predicting ASD.

In Fig. 8, the performance metrics Sensitivity, Specificity and Accuracy are marked on the x-axis and the percentage of results is marked on the y-axis. From

Fig. 7 Adolescent dataset versus TP, TN, FP, FN

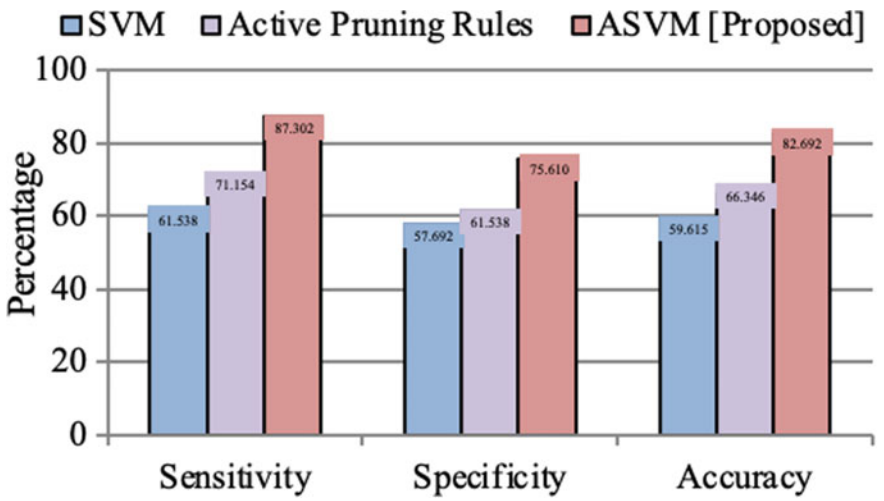

Fig. 8 Adolescent dataset versus sensitivity, specificity, accuracy

the figure, it has been observed that ASVM has outperformed the other two algorithms namely SVM [19] and Active Pruning Rules [25]. The linear model present in ASVM assists the classifier to perform better classification. SVM [19] and Active Pruning Rules [25] would have ignored the significant features and this result in poor classification.

In Fig. 9, the performance metrics Precision, Recall and F-Measure are marked on the x-axis and the percentage of results is marked on the y-axis. From the figure, it is evident that ASVM has better performance in terms of precision, recall and

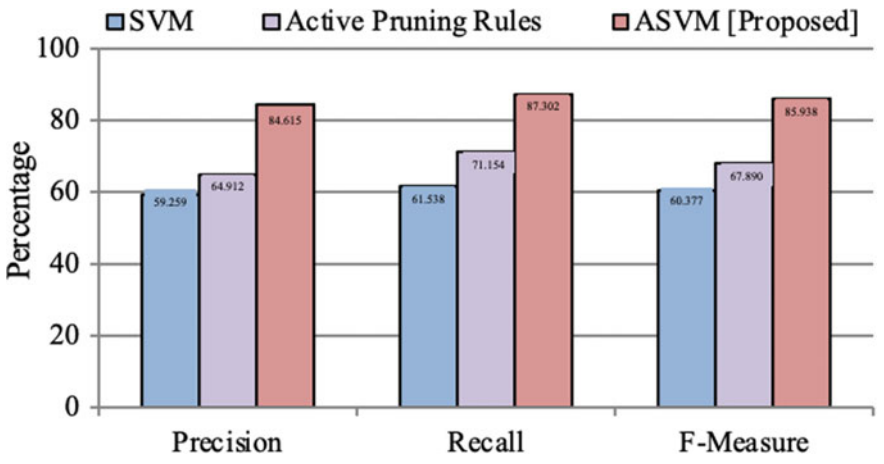

Fig. 9 Adolescent dataset versus precision, recall, F-measure

F-measure than SVM [19] and Active Pruning Rules [25]. ASVM applies predicted output as input for estimating the class label and this assists to achieve better results.

5 Conclusion

Researchers face different challenges in Autism Spectrum Disorder (ASD) prediction because of the presence of complexities. This paper has proposed Adaptive Support Vector Machine (ASVM) to predict ASD more accurately. To meet the challenge predicting ASD necessary modifications have been done on SVM algorithm. Three benchmark datasets has been chosen to evaluate the performance of KFSVM against previously available algorithms for the prediction of ASD. Benchmark metrics are used to measure the performance of KFSVM. Experimentation results make an impact that ASVM has a enhanced accuracy in predicting ASD than other algorithms. Future dimension can be focused to increase the classification accuracy by utilizing optimization algorithms.

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Detection and Classification of Areca Nut Disease Using Convolutional Neural Network

B. G. Jagadeesha and Ramesh Hegde

Abstract Areca nut is one of the major commercial crops in India. Koleroga (fruit rot) is the major disease for areca nut. A new technique for the detection and classification of areca nut disease, Koleroga, using the Convolutional Neural Network (CNN) is proposed. The CNN is trained using healthy as well as diseased areca nut images. An accuracy of 95–99% is achieved with the proposed method.

Keywords Areca nut · Koleroga · Machine learning · Deep learning · Convolutional neural network

1 Introduction

Areca Nut (AN) or Betel nut is the vital component of 'Pan' chewed by Indians for mood enhancing. Areca nut is a commercial crop grown in different regions such as Karnataka, Assam, North East and Western Ghats. It is a yearly crop produced by Areca trees grown in dedicated plantations.

Like any other plantation crop, Areca nuts are also afflicted by a few seasonal and non-seasonal diseases [1, 2]. Koleroga or Fruit rot is the most dangerous among them. In this work, we consider the detection and classification of Koleroga which normally originates and spreads during heavy rain fall monsoon months (July–September). The main symptom of Koleroga is rotting and consequent early shedding of young areca nuts. In early stages, dark wet lesions appear around the stalk end of the nut which gradually spread towards the free end. In general, the surface is partly or fully covered by somewhat brownish coloured ugly patches as shown in the sample of Fig. 1a. For the purpose of comparison, a sample of healthy nuts is shown in Fig. 1b. Infected nuts have characteristic discoloration and distorted textures compared to

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(a) Diseased (b) Healthy

Fig. 1 Diseased and healthy areca nut samples

healthy ones. This fact is used to distinguish the diseased nuts from the healthy ones by getting their images and then applying the techniques of image classification.

Object Classification Using Their Images

Dissimilar objects can be classified by analysing their 2d colour images as they contain sufficient visual characteristic features to represent their respective classes. Thus, image processing techniques have become one of the important tools for classification of visually dissimilar objects.

Image based classification can be carried out in two ways.

1. Image Analysis
2. Machine Learning.

Image Analysis Method: The salient visual features, like colour distribution, textures etc., of the target mage are extracted using segmentation, contour mapping, histogram analysis and so on. Then, the image is classified according to the knowledge base about the involved classes and the result of the present analysis.

Machine Learning Method: Artificial Deep Learning (DL) neural network is constructed which is trained using large number of image samples belonging to each class. Then, the network learns the spatial features of image samples of different classes. Once the learning is complete, the DL network can predict the class of the present target image.

In this paper, we use Convolutional Neural Network (CNN) which is an important DL network to detect and classify the areca nut disease Koleroga.

2 Related Work

Very less number of works has been carried out on diseases of areca nut. Naik et al. [1] worked on to find long lasting method for managing fruit rot disease of areca nut. In 2004 Saraswathy [2] worked on diseases and disorders of areca nut. Albawi et al. [3] described all the elements and significant issues relevant to CNN.

3 Basic Principle

Consider the three image samples shown in Fig. 2 which represent three designated classes. The healthy nuts are shown in Fig. 2a, moderately and severely infected ones are shown in Fig. 2b, c respectively. Moderately rotted nuts show mild discolouration while severely rotted nuts have a higher degree of discolouration with more distorted texture. Thus the three classes used in this work are,

1. Healthy
2. Moderately Rot
3. Severely Rot.

The degree of spatial colour and texture distortions of areca Nut (AN) images are used to distinguish these three classes using Convolutional Neural Network (CNN). Our proposed method is designated as ANR-CNN which stands for Areca Nut Rot (ANR) detection and classification using CNN.

In this paper, we describe the application of Deep Learning (DL) based on Convolution Neural Network (CNN) to achieve ANR-CNN classification.

3.1 Convolution Neural Network

A CNN is essentially an Artificial Neural Network where the mathematical operation 'Convolution' is carried out in one or more of its layers. This bestows Deep Learning capability to the artificial neural network. CNN is especially suitable for detecting intricate spatial patterns hidden in colour images [3]. The CNN specially designed for ANR-CNN is designated as ANR-CNNnet. A representative diagram of a ANR-CNNnet is shown in Fig. 3. The net is formed by a large number of inter connected nodes in multiple cascaded layers [4].

(a) Healthy (b) Moderately Rotted (c) Severely Rotted

Fig. 2 Classification into three categories

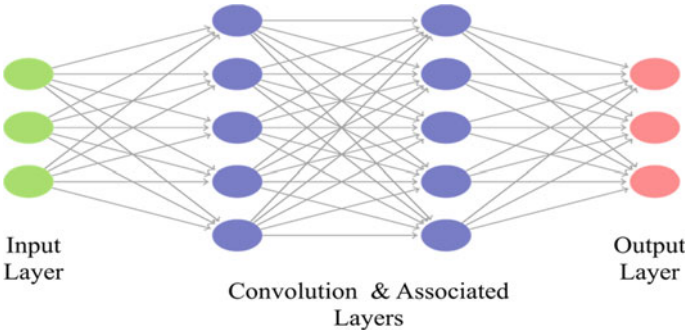


Fig. 3 Symbolic representation of a CNN. Courtesy Holzinger et al. [4]

The input dataset to ANR-CNNnet is the AN images under consideration and the output is the class (Healthy, Mild Rot and Sever Rot) to which the input images belong. In general, the input dataset is formed in two ways.

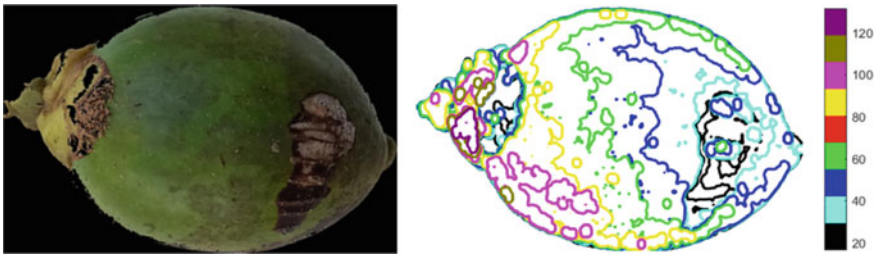
1. Direct usage of images as the input
2. Indirect usage of dominant features of the images as input.

   (1) In those cases where the distinguishing characteristics of the images are clearly visible (on human inspection), direct usage is adopted. As an example, this approach is adopted for the recognition of handwritten digit images [5]. Even when the images are used directly, a few pre-processing operations, like normalization, resizing, contrast adjustment etc. are used while forming the input dataset. A major disadvantage of direct usage is, the size of the input is relatively large, as the full image with thousands of pixels is the input to CNN.

   (2) In the indirect approach, the distinguishing features are dispersed and camouflaged there, but not directly perceptible to human visualization. In such cases, dominant and well-established distinguishing features of the images (like geometric primitives, principal components, image moments, spatial transforms, etc.) form the input dataset. Some of the features are invariant with respect to scaling, rotation, variation in illumination and so on. The main advantage of this approach is the sharp reduction in the input size that leads to speedy training of the CNN. In this work, we use the indirect approach where certain morphological features of the AN images form the input dataset.

3.2 Dataset for Training and Testing

Training is the most important process in the working of CNN during which, it learns the complex patterns of the input images. In ANR-CNN, we use certain morphological features based on the contour maps of the AN images



(a) Original AN image (b) Its contour lines

Fig. 4 Original image and its contour lines for a moderately rotted AN image

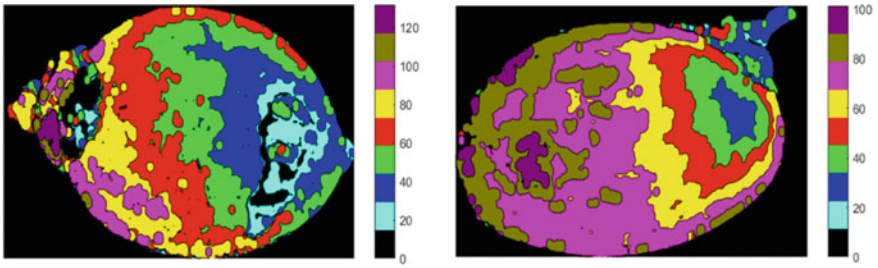
(a) Original AN image (b) Its contour lines

Fig. 5 Original image and its contour lines for a relatively healthy AN image

(1) ***Contour map***: A contour is a curve on the given 2d image that joins all the points of same intensity or colour value. The original image and its contour lines are shown for a moderately rotten AN image is shown in Fig. 4 whereas a relatively healthy image and its contour lines are shown in Fig. 5. Both of them use nine level contours. The contour map of a gray level image is generated using the Matlab function **contour(…)**.

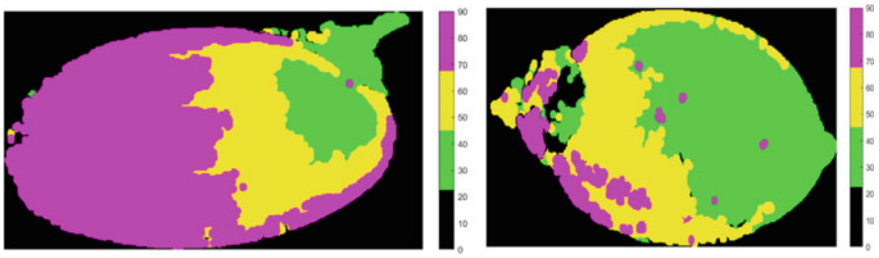
A *filled contour map* is generated using the Matlab function **contourf(…)** [6]. In it, the areas encircled by different contour lines (curves) at different levels are filled by the specified colours as shown in Fig. 6. Each distinct level is represented by its unique colour, marked in the colour bar as shown in Fig. 6. Thus the colour of a region represents the corresponding contour map region.

A filled contour map of an AN image can represent the degree of rot in that Areca Nut. It is experimentally found that the degree of rot is lesser when regions of successive levels are contiguously distributed. Then the AN image has a smoother texture. On the other hand, discontinuous and scattered distribution means a higher degree of rot. The distribution of regions of the filled, four level contour map of a healthy AN image, is shown in Fig. 7a. The 4 level contour map layout of another AN image with moderate rot is shown in Fig. 7b where we can observe the scattered distribution.



(a) Filled contour maps for Fig. 4 (b) Filled contour maps for Fig. 5

Fig. 6 Filled contour maps for images in Figs. 4 and 5



Healthy AN Image Moderately Rotten AN image

(a) Almost contiguous distribution of map regions (b) Scattered distribution of map regions

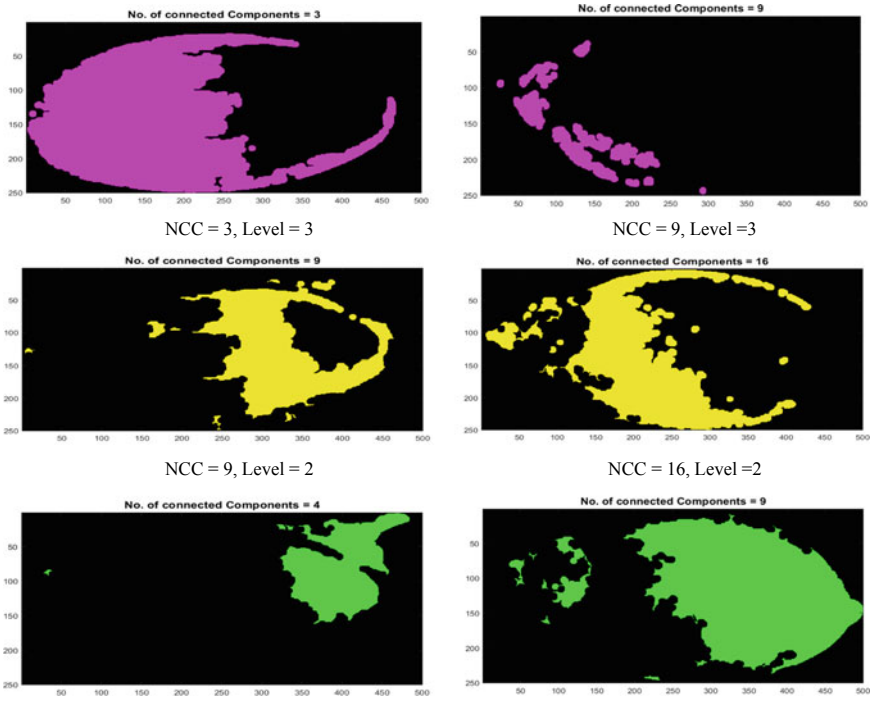
Fig. 7 Distribution of contour map regions for AN image of Fig. 5

(2) ***Connected components of regions***: The Number of Connected Components (NCC) [7], of a specific region, represents the degree of scatter of that region. A fully contiguous region has NCC = 1 as depicted by the black colour region of Fig. 7a. When a region is scattered, NCC value will be higher. For the purpose of comparison, NCC values for different regions from Fig. 7a, b are separately shown in Fig. 8.

The NCC values for different regions in healthy and moderately rotten images are summarised in Table 1.

Thus, by knowing the NCC values of contour map regions, we can determine the degree of rot of an Areca nut. Higher the NCC value, the degree of rot is more. Lower values of NCC indicate lesser rot infection of the Areca nut. Therefore, the NCC value represents the degree of rot. A major advantage of NCC is, it is independent of the scaling and orientation of the image. Hence, scale adjustments and skew corrections are not pre-requisites when we use NCC values to determine the state of rot from the contour map of AN images.

(3) ***Information content of contour maps***: Information content of a contour map can be increased by increasing the Number of Contour Levels (NCL) selected while generating the contour map. Fine grained details are exposed when NCL



NCC = 3, Level = 3 NCC = 9, Level =3

NCC = 9, Level = 2 NCC = 16, Level =2

NCC = 4, Level = 1 NCC = 9, Level =1

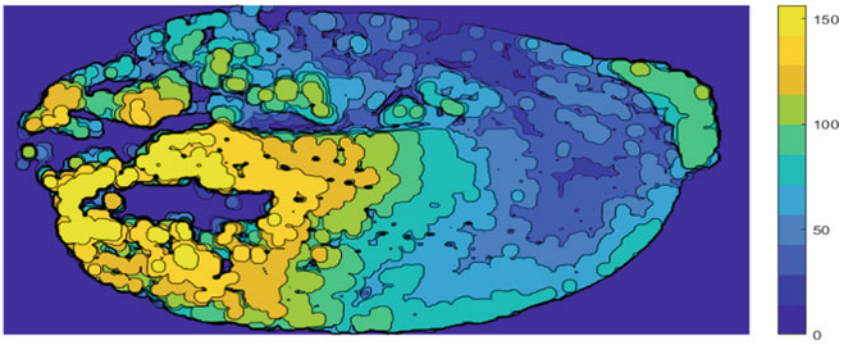
(a) Contour map regions from 7(a) (b) Contour map regions from 7(b)

Fig. 8 NCC values for a healthy and moderately rotten AN images of Fig. 7a, b

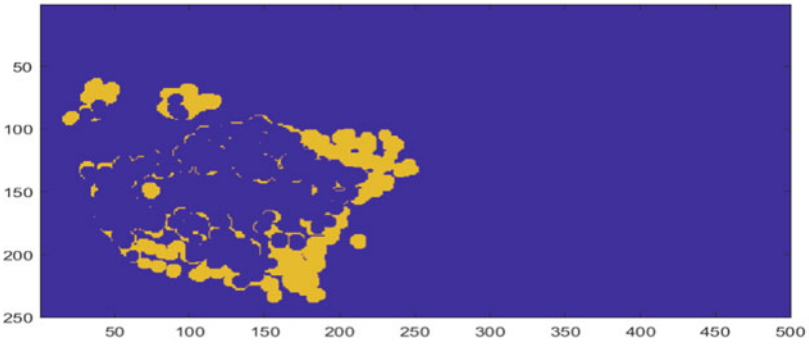
Table 1 NCC values for different regions in healthy and moderately rotten images

Regions	Intensity value range (see Fig. 7)	Number of connected components (NCC)	
		Healthy AN image	Moderately rotten AN image
Pink	68–90	3	9
Yellow	45–67	9	16
Green	22–44	4	9

is high as in Fig. 6a which has NCL = 9. On the other hand, fine grained details are missing in Fig. 7b which has NCL = 4, even though both maps are derived from the same parent AN image of Fig. 4a. Thus, a higher NCL contour map contains more information about the spatial features of the image and hence the corresponding NCC values of different regions will also be higher. When NCL is high, the contour map regions are dispersed and many of the connected components are too small to be significant as shown in Fig. 9.



(a) 10 level contour map



(b) Level 8 region

Fig. 9 A 10 level contour map and its Level 8 region

In Fig. 9a, a 10 level contour map is shown. In Fig. 9b, its Level 8 region is separately shown which has a large number of tiny (area very small) Connected Components (CCs). These tiny CCs do not contribute significant information. Therefore, these small area components are removed using the morphological operation **bwareaopen(…)** [8]. The Matlab function **bwareaopen(BW, P)** removes CCs that have fewer than P pixels (area) from the binary image BW. Here, P is the area of the CC in terms of the pixels contained in that component (sub region). By choosing proper P value, the required number of significant CCs can be retained. As parameter P is increased, more number of low area CCs are removed and the remaining number of higher area CC's decreases. The functional relationship, between parameter P and the remaining Number of CCs (NCC), represents additional information about the spatial feature of the target image. To capture the functional relationship between parameter P and NCC, a table is formed that holds the values of NCC for successive values of P in contour map regions at various levels as shown in the samples of Table 2.

Let us denote the successive levels of the contour map as Level = [1, 2, …, L] where L is the total number of levels used in generating the filled contour map. In the

Table 2 Values of NCC as a function of P and the contour map region at different levels

Level	Values of NCC							
	P = 3	P = 6	P = 9	P = 12	P = 15	P = 18	P = 21	P = 24
1	65	37	21	16	8	8	6	5
2	42	18	15	12	11	9	5	4
3	20	13	7	4	4	3	2	2
4	23	16	13	12	12	11	11	9
5	27	21	11	9	9	8	8	8
6	38	21	15	10	6	6	5	5
7	15	10	9	6	6	6	6	6

example of Table 2, L = 7. In Table 2, the parameter P of function bwareaopen(BW, P) is varied from P = 3 to 24 in steps of 3. Here, the number of steps taken by P, represented by N is 8. Therefore, the information in Table 2, can be represented by the matrix of size L × N. This characteristic matrix of AN image is represented by the symbol C which is an integer matrix that depends on L and P. Thus for Table 2, the characteristic matrix C is,

$$C = \begin{bmatrix} 65 & 37 & 21 & 16 & 8 & 8 & 6 & 5 \\ 42 & 18 & 15 & 12 & 11 & 9 & 5 & 4 \\ 20 & 13 & 7 & 4 & 4 & 3 & 2 & 2 \\ 23 & 16 & 13 & 12 & 12 & 11 & 11 & 9 \\ 27 & 21 & 11 & 9 & 9 & 8 & 8 & 8 \\ 38 & 21 & 15 & 10 & 6 & 6 & 5 & 5 \\ 15 & 10 & 9 & 6 & 6 & 6 & 6 & 6 \end{bmatrix} \tag{1}$$

The Frobenius Norm of C, represented by symbol FN(C) is given by,

$$FN(C) = \sqrt{trace\left(C^T * C\right)} \tag{2}$$

FN(C) is a scalar that represents the effective magnitude of matrix C. For the matrix C given by (1), the value of FN(C) is found to be 135.23. Since the elements of C are lower for a healthy AN image compared to those from a rotten image, FNC(healthy) is lesser compared to FNC(rotten). Therefore, for the three classes of Areca nut disease status, the corresponding FNC's have the following relationship as shown in Table 3.

In ANR-CNN, characteristic matrices C's of AN images are used as the training and testing input data set. The corresponding out values are the categorical values depending the disease status of the Areca nuts as indicated in Table 3. It is assumed that the disease status of each image is known priori as the ground truth. This information is gathered by the visual inspection of the Areca nut by say an expert in Areca

Table 3 Disease status and relative FNC values

Disease status of AN	Class (categorical values)	FNC value
Healthy	1	Low (FNC < 120)
Moderately rot	2	Medium (120 ≤ FNC ≤ 200)
Severely rot	3	High (FNC > 200)

cultivation. The FNC ranges in Table 3 are obtained based on the advice of the Areca nut rot disease experts.

4 Classification of Areca Nut Rot Disease

The classification of Areca nut rot disease by ANR-CNNnet takes place in four phases.

4.1 Four Phases of ANR-CNN

1. Preparation and storage of Data Set for training with validation and testing.
2. Construction of ANR-CNNnet.
3. Training and validation of ANR-CNNnet with suitable options.
4. Testing ANR-CNNnet.

The basic classification operation of ANR-CNN is described by the flow-chart shown in Fig. 10.

4.2 Phase 1: Preparation and Storage of Data Set for Training, Validation and Testing

Raw images of healthy and diseased Areca nuts are obtained from Areca plantations, using a reasonably high resolution camera. The colour images are initially stored in 'jpg' format. Other standard formats also could be used. The RGB images are converted to equivalent gray scale images of uniform size. Then, based on the contour maps, the corresponding characteristic matrices are obtained which form the input data set as explained earlier in Sect. 3.2. The matching output data set is the categorical class values obtained from visual inspection of AN's under consideration by appropriate botanical experts.

Let the size of the dataset be Q which is a large number and in our work, we have Q = 330 and correspondingly 330 characteristic matrices as,

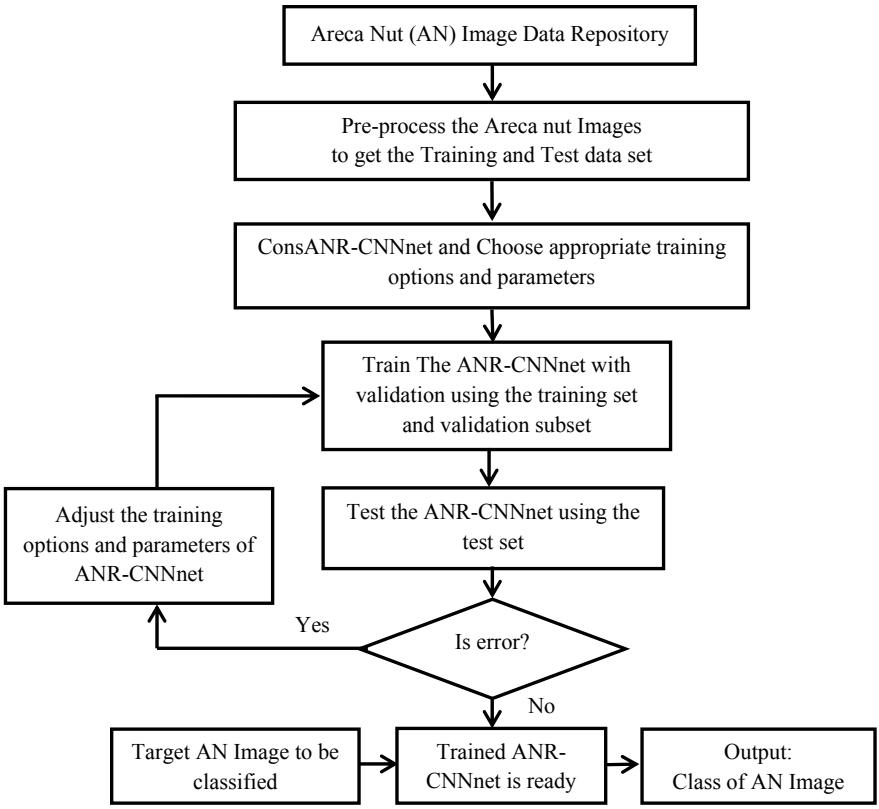


Fig. 10 Classification of AN images using ANR-CNN

$$C = \left[C(1), C(2), \ldots, C(q), \ldots, C(Q)\right] \tag{3}$$

where $Q = 330$ is the total number of matrices in the dataset. C(q)'s are so selected that all the three categories are distributed equally. That is, out of total Q, the share of three classes is one third of Q each.

In general, the full dataset is split into three subgroups as follows.

- First sub-group: 80% of dataset for training represented by R samples ($R = 0.8 * Q$)
- Second sub-group: 10% of dataset for validation [ref] represented by V samples ($V = 0.1 * Q$)
- Third sub-group: 10% of dataset for testing represented by S samples ($S = 0.1 * Q$).

Here we have, $Q = R + V + S$. Here also, the sub groups are so chosen that the three classes are equally distributed in all the subgroups. For training with validation we use ($R + V$) samples and S samples for testing. The allocation of C matrices is as shown in Table 4.

Table 4 Distribution of sample in respective subgroups

Total	Q = 330								
Operation	Training (R)			Validation (V)			Testing (S)		
Sub-groups	R = 0.8 * Q = 264			V = 0.1 * Q = 33			S = 0.1 * Q = 33		
Class	1 (88)	2 (88)	3 (88)	1 (11)	2 (11)	3 (11)	1 (11)	2 (11)	3 (11)
Input samples	[C(1)…C(264)]			[C(265)…C(297)]			[C(298)…C(330)]		

Thus, the input samples for training, denoted by **XTrain** is, **XTrain** = [C(1)…C(264)].

The input samples for validation, denoted by **XValidation** is, **XValidation** = [C(265)…C(297)].

The input samples for testing, denoted by **XTest** is, **XTest** = [C(298)…C(330)].

The **YTrain**, **YValidation** and **Ytest** values are the matching class types (1, 2, 3) of **XTrain**, **XValidation** and **XTest**, obtained using Eq. (2) and the information from Table 3.

4.3 Phase 2: Construction of ANR-CNNnet

ANR-CNNnet is constructed using cascaded processing layers with suitable functionalities to obtain the correct classification. The selection and design of various layers depends mainly on the number of classes under consideration and the characteristics of the input data. In general, the arrangement of different layers, for image classification (see Fig. 3), is as follows.

1. Image Input Layer that accepts the training and testing images for further processing
2. Two or more cascaded 'convolution units'. A typical convolution unit consists of,
    a. 2d Convolution Layer
    b. Batch Normalization Layer
    c. 'Relu' (Rectified Linear Unit) Layer
    d. Average or Maximum Pooling Layer
3. Fully connected output layer block which is generally formed by,
    a. Drop out layer
    b. Softmax layer
    c. Classification layer which provides the final output.

For more information, refer to [3, 4]. The actual layers used in ANR-CNNnet are as follows.

```
layers = [
  imageInputLayer([L N 1])
  convolution2dLayer(3, 3)
  batchNormalizationLayer
  reluLayer
  averagePooling2dLayer(2,'Stride', 2)

  convolution2dLayer(3, 6,'Padding', 1)
  batchNormalizationLayer
  reluLayer
  averagePooling2dLayer(2,'Stride', 2)

  convolution2dLayer(3, 8,'Padding', 1)
  batchNormalizationLayer
  reluLayer

  dropoutLayer(0.2)
  fullyConnectedLayer(3)

  softmaxLayer
  classificationLayer ];
```

ANR-CNNnet has three convolution layers, three batch Normalization Layers, three relu layers and two average Pooling 2dLayers along with the input layer, the classification Layer and other necessary layers. ANR-CNNnet layer architecture is inspired by the 'digit image classification' example by Matlab [5]. For more details see Refs. [9–11]. A brief description of various layers used in ANR-CNNnet is given below.

(1) *ImageInputLayer*([L, N, 1])

The input layer, even though called `ImageInputLayer`, accepts 2d matrices, converted to 3d, by taking one as the size of third dimension. In this case the input layer accepts matrices of dimension L × N reshaped as L × N × 1. The function `imageInputLayer([L,N,1])` builds the Image Input Layer.

(2) *Convolution Layer*

The function `convolution2dLayer(...)` builds the convolution layer with proper number of convolution filters of appropriate sizes. Convolution layer is the most important component of any CNN and it captures the complex spatial pattern of its input and provides the desired output.

(3) *Batch Normalization Layer*

This layer is to normalizes its input stream and drives the succeeding ReLu layer. The statement `batchNormalizationLayer` builds the Batch Normalization Layer. For more details, see Ref. [9].

(4) *Relu Layer*

Relu means Rectified Linear Unit and performs nonlinear activation. The transfer function of Relu layer is equal to that of an ideal half-wave rectifier. Statement 'reluLayer' constructs the relu layer.

(5) *Average Pooling 2d Layer*

The purpose of this layer is to divide the input into several groups or pools and to extract the average of each pool. The `averagePooling2dLayer(2,'Stride',2)` function constructs this layer. It has a pool size of (2, 2), step size used in covering the input.

(6) *Fully Connected Layer*

In this layer, all the neurons from the previous layer are exhaustively connected to this layer. The function `fullyConnectedLayer(3)` constructs this layer. Here, the parameter 3 is the total number of classes to be used for classification.

(7) *Soft Max Layer*

Softmax layer is generated by softmax(…) function [12] that calculates the corresponding probabilities of different classes in a multi-class classification problem. Softmax layer is generated by key statement `softmaxLayer` and it is the penultimate layer in ANR-CNNnet.

(8) *Classification Layer*

This firms the final layer of the ANR-CNNnet. This Layer receives the probability values from the softmax layer and assigns each value to the three distinct classes of the ANR-CNNnet. This layer is constructed using *`Classification Layer`*.

4.4 Phase 3: Training and Validation of ANR-CNNnet with Suitable Options

After creation, ANR-CNNnet is ready for Training along with runtime options as given below.

Options:

```
n_epoch=50;
options = trainingOptions('sgdm', ...
   'MaxEpochs',n_epoch, ...
```

```
'InitialLearnRate',1 * 1e-3, ...
'LearnRateSchedule','piecewise', ...
'LearnRateDropFactor',0.1, ...
'LearnRateDropPeriod',30, ...
'Shuffle','every-epoch', ...
'MiniBatchSize',40, ...
'Verbose',true,...
'ValidationData',{XValidation,categorical(YValidation)}, ...
'ValidationFrequency',30, ...
'OutputFcn',@(info)stopIf(info),...
'Plots','training-progress');
```

Here, the option 'sgdm' is the abbreviation for "stochastic gradient descent with momentum" [13]. Maximum Number of epochs [5] is fixed at 50. s**topif(…)** function is coded such that the training process gets terminated when the Training-Accuracy is at 100% and Training-loss goes below 0.01. For other options, refer [5].

Training is carried out using the trainNetwork(…) function as,

```
net = trainNetwork(XTrainR,categorical(YTrainR),layers,options);
```

Here, ***XTrainR*** and ***YTrainR*** are the reshaped versions of ***XTrain*** and ***YTrain***. The reshaped formats are the requirement for the correct working of the ANR-CNNnet whose input layer is the `imageInputLayer([L,N,1])` [5]. Other options are self-explanatory. Validation Data and frequency are included in the 'options' section given above.

The `categorical(ytrainCNN)` function converts the integer array ytrainCNN into the corresponding array of categories (labels). The training stops when the **stopif(…)** condition is satisfied. s**topif(…)** function is coded such that the training process gets terminated when the Training-Accuracy is at 100% and Training-Loss goes below 0.01. Otherwise, the training process terminates when the maximum number of epochs set (in this case 50) is reached. For other options, refer [5].

4.5 Phase 4: Testing

After completing the training, ANR-CNNnet is tested using the function `classify(net,XTestR)`. While testing, the input to ANR-CNNnet is the data set ***XTestR*** which is formed by reshaping ***XTest*** properly. The output of the test operation is given by ***Yout*** as, ***Yout*** = `classify(net,XTestR)`.

This **Yout** is compared with **YTest** and the percentage error is determined as follows.

$$No.\,of\,errors = No.\,of\,mismatches\,between\,\boldsymbol{Yout}\,and\,\boldsymbol{YTest} \tag{4}$$

$$Percentage\,error = 100 * (No.\,of\,errors)/S \tag{5}$$

If the error is not zero the training parameters and options are adjusted and fine-tuned until the error reaches zero or very nearly zero.

5 Performance of ANR-CNN

A couple of experiments are carried out, to obtain the performance of ANR-CNN. The parameters used are given in Table 5.

Experiment 1

The ANR-CNNnet is constructed according to Sect. 4.3, with parameters as given in Table 5. ANR-CNNnet is trained under options as specified in Sect. 4.4. Mini-batch Accuracy and Mini-batch Loss and additional details are displayed in Table 6, for successive iterations of the training progress.

Table 5 Various parameters used in ANR-CNNnet

Parameters/variables	Symbol	Values
Number of images	Q	$110 \times 3 = 330$
Number of classes	–	3
Size of $\boldsymbol{C}$	$L \times N$	7×8
XTrain *samples*	R	$88 \times 3 = 264$
XValidation *samples*	V	$11 \times 3 = 33$
XTest *samples*	S	$11 \times 3 = 33$
Maximum no. of epochs	*n_epoch*	50
Validation frequency	–	30
Mini-batch size	*mbs*	40
Class types	–	[1, 2, 3]

Table 6 Training progress details

Epoch	Iteration	Time elapsed (hh:mm:ss)	Mini-batch accuracy (%)	Validation accuracy (%)	Mini-batch loss	Validation loss
1	1	00:00:08	32.50	37.78	1.6544	3.6924
3	30	00:00:17	85.00	82.22	0.7833	0.3308
4	50	00:00:20	92.50	–	0.6547	–
5	60	00:00:22	95.00	75.56	0.0934	1.0242
7	90	00:00:28	90.00	97.78	0.2901	0.0901
8	100	00:00:31	100.00	–	0.0225	–
10	120	00:00:34	100.00	100.00	0.0373	0.0418

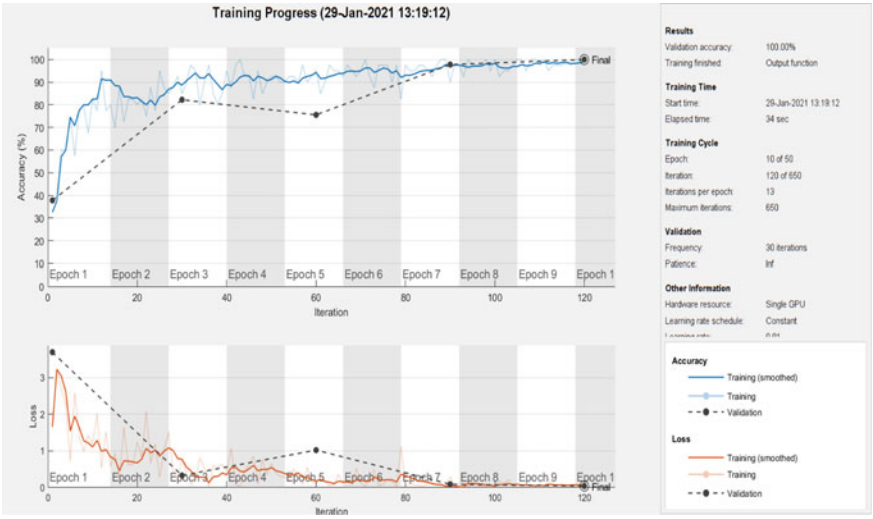


Fig. 11 Training progress plots

The corresponding training progress plots are shown in Fig. 11. Mini-batch Accuracy of 100% coupled with validation accuracy of 100% assures a perfect training with zero error. Then the training operation is terminated by 'OutputFcn', @(info) stopIf(info) [5], even though the actual number of epochs has not been reached the maximum epoch count limit (50 in this case).

In Fig. 11, the training converges with Mini-batch and validation accuracy of 100% each, in 120 iterations in the 10th epoch. When the number of training iterations (NTIs) is less than 120, there will be error and leads to misclassification.

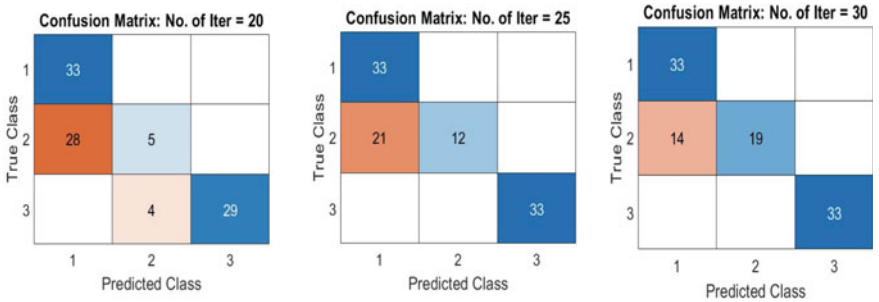
Experiment 2

Confusion Matrices [14] show the distribution of misclassification errors among different classes. The Confusion matrices for 3 instances corresponding to NTI's 20, 25 and 30, are shown in Fig. 12a–c respectively. Number of Misclassification (NM) in each case is found to be 28, 21 and 14 in that order.

The number of levels L used in contour mapping and N, the number of bwareaopen(…) operations can be increased to get better performance by reducing the degree of misclassification.

6 Conclusion

A new algorithm ANR-CNN that classifies the Rot status of Areca nuts, using CNN has been described. The three classes under consideration are, healthy (no Rot), moderately Rot and severely Rot. The main contribution of ANR-CNN is the use of



(a) NM = 28 (b) NM = 21 (c) NM = 14

Fig. 12 Confusion matrices for three dissimilar NTI's

characteristic matrices of images instead of images themselves directly. The characteristic matrices which represent the spatial texture and distribution of illumination intensities are obtained from the filled contour maps of the images. From the distribution of contour regions, the number of connected components in each region is obtained and the characteristic matrices are obtained based on the distribution of connected components in different contour regions. The size of the characteristic matrix of a given image is far lower compared to the size of the original matrix. This reduces the data size required for training ANR-CNN and in turn increases the training speed. Thus ANR-CNN provides relatively high speed classification with lesser memory overhead.

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Pollutant Based Forecasting Using AQI Values

Sandra Sebastian, Manu S. Kumar, Sreelakshmi Vinod, and T. Remya Nair

Abstract Air pollution is a rising issue that the society face. In technology there are progressions leading to evolved life, greenhouse gas pollution is an example. This propounds study focuses on the major contributors of air pollution in different metropolitan areas. Industrialization has escalated in the past few years which resulted in the level of pollution hikes and caused severe impact on the ecology and human rights. In this paper, we are trying to find an accurate algorithm for executing a system, using the Anaconda Tool for forecasting the risks in health. Methods used here are Decision tree classifier and Multiclass Classifier. Forecasting of health risks is done on the basis of the Air quality index values of air pollutants such as NOx, CO, O_3, SO_2, Xylene, Toluene. Depending on the level of air quality the AQI can be measured.

Keywords Data mining · AQI · Decision tree algorithm · Multiclass classifier · Accuracy calculation

1 Introduction

Severe respiratory conditions can be caused by the air emitted into the atmosphere. Method, skin problems and other questions related to health. Eyes that cause discomfort are also affected by issues. Consequently, it is a serious problem to provide air monitoring and analysis for a safe and good life. Pollution from the air is caused by airborne toxins and particulate matter that is unsafe to breathe in. Because of the growth of enormous industries and the extensive use of vehicles, it is a rise in abomination that results in a drastic shift in the climate, which in turn leads to an extreme heating trend. This results in global warming. The most harmful aspect of air pollution is that it can induce extreme exemption. Issues with human life. Its

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threshold is exceeded by contaminants. Various software/tools for the prediction of air pollution are used and it is a tremendous one. These greenhouse gases are the kind of greenhouse gases pollutants that inhibit air quality. GHGs are responsible for global warming, which causes the loss of the ozone layer.

We decide on the appropriate proposals for action to minimize air pollution. We may, therefore, predict the escalation of air emission levels that are merely dangerous to susceptible individuals only by air analysis. For health issues related to levels of air quality, the quality of ambient air is measured. The data mining suggested in this paper is techniques to examine the pollution of the air in such a way that it is possible to take appropriate steps to reduce the adverse effects. Impacts of rising air pollution. The consistency of the AQI is a numerical value that indicates how contaminated it is. The suggested data mining in this paper is techniques for evaluating air pollution in such a way that appropriate steps to reduce the adverse effects may be taken. Impacts of increasing emissions from the environment.

2 Literature Review

This proposed study focuses primarily on the dramatic data on air pollution in different metropolitan areas [1]. The paper discusses methods of data mining for prediction of air pollution [2]. Cleaner air should be India's focus for economic growth with regard to benefits of longer lives and fewer incidences of PM-related sickness [3]. Air quality Index is to identify air quality of current situation. AQI calculation done seasonally and daily revealed that air quality status in the research area under various classes ranging from fine, moderate, satisfactory, and unacceptable [4]. Estimating AQI using different methods and mainly 4 pollutants, and finding out air quality in a particular region [5]. Health issues while PM exposure have been a great influence than we think it is, the research focuses on the understanding on the effects of human health [6].

3 Conceptual Framework

There are numerous algorithms used in this suggested scheme. We use the Decision Tree first and then the multiclass classifier later. By analysing this algorithm, we can determine which one is the most accurate and capable of predicting health problems caused by any contaminants. We will use the SMOTE algorithm and PCA later.

3.1 Decision Tree

An algorithm used primarily for classification. The target variable of a new dataset can be predicted by applying this algorithm to our dataset.

3.2 Multiclass Classifier

To conduct classification duties for two or more classes, this method is used. This procedure implies that a single mark is assigned to a specific sample.

3.3 Dataset Preparation

The Dataset used here is taken from kaggle. They are City, date, PM2.5, PM10, NO, NO_2, NOx, NH_3, CO, SO_2, O_3, benzene, Toluene, Xylene, AQI, AQI bucket.

3.4 SMOTE

One of the most widely used methods of oversampling to solve the imbalance problem is SMOTE (synthetic minority oversampling method). By randomly increasing minority class instances, it aims to balance class distribution by replicating them.

3.5 PCA

Principal Component Analysis, or PCA, is a method of dimensionality reduction that is often used by converting a large set of variables into a smaller one that still retains much of the information in the large set to decrease the dimensionality of large data sets (Figs. 1 and 2).

Good (0–50)	Minimal Impact	Poor (201–300)	Breathing discomfort to people on prolonged exposure
Satisfactory (51–100)	Minor breathing discomfort to sensitive people	Very Poor (301–400)	Respiratory illness to the people on prolonged exposure
Moderate (101–200)	Breathing discomfort to the people with lung, heart disease, children and older adults	Severe (>401)	Respiratory effects even on healthy people

Fig. 1 Predefined buckets of AQI

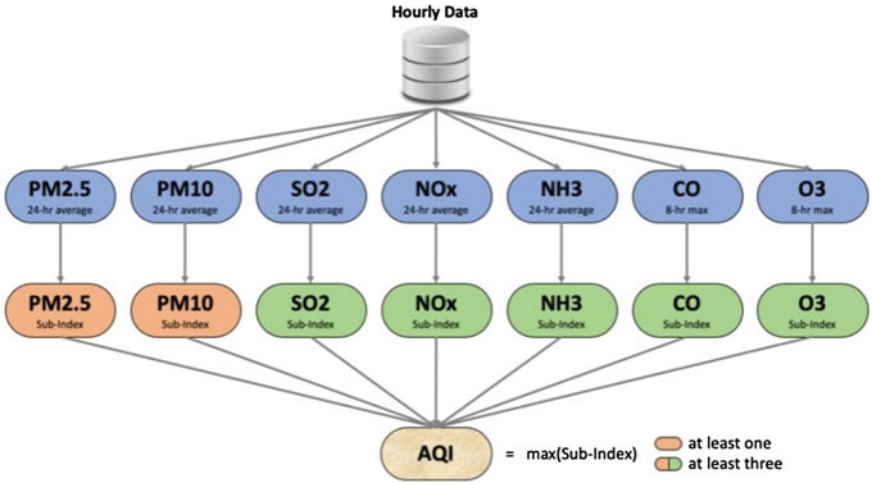

Fig. 2 Formula

4 Understanding and Interpretations

The process of extracting useful data is termed as Data mining. The data can be acquired from an extensive dataset which is engrossed in two fundamental tasks. Classifications are the supervised learning approach where we can train the classifier for class specific labels.

4.1 Classification

For a new record, it can predict the class mark to which the classifier is not trained.

4.2 Prediction

Used in place of class labels to forecast missing data values (Fig. 3).

$$\text{Accuracy rate} = \text{Total number of correctly classified instances}/\text{Total number of instances} \quad (1)$$

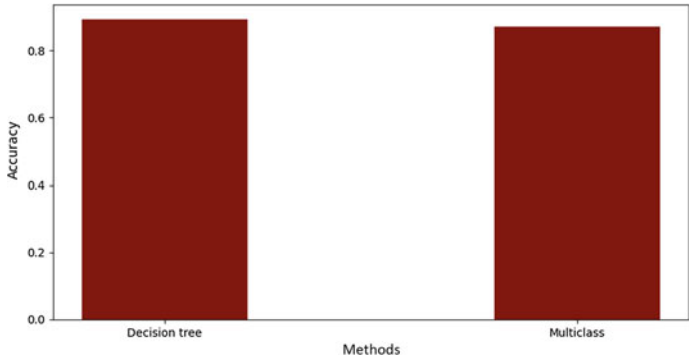

Fig. 3 Pollution level prediction accuracy

5 Major Findings

5.1 Stage 1

Preprocessing dataset

- Removing unwanted columns
- Removing null values
- Adding AQI column
- Adding pollutant level column.

Data balancing

- Balance data using SMOTE method.

Training

- Train decision tree classifier using preprocessed data
- Save trained model
- Train multi class classifier (SVM) using preprocessed data
- Save trained model.

Pollution level prediction

- Load trained models
- Preprocess input values
- Predict pollution level using both models.

5.2 Stage 2

Finding major pollutant

- Choose dataset
- Preprocess data
- Perform PCA on data
- Choose remedies based on the major pollutant.

5.3 Testing

Input: Values of pollutants.

Output: Pollution level.

6 Result

The number of data collected totally for this study is 6237 out of which 80% data is taken to train and 20% data is taken to test.

6.1 Decision Tree

The Decision classifier gave the accuracy of 87.6404% and with the error rate 12.3596% (Fig. 4).

6.2 Multiclass Classifier

The accuracy for Multiclass Classifier is 86.9795% obtained and the error rate is 13.0205% (Fig. 5).

Here it has been proved that the Decision Tree is better than the Multiclass Classifier algorithm by the accuracy calculated.

7 Conclusion

To lead a healthy life for us and the near future generations the study of air quality is extremely necessary. In the construction of a city, air quality is important with good health rate and implementing environmental policies. The information is acquired from multiclass classifier and Decision tree techniques. These techniques have been analyzed and compared to determine the optimum precision. The accuracy of Decision tree is 87.64044 and 86.9795% for the Multiclass Classifier. Therefore we

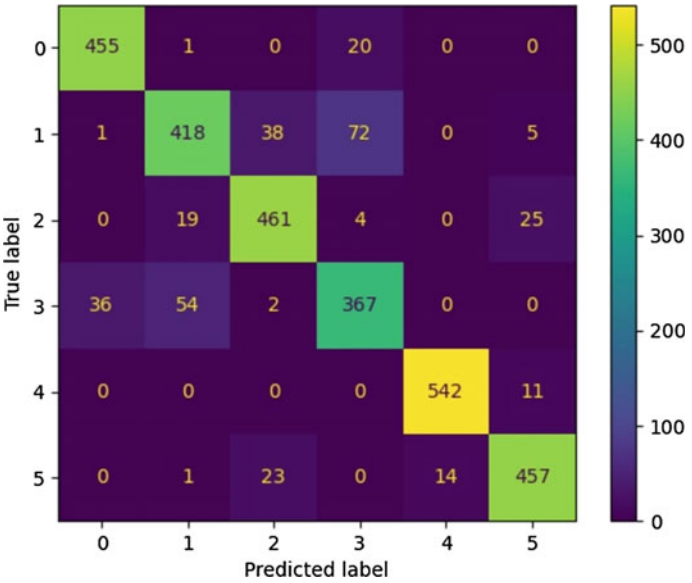

Fig. 4 Accuracy level prediction

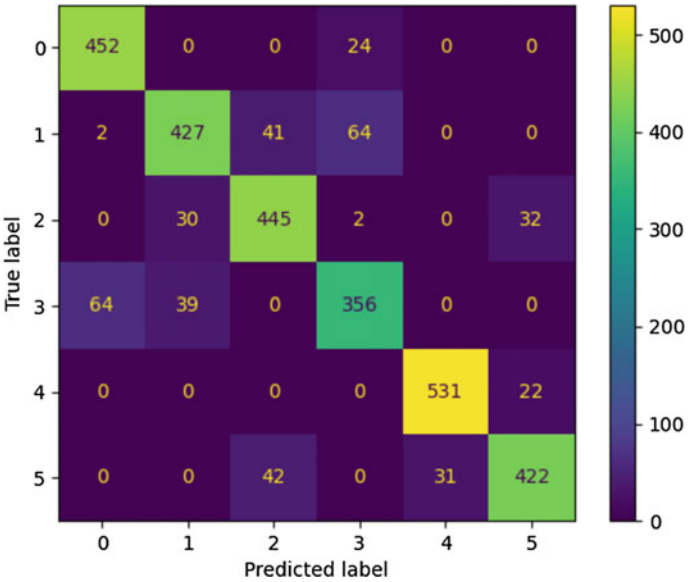

Fig. 5 Accuracy level prediction

conclude by stating that Decision Tree algorithm has better accuracy for prediction of than the Multiclass Classifier.

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Mobile Sensor Nodes Traversal Patterns to Attend Random Events

Ganala Santoshi

Abstract A group of Mobile Sensor Nodes are deployed over the Region of Interest to collect the data from the random locations. In order to increase the MSN life time along with the network life time, appropriate MSNs are selected which requires less amount of energy depletion compared to the counterparts. Necessary algorithms are proposed for the selection of suitable MSN by considering their component status, energy parameters and cost of the traversal.

Keywords Mobile sensor nodes · Random events · Traversal patterns · Battery depletion

1 Introduction

Wireless sensor networks (WSNs) with mobile sensor nodes have been widely used in many applications. They are considered as a promising solution and also as a replacement to the people for discovering, collecting the data from a highly dangerous regions or the regions in which human intervention is not appropriate. The mobile sensor nodes (MSN) are small compared to conventional robots. They can be programmed to enter into the sensing area for the purpose of sensing and to collect the data [1–5], where the environment not suitable for large robots to operate.

Sensor nodes equipped with locomotive facilities need not be placed at predetermined positions, instead MSNs can randomly be deployed over a specified area. To achieve effective coverage over the area that need to be monitored, a subset of MSNs often requires relocation. Since they are battery-powered, the energy consumption in movement is much higher compared to the sensing and communication. This necessitates an efficient sensor movement and scheduling strategies to cover the specified location are without coverage holes with an objective of saving energy as much as possible [6–8].

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2 Related Work

Shortest path for MSNs to collect data with a series of constraints are discussed in [9]. To track multiple targets, nodes with adjustable monitoring directions are used in [10], nodes are selected on rotational basis to investigate the node scheduling strategies and the evolution of target locations. Issues related to coverage in 3D wireless networks (WSNs) are highlighted in [11]. Optimized path for mobile nodes with high dimensionality and large space are discussed in [12].

From the literature it can be verified that, application of MSNs very specific in nature. Existing solutions may not fit for the ever-changing real time issues. The design and deployment of MSNs need to be carried out carefully, according to the problem statement.

3 ROI Description

The area to be monitored is rectangular in shape, called as ROI (Region Of Interest). ROI is divided into regular hexagons in tessalation fashion, it strictly follows the foundations of triangle based partition as stated in [13], as shown in Fig. 1 is similar to partition shown in [14]. This kind of partition is free from coverage holes and makes minimum number of polygons required to cover the ROI.

Length L and breadth B are assumed as dimensions of the ROI. Side of the regular hexagon h; $h = r_s$, where r_s is sensing range of the sensor. ROI is divided into Y′

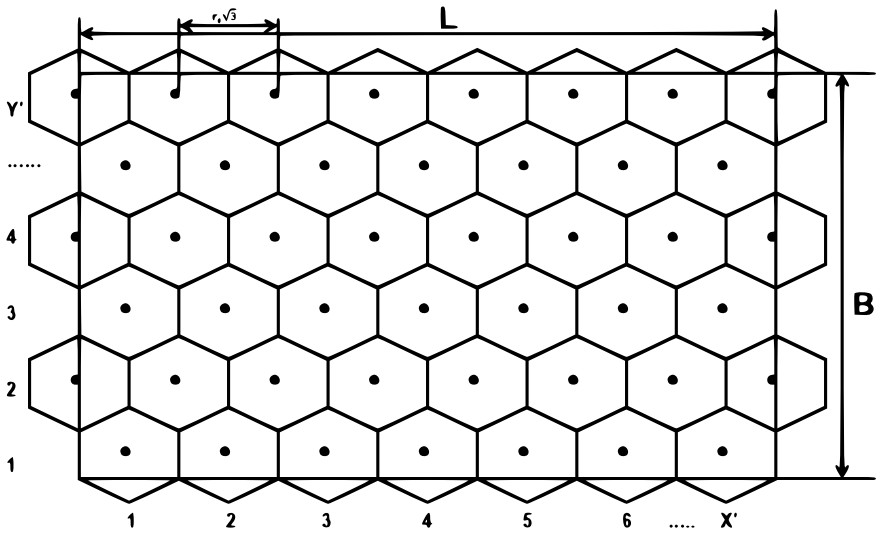

Fig. 1 Partitioning of rectangular ROI into regular hexagons

of rows, and each row contains X′. The values of Y′ and X′ can be obtained from Eqs. (1) and (2).

$$L = X' \times r_s\sqrt{3} \tag{1}$$

$$B = r_s\sqrt{3} + r_s\sqrt{3}(Y' - 1)\frac{3}{2} \tag{2}$$

4 Problem Formulation

Consider a scenario in which, information need to be collected from a random locations on the ROI. Such random locations are termed as random sensing point (RSP). A group of MSNs are deployed over the ROI. To collect the information from the RSPs, one of the MSNs need to be moved to the RSPs from their present locations. Since the MSNs are also randomly deployed, current locations or landing locations of the few MSNs may be closer. In some cases, no MSNs may be positioned near to RSP.

5 Proposed Solution

Solution to the above proposed problem is divided into 3 sections.

1. Identification of the active MSNs based on their components status: MSNs are made up of micro electro mechanical components. They consists of mobility units, sensing units, communication units and other supporting units. Hence the failure in one or more components cant not be ruled out.
2. Identification of the suitable MSNs to attend RSP based on energy parameters: MSNs are limited with energy source. They are battery operated. An MSN which depletes less amount of energy can stay more time in active state. MSN with less amount of residual energy has high chances of failure during the traversal and also in getting disconnected from other MSNs.
3. Identification of the suitable MSN to attend RSP based on distance parameters: The amount of battery depletion is directly proportional to the total distance the MSN travels. To have MSNs for longer duration of time, at every time an MSN which depletes minimum energy to reach the RSP need to be selected.

6 Results and Discussions

For experimental purpose flat ROI with 10 rows and each row with 20 regular hexagons is considered. RSP and MSNs locations are identified with hexagon numbers. As shown in Table 1, a total number of 15 RSPs are generated. A total 15 number of MSNs are randomly deployed over the ROI. Position of MSNs are shown

Table 1 MSNs and RSP locations

RSP No.	RSP loc	MSN loc	RSP row No.	RSP hex. No.
1	118	32	6	18
2	132	184	7	12
3	49	177	3	3
4	55	172	3	15
5	186	31	10	6
6	171	105	9	11
7	25	153	2	5
8	28	184	2	8
9	61	74	4	1
10	59	78	3	19
11	29	89	2	9
12	33	48	2	13
13	134	35	7	14
14	26	145	2	6
15	77	182	4	17

as MSN Loc. The total hexagons on the ROI is 200. Hence the RSP can range from 1 to 200. First RSP is generated at 118. MSN No. 6 is near to the RSP 1. For RSP 1, MSN 6 is selected, as its previous travel distance is 0 and expected travel distance is 13. Out of 15 MSNs MSN 6 is got selected.

RSP 5 is generated at 186, which is closer to MSN 2 and 8. Both the MSNs previous travel is 0 units and need to be traveled to reach RSP 186 is 2 units. Hence any one the MSN can be selected from the tie. Similar scenario can be observed for RSP 12, where MSN 1 and 13 in tie. For RSP 12 MSN 1 is selected.

RSP 8 is generated at 28. To this MSN 1 and MSN 5 are closer. MSN 1 needs 4 units of travel and MSN 5 needs a travel of 3 units. MSN 5 had already traveled 6 units in past, hence the total travel expenditure comes to 9 units. But MSN 1 had no travel history. So the total travel expenditure for MSN 1 to reach RSP 8 raises to 4 units only. Hence MSN 1 is selected to reach RSP 8.

RSP 10 is generated at 59. MSN 9 is at 61, hence it requires only 2 units of travel. But MSN 9 already traveled a distance of 13 units to attend previous RSPs. If MSN 9 is allowed to attend RSP 10, total travel for this MSN goes upto 15 units. Which is least compared with other MSNs travel. Hence it is selected.

RSP 14 is generated at 26. The nearest MSNs are 5 which is at 25 and 13 which is at 29. On initial comparison MSN 5 fits for the traversal. But MSN 5 has already traveled a distance of 6 units. MSN 13 has already traveled a distance of 1 unit. So, to reach the RSP, total distance need to be traveled by the MSN 5 raises to 7 units and 13 raises to 4 units. Hence MSN got selected to attend RSP No. 14, as shown in Table 2. Algorithm 1 is master function which helps in calling the other functions. All called algorithms requires a certain number of input parameters. On successful

Table 2 Distance parameters for MSNs

RSP No.	MSN No.	Already traveled	Expected to travel	Total
1	6	0	13	13
2	14	0	13	13
3	12	0	1	1
4	12	1	6	7
5	2	0	2	2
5	8	0	2	2
6	4	0	1	1
7	5	0	6	6
8	5	6	3	9
8	1	0	4	4
9	9	0	13	13
10	9	13	2	15
10	12	7	11	18
11	13	0	1	1
12	1	4	1	5
12	13	1	4	5
13	14	13	2	15
14	5	6	1	7
14	13	1	3	4
15	10	0	1	1

execution, it reruns output in the form of array or as a single entity. Functions listed in the algorithm need to be executed in the same order as listed.

Algorithm 1 Selection of MSN to Attend Random Sensing Point

Input : RSP Information & MSNs Information
Output : Suitable MSN to reach RSP
1: Status Matrix()
2: Cost Matrix()
3: Energy Matrix()

This Algorithm 2, helps in selecting the active MSNs. Before proceeding to select a suitable MSN for traversal, the status of all the components need to checked. Count is a global variable which keeps the count of total number of MSNs available. All the components of every MSNs will be checked for their working condition. If the components status is fit (1) for further operations, then such MSN IDs will be added to list of active MSNs. The MSNs with one or more failed components e.g. unfit (0),

are not considered for further operations. This algorithms provides the IDs list of active MSNs as array.

Algorithm 2 Status Matrix

Locomotive Units [L], Sensory Units [S]
Communication Units [C], Location & Other Units [O]
Total number of active MSNs [Count]
Input : MSN status parameters [L, S, C, O], Count
Output : One dimensional list of active MSNs with ID

```
1: I = 1
2: while I ≤ Count do
3:    if (L = 1) & (S = 1) & (C = 1) & (O = 1)  then
4:       Set : S = 1
5:       Add : MSNID to the active MSNs list
6:    else
7:       Set : S = 0
8:       Remove : MSNID from active MSNs list
9:    end if
10:    I ← I+1
11: end while
12: Set : Count = No. of active MSNs
```

Algorithm 3, helps in calculating the distance between the RSP and all the active MSNs. Output of Algorithm 2 is provided as input to Algorithm 3. Hence these calculations are applied on the list of active MSNs. From the list of MSNs, the MSNs with shorter distance between itself and RSP is considered for further rounds. Algorithm 4 plays a major role in the entire process. This algorithm considers the distance already traveled by the MSNs in attending previous RSPs. In additions to that, it checks for the distance need to be traveled to reach the current RSP. MSNs need to perform sensing, co-coordinating, communicating activities at every RSP. Hence a fixed amount of energy is fixed as threshold for all the MSNs.

Algorithm 3 Cost Matrix

Location of RSP [LRSP], Location of MSN [LMSN]
Distance Need To Be Covered [DN] to reach RSP
Input : Location parameters [LRSP, LMSN]
Output : Two dimensional list with IDs of active MSNs sorted by DN

```
1: while I ≤ Count do
2:    DN : Distance between LRSP&LMSN
3:    Add : MSNID&DN to the active MSNs list
4:    I ← I+1
5: end while
6: Sort : MSNs by the value of DN in ascending order
```

In some cases, a particular MSN may need to travel shorter distance to reach RSP, but it might have traveled a longer distance in attending previous RSPs. In some

cases the distance need to be traveled by the MSN reach the present RSP may be more, but it has not traveled or traveled a less distances in attending previous RSPs. During the selection process, the total distance already traveled is added with the expected distance need to be traveled to reach the RSP.

Algorithm 4 Energy Matrix

Residual Energy [RE], Threshold Energy [TS] Distance Already Traveled [DA]
Units of Distance Need To Be Covered to reach RSP [U]
Unit Length [UL], Battery Depletion Style [DS]
Expected Energy Depletion Per Unit Travel [EU]
Expected Energy Depletion to reach RSP [ED]
Input : MSN energy parameters [RE, TS, DS, ED], DA, DN
Output : Two dimensional list with IDs of active MSNs sorted by RE

1: **while** I $\leq$ Count **do**
2: U = $\frac{\text{DN}}{\text{UL}}$
3: ED = U $\times$ EU
4: **if** (RE $>$ TS) & (RE $>$ ED) **then**
5: Set : E $= 1$
6: Add : MSNID & RE to the active MSNs list
7: **else**
8: Set : E $= 0$
9: **end if**
10: I $\leftarrow$ I+1
11: **end while**
12: Sort : MSNs by the value of RE in ascending order

7 Conclusion

A group of MSNs are randomly deployed over the ROI. Suitable MSNs are selected according to the cost of the travel between the RSP and current locations of MSNs. MSNs are selected on basis of amount of energy depletion on comparing with other counter parts. It has been identified that, in some cases more than one MSNs become eligible for traversal. In some cases the MSN got selected during the first selection process become ineligible for traversal due to cost associated with further traversals.

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A Realistic Farming Simulator Inspired from Agricultural Style of India

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Abstract Agriculture is considered as the backbone of Indian economy and it acts as the most important factor of all economic activities of human beings. In this modern era knowledge of farming has not been that much great with people especially as computers have taken over human lives. Agriculture knowledge is founded on experience and can be passed down from generation to generation by experienced elders. We created a farming simulation game called "Uzhavan" (Former) with the aim of rekindling new generation's interest in farming and educating people on farming based on traditional agricultural style and patterns of Tamil Nadu with realistic soil types and climatic conditions. The simulation game was designed with the objective of allowing participants to experience the real world of agriculture and the role of a farmer in the process of cultivating a ranch, as well as raising agricultural awareness among the general public. The game's main goal is to educate the player about the various stages of farming that lead to successful crop production.

Keywords Gaming realistic gaming · Simulation · Role play · Farming · Gamification · Unity agriculture education game

1 Introduction

In this modern technical era, gaming is the most significant entertainment and education tool. Most of the games [1] follow goals, rules, challenge and interaction which help the user to get the real time practical exposure and improvise the skills of the user using the gaming environment. Gaming plays an important role in educational simulation to improvise the psychological role of learners. Gaming is one of the most

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sophisticated tool in education which simulates the environment more realistic and improve the customized practical skills for different levels of learners.

Simulation [2] is a recreation of a real world situation, designed to explore key elements of that situation. Simulation offers the opportunity to live the world of the phenomenon that we are studying. The role of video game in recent decades is to entertain people in a unique way hence they encourage the player's to become a part of game script. In today's sophisticated environment video game require the player's to pay constant attention to the game. Most widely acknowledged "positive" impact is that video games may help the children to improve their dexterity and computer literacy.

Educational games [3] specially designed for the purpose of learner centric to improvise the knowledge of the user. Educational games provide the realistic simulation environment to make the learner to understand the concept better manner and provide the practical skills to solve the problem in a realistic environment. Educational games are improved with the help of augmented reality, virtual reality and gamification. Developing agriculture based games inculcate the knowledge of agriculture and induces the young generation to take up their career in agriculture area.

India is an agricultural based country where potential youths are educated with computers and technology. These Agricultural based games will benefit them to enrich their knowledge and experience in the field of agri and serve them to become a good farmer. Most of agricultural activities and decision are learned by experience only where this simulation game provides the knowledge of experience without wasting cost and land.

In this work we have designed the agricultural farming simulation role play game which has the objective to educate the learners regarding the farming of traditional agriculture style with the pattern of Indian soils and climatic condition using realistic simulation environment.

2 Existing Literature Works

In this chapter we are focusing on the study of agriculture and farming based educational games. Most of the educational games are classified into simulation based games and role-play based games (Laitconomine game, Stardew valley, Farming simulator). Simulation games are further classified into computer based simulation and mobile device based VR simulation. Each games are designed with different composition and utility function.

2.1 Stardew Valley

Stardew valley is an open ended game which was developed by Eric [4]. This games role play the country life where each player inherits the old farm plot of

his grandfather in the Stardew valley with hand-me-down tools and some coins of penny.

The player start the game with new life and manages their character time and energy levels as they clear land, plant and tend crops, raise live stocks, craft goods, and also engage in social activities including romances leading towards marriage. All the inhabitants of the small town in this game are raising their money to grow the form to next level. The game is open-ended, encouraging the player to conduct the task however they see fit. The game extends to support four different players to play simultaneously.

2.2 Farming Simulator

Giant Software developed the Farming simulator [5] to provide the complete forming experience in gaming mode. The first phase episode of the Farming simulator was released in the year 2008. Farming simulator 19 was released in 2018 with a redesigned graphics engine and additional horse farming.

The locations of the game are features on American and European environments. Players are able to plant, breed livestock of pig, cow, chicken etc., grow crops and sell farm-created properties. Game play consists largely of driving slowly up and down in straight line which based on belt system. The belt can move forward and backward this allows the player to adjust his position. This game increase the productivity of farm by incorporating various range of innovative modern farming practices, which includes new modern machinery with the corps of oat and cotton. The player perform the actions of plowing the land, sowing the seed and harvesting the crop, and then reforms the land back to the sowing condition by driving up and down again.

2.3 Laitconomie

The Laitconomie game [6] generates the conditions for farmers to mobilize their expertise and mutual knowledge of others to respond the need for local innovation. This game is based on the concept of self-design. Due to a small scale, the game experiment produced the findings in terms of co-production expertise and improvements in the farming practices of the players. The basic scenario portrayed in the game involves the price of the refined feed, which varies unpredictably. This game involves animal forming along with regular agriculture simulation. Most of the tools in agro based gaming are also available in this game.

The game also focus the areas of cow feeding systems, levels of milk production, cultivation and storage of forage crops dependence on industrial feed. In this game each player plays the role of dairy farmer and sits at separate table to fill in. There is five category of cards are available such as lands, cows, crops, varies types of cow field and milk production.

Each player is allocated a number of cows and a number of 1 ha plots. Players get simple instruction about the steps to be taken in each round of the game. The result is displayed on large board so that player can compare them with those of others and follow everyone's evolution.

3 Proposed Work

Objective of this work is to educate the people on agriculture and farming, with the help gaming. We designed the real time farming simulation game in the name of Tamil word "Uzhavan" which has the meaning of Farmer. This game is completely inspired from agricultural style and patterns of India which has different climate and soil condition across the nation. During the initial development, we are primarily focusing the realistic soil types and climatic conditions based on environmental factors of Tamil Nadu.

An elaborated research survey has been carried out on factors such as soil types, climatic conditions, cropping patterns of Tamil Nadu and all of them are implemented in the game. The various types of soils and crop production of Tamil Nadu are in listed out in Tables 1 and 2 (Fig. 1).

3.1 Knowledge Required for Farmers

Farmers are major actor in this game who needs the knowledge form crop selection stage to harvesting stage [7]. Essential knowledge gathered by the farmers is [8] furnished below which can be provided at each level of the proposed game.

Crop Selection: The farmer should understand proportional price of various crops. For example, Farmer can select the crops based the money value. Sometime Government announces prices for certain crops at the time of seeding based on consumer market need and selling potential of the crop which could play a role in selection of

Table 1 Soil classification

Types of soil	Areas in Tamil Nadu
Red loam	Erode, Namakkal, Salem, Dindigul and Coimbatore
Laterite soil	Dharmapuri, Kancheepuram, Tiruvannamalai, Thiruvallur and Vellore
Black soil	Thoothukudi, Virudhunagar, Pudukkottai, Dindigul, Tiruchirappalli, Ramanathapuram
Sandy coastal	Pudukkottai, Madurai, Dindigul, Perambalur, Thanjavur and Tiruchirappalli
Alluviam	Coimbatore, Tiruchirappalli, Karur, Theni, Madurai
Red sandy soil	Kancheepuram, Tiruvannamalai, Thiruvallur and Vellore

Table 2 Vegetables growing places

S. No.	Name of the crop	Area (ha)	Major growing districts
1	Tapioca	87,924	Namakkal, Salem, Villupuram, Dharmapuri and Erode
2	Onion	28,105	Perambalur, Trichy, Tirupur, Tirunelveli, Dindigul and Namakkal
3	Tomato	23,954	Krishnagiri, Salem, Dharmapuri, Theni and Coimbatore
4	Drumstick	12,491	Theni, Dindigul, Theni, Ariyalur, Thoothukudi and Tiruppur
5	Brinjal	11,016	Salem, Krishnagiri, Vellore, Dindigul and Dharmapuri
6	Bhendi	8925	Salem, Vellore, Dindigul, Dharmapui and Tiruvannamalai
7	Watermelon	5623	Kanchipuram, Villupuram, Thiruvallur, Tiruvannamalai, Erode and Ariyalur
8	Potato	4737	The Nilgiris, Dindigul, Krishnagiri and Erode
9	Carrot	3592	The Nilgiris, Krishnagiri, Theni
10	Bitter gourd	1877	Coimbatore, Salem, Dindigul, Cuddalore, Krishnagiri, Tiruvarur, Thoothukudi and Theni

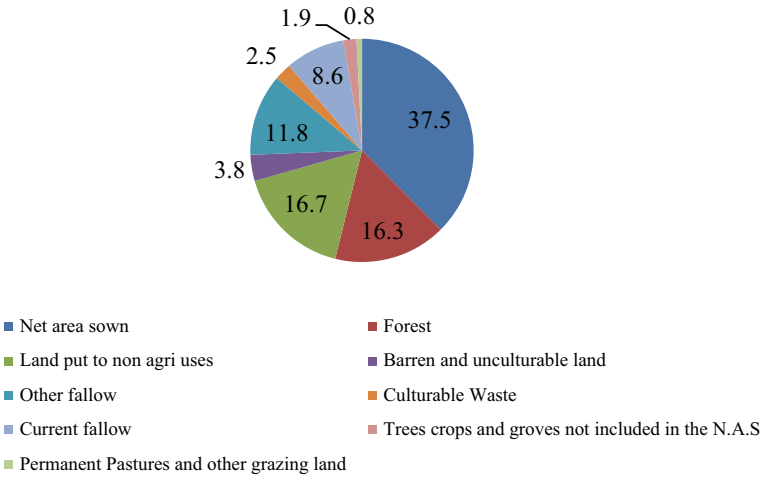


Fig. 1 Classification of land area in Tamil Nadu

a crop. Budget calculation for the cultivation plays an impartment role of consideration. Feasibility of the crop depends on the environment and also the consistency and excellence of the soil.

Land Preparation: During the Soil preparation, former people should track any disease from the earlier agriculture and take precaution measure to predict and prevent the disease in next time. Based on the earlier crops and manure the land should be

prepared to its normal fertility. The construction and design of the field for productive irrigation of crops must be carried out. The modern techniques can be utilized for preparing and leveling the fields.

Seed Selection: In this seed selection phase players can decide the quantity and price of seed required per acre. They can also know the climatic condition of their zone and suitable seed for that particular area. This game provides complete awareness about the soil and seed. At the outcome of this game the player can easily assess the yield and sprout to sown ratio calculation. Additionally this game provides the information and location about the nearby seed distribution office.

Seed Sowing: Sowing the seed at the appropriate time will produce the perfect yield. Every farmer gets this knowledge by their own experience, but in this game they can get it by repeatedly playing. This simulation game provides the experience of sowing the seed at the correct time to make the good yield. Best methods and instruments for sowing the seeds also to be experienced by using this section.

Irrigation: Quantity and time of water irrigation produce better yield in agriculture. The knowledge about the time of irrigation and quantity of water to be given to the plants should be taken into account. Maintaining and managing the frequency of irrigation will protect the plant health and water sources.

Crop Growth: Awareness of plant growth is about the number of plants per unit area. Optimum number of seed sprouts in the unit area will yield better. Farmers need to minimize density for healthier plant growth. Comparison of plant rate of growth, leaf size, crop colour, etc. with projected growth for specified conditions and input conditions are calculated. Continuous monitoring and assistance is required in order to sustain the anticipated growth. Frequency, quantity and method of fertilization are essential for weed management which involves time, duration and process.

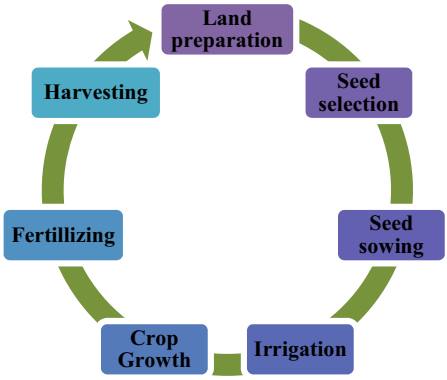
Harvesting: Method of harvesting will vary with respect to different corps. Harvesting at right time using right method will yield better. Harvesting knowledge includes the comparative market rates of corps and agriculture market strategies. Proper storage facilities must be done for harvested crops.

Working: In "Uzhavan" simulation game each player can take the role of farmer and start playing. It mainly focused on planting and harvesting crops. The above mentioned seven knowledge required for farmers are consider to be seven stages in the game where the player gets simple instruction in each stage about the moves to be taken in each rounds of the game.

3.2 Mechanism Diagram

Figure 2 explains the mechanism of flow of game in various levels. The levels are sequential and continuous to lead the successful end of the game. At each level

Fig. 2 Gameplay levels



necessary tools and sufficient knowledge are to be provides as assistant for the gamer to simulate the realistic environment.

4 Implementation

The whole simulator is designed in Unity [9], which is a open source computer application to design games. The version of Unity used in here is 2018.1.6f1. Our game is inspired from Stardew Valley [2.1], a game above mentioned in existing systems. So we decided to go with two dimensional world.

Fortunately, Unity provides most of the game development components within the application itself. It makes the process more feasible. The components and scripts used in Unity are described below.

4.1 Game Objects

Game objects are objects of any type from image file to empty objects. The objects are often saved as prefabs. Prefabs are game objects that can store its properties within itself making the prefabs to be used as a template.

SPRITE 4.1 SCYTHE

SPRITE 4.2 SPROUT

The above sprites, sprite 4.1 and 4.2 represents scythe and sprout sprites respectively. These sprites are used in unity as game objects or prefabs.

Object Components: Components are those which define a game object. These can be added to objects as per the need such as Rigidbody which adds rigidity to the given game object. Other such game objects are Box Collider, Mesh Renderer, and Sprite Renderer etc.

Tile Mapping: In 2D games tile mapping is one of the technique that is used to create places in the game. A grid is first created then tiles are added to the game. The grid here is a game object that has its own components.

Sprite Editor: Sprite is a texture or an image file that is used in tile mapping. The editor used to edit the sprite from the whole sprite page is called sprite editor. Figure 3

Fig. 3 Sprite collections

represents the collection of sprites together. From here the sprites are edited to get individual sprites.

Tile Palette: Tile palette is a Unity's version of paint that is used to paint the sprite over the grid in the game. Tile palette has options to fill sprites in one by one way or fill a whole grid with bucket tool.

4.2 Camera and Its Movement

Camera is a component in the game. Camera is the main way of output for the game. In order to move the camera with player we added a script where camera moves itself to the position where the player object is currently at.

Script 4.1

```
void LateUpdate ()
{
if(transform.position!= target.position){
Vector3 targetposition = new Vector3(target.position.x,
target.position.y , transform.position.z);
        targetposition.x=Mathf.Clamp(targetposition.x, minPosi-
tion.x, maxPosition.x);
targetposition.y = Mathf.Clamp(targetposition.y, minPosition.y,
maxPosition.y);
transform.position = Vector3.Lerp(transform.position, targetpo-
sition, smoothing);
} }
```

Here we used a function called LateUpdate() because to add a cinematic camera effect.

4.3 Player and Animation

The player object is the main character of the game and it moves as per the input given. The animations for walking and doing work are added through scripts.

Script 4.2

```
void Start () {
myRigidbody = GetComponent<Rigidbody2D>();
animator = GetComponent<Animator>();
}
```

The script is given the transform details of the player object and animator is added.

Script 4.3

Fig. 4 Screenshots of different stages in the game

```
void Update () {
change = Vector3.zero;
change.x = Input.GetAxisRaw("Horizontal");
change.y = Input.GetAxisRaw("Vertical");
UpdateAnimationAndMove();
}
```

The input is received from the user and stored I the variables. Then the animation function is called.

Script 4.4

```
void UpdateAnimationAndMove()
    {
        if (change != Vector3.zero)
        {
            MoveCharacter();
            animator.SetFloat("moveX", change.x);
            animator.SetFloat("moveY", change.y);
            animator.SetBool("walking", true);
        }
        else
        {
            animator.SetBool("walking", false);
        }
    }
```

This is where the animation is called for the player movement. The animations for the movement are given by adding few frames of the character in the animator window and it is played when the keys are pressed (Fig. 4).

4.4 Gameplay

The various stages were involved in game play at each stage the farmer has been instructed by simple instruction. The game play contains various game objects

1. The farmer character cleans the field filled with unwanted weeds by using the scythe. Once the user clicks the scythe object by using cursor the scythe works and when user clicks in the desired place where the weed has to be removed the scythe removes the weeds.
2. The farmer after cleaning the field the watering is done in the field for making the soil more fertile. The game has watering object and a pond to irrigate the land. The land is irrigated by clicking the watering object and clicking on the required farm area.
3. After irrigation, seeding is done by clicking the seed object. From the various varieties of seeds available the user has to select the desired seed and the desired amount to plant the crop in the farm. The seeding has to be done according to the season suitable for its growth.
4. After seeding the crop growth is monitored by using timer clock settings available once the crop starts yielding it should be irrigated and fertilized by the farmer by using the potion game object. The player should closely observe the timer and fertilize the crop in appropriate time.
5. Once the timer gets over the crop reaches the maturity level the farmer has to use the scythe to harvest the crop and gain the yield.

5 Evaluation

The evaluation of most of gaming systems are depended on the usability, interestingness and cognitive level of players. These evaluation parameters are varying for different level of players at different age groups.

In this work we categories the level of players as Novice, Intermediate and Expert level of player based on their playing ability. We consider the four categories of age groups; first one is upto 18; second is between 18 and 25; third category as 25–45 and final one is above 45. Table 3 shows survey report of the different players at different age group. These reports are considering the people those who are having digital literary skills.

6 Conclusion

The experimental results of the realistic forming simulator game indicates that novice player can be easily engaged by the game using its simple interfaces and it requires minimum knowledge of input about the technological and financial resources.

All participants has evaluated the game and a detailed survey has been taken from various age group of people from various places of Tamil Nadu. The players felt that the game was easy to play, understandable and representing well their reality and mentioned learning as the main result of the game.

Table 3 User survey

S. No.	Age group	Level	1	2	3
01	8–18	Novice	60	72	91
		Intermediate	75	70	89
		Expert	95	65	93
02	18–25	Novice	72	76	85
		Intermediate	81	73	84
		Expert	96	47	82
03	26–45	Novice	59	77	80
		Intermediate	71	79	79
		Expert	84	89	87
04	>45	Novice	41	92	88
		Intermediate	43	90	84
		Expert	47	93	71

1—Understandability
2—Entertaining
3—Educational level: All values are in percentage

The players who played the game commented that the game is majestic and modest in scope and scale and it should be a boom to next generation technological based agriculture. The result of the game suggested that there is real interest in further exploring the potential of self-design simulation games in participatory projects especially in the area of agriculture innovation.

Future extension of the game could improve smoother graphical details along with recent IoT technology to simulate the smart farming environment for future. Smart farming will bring the farmer to increase their profit using technology enable efficient agriculture method.

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Grayscale Image Histogram Estimation Structure Based on FPGA

Bonagiri Koteswar Rao, Giri Babu Kande, and P. Chandrasekhar Reddy

Abstract In recent years, most of the research work is done statistical image description as histogram estimation. In this we proposed a PDF architecture used to estimate the histogram of a grayscale image of 16 samples. Because of effective hardware utilization of histogram structures, it is well suited to generate histograms for various applications like military and medical applications which is not possible in MATLAB software. The histogram structures are implemented in FPGA platform. These histogram estimation values generated by the modelsim are similar to the histogram estimation values of MATLAB output with 100% accuracy. Experimental results shows that slice registers, slice look up tables (LUT) and frequency of proposed structure is improved when compared with the existing structure for all the sample values.

Keywords Probability density function (PDF) · Histogram estimation · Grayscale image · Field programmable gate arrays (FPGA)

1 Introduction

Based on a variable data, estimation of a probability density function (PDF) is very important issue arising in various domains like image processing applications, machine learning, pattern recognition, telecommunications etc. Estimation of a random variable can be done using semi parametric, parametric and non parametric techniques [1]. Histogram is the most fundamental non parametric estimator and is the simplest PDF estimator, has numerous applications in signal and image

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processing [2]. These estimators are good in image segmentation and can enhance the contrast quality and brightness of grayscale image. Several histogram estimators are proposed to estimate the PDF and to monitor the behaviour of optical channels in wideband applications [3].

In general histogram of an image can be plotted using MATLAB simulation tool but it is not feasible to generate histogram architecture [4]. In this paper development of histogram architecture for different sizes of 4 × 4 grayscale image has been addressed. Grayscale is a range of monochromatic shades from black to white. Therefore, a grayscale image contains only shades of gray and no colour [5].

While digital images can be saved as grayscale (or black and white) images, even color images contain grayscale information [6]. This is because each pixel has a luminance value, regardless of its color. Luminance can also be described as brightness or intensity, which can be measured on a scale from black (zero intensity) to white (full intensity) [7]. Most image file formats support a minimum of 8-bit grayscale, which provides 2^8 or 256 levels of luminance per pixel [8]. Some formats support 16-bit grayscale, which provides 2^{16} or 65,536 levels of luminance [9].

The introduced histogram estimation structures are implemented on various field programmable gate array (FPGA) boards which includes Virtex-6 and Virtex-7 devices. Because of flexibility and reconfigurability nature of FPGA, we developed various image histogram structures on these FPGA devices. With the use VLSI implementation which can boost up the speed of the architecture with the reduced power dissipation along with the reduced hardware resource utilization. These features are very important when the architectures are specifically designed for real time applications. The desired parameters for the VLSI based system are area, power and speed. Designers must remind these parameters and ensure there is a trade-off between them. Most of the research works are concentrated on the speed and power consumption. In this work, we are aiming at the reduction of hardware resource utilization along with increased speed.

Both existed and proposed histogram structures for various sizes of gray scale images are implemented on two different Xilinx FPGA boards namely XCV61524 and XCV7akdb2 and we analyzed different parameters. The difference between FPGA and ASIC is that in case of ASIC the system once embedded with a function can not be modified whereas in FPGAs are highly flexible devices.

This rest of this work is organized as follows. In Sect. 2, the structure of basic histogram was described. In Sect. 3, we observed the simulation and synthesis result and also compared the histogram structures for different gray scale images. Section 4 deals with the conclusion.

2 Histogram Estimation Structure

The histogram estimation structure is shown in Fig. 1.

With help of MATLAB input grayscale image of sizes 3 × 3, 4 × 4, 8 × 8 and 16 × 16 is converted into its equivalent binary values. In image each pixel consists of

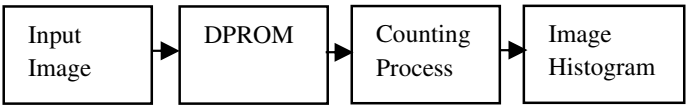

Fig. 1 Histogram estimation structure

intensity levels ranging from 0 to 255. Each pixel intensity value is represented by 8-bit binary value. The dual port ROM (DPROM) consists of 256 address lines where each address line consists of 8-bit binary value. The data stored in each address location in DPROM is represented by 256 binary values. The grayscale image is shown in Fig. 2.

The address and its corresponding binary values are shown in Table 1.

Fig. 2 Grayscale image

Table 1 Address and data patterns

Address	Data patterns
0	1111……1111111
1	0111……1111111
2	0011……1111111
.	……..
.	……..
254	0000……0000011
255	0000……0000001

With reference to the clock cycle, the sample values are given to the DPROM to execute the pattern operation. In DPROM module 8-bit binary sample values are stored. Each memory location like M[0], M[1], … M[255] can store 256 bit values. Based on the clock cycle pattern process can be done by sample values, DPROM output count of 9, 16, 64 and 256 values are executed.

The output of DPROM i.e., 256 bit values are applied to the counting process module which consists of bin counters used to count the number of one's present in the 256 bit values. The binary value of image data is applied to the AND gate of counting process module. The counting process provides outputs from 0 to 255. The pixel density values 0, 1, … 255 are given to 1st, 2nd and 256 stages respectively. Finally the counting process provides count values of pixels which are having same intensity levels.

The count values stored in the bins of a counting process module are extracted and saved in a text file. The text file is applied to the input of MATLAB which generate histogram based on the values stored in the text file.

3 Simulation and Synthesis Results

In this section, the histogram estimation structures with 2 ROM blocks and 1 DPROM block are implemented in Virtex-6 FPGA device using verilog HDL code in Xilinx ISE 14.5 tool. The Register Transfer Level (RTL) schematic of the proposed architecture with DPROM is shown in shown in Fig. 3.

The FPGA performance of histogram estimation for both existed and proposed structures of grayscale images with 16 samples are displayed in Table 2. From Table 2, it is observed that the performance of proposed histogram estimation structure is better in terms of slice registers, slice LUTs, fully used LUT flipflop pairs, frequency and delay is improved when compared with the existed estimation structures. The simulation results of proposed histogram structure is shown in Fig. 4.

4 Conclusion

In this paper, the histogram estimation structure for grayscale image size of 16 samples is designed using verilog HDL and implemented in FPGA. Histogram bin values obtained from both MATLAB and modelsim are same with 100% accuracy. FPGA performance of proposed histogram estimation structure is improved with the use of DPROM. The main advantage of this proposed structure was hardware utilization has been reduced and frequency i.e., the speed is improved when compared to the existing structure.

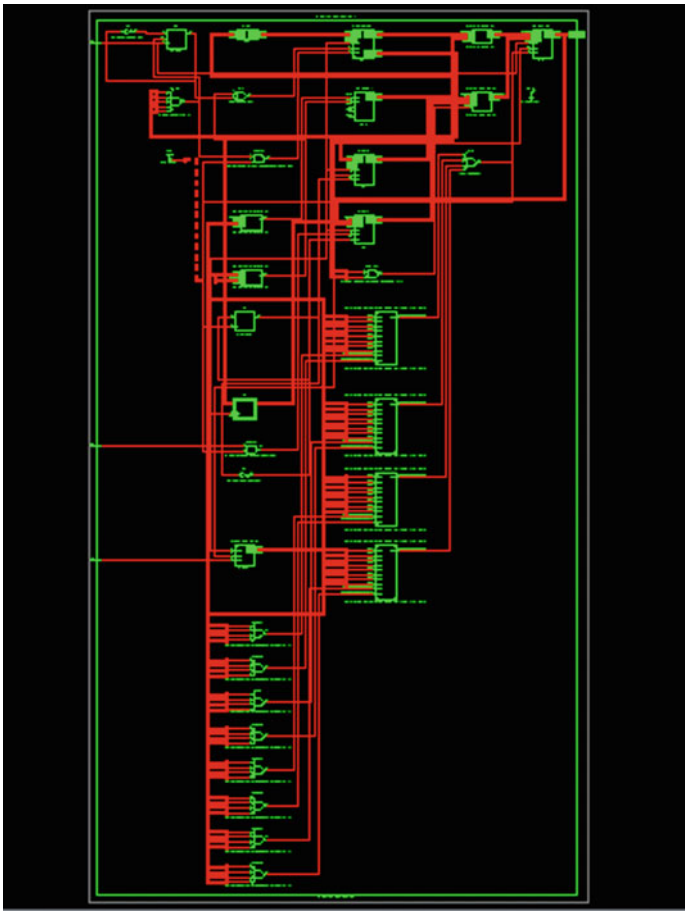

Fig. 3 RTL schematic of histogram structure

Table 2 FPGA performance analysis of 16 samples

FPGA performances	Total resources	Occupied		% of utilization	
		Existed	Proposed	Existed	Proposed
Slice registers	93,120	288	288	0	0
Slice LUTs	46,560	11,528	1226	24	2
Fully used LUT-FF pairs	11,669	147	192	1	14
Frequency	156	8	8	5	5

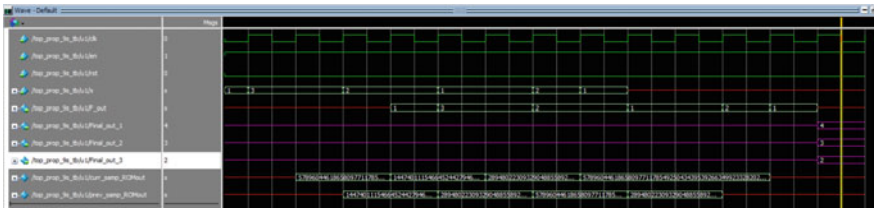

Fig. 4 Simulation results of proposed histogram structure

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Estimation of Tropospheric Scintillation Effects on Satellite Communication Signals at Ka Band Frequencies for Indian Climatic Conditions

Rapaka Prabhakar and Teppala Venkata Ramana

Abstract In the Satellite communications Ka band (30/20 GHz) link using with many advantages but scintillation effects are more significant. The "Scintillation" term means rapid signal fluctuations in phase and amplitude due turbulence. These fluctuations caused by irregularities of turbulence in humidity, temperature and pressure posses rapid changes in fraction time in the radio refractive index which is a function of wet term radio refractive index. Hence there is a need to quantify the scintillation phenomenon for the antenna tracking systems and adaptive power control satellite communication system design with complete knowledge on scintillation characteristics like rapid fluctuations in signal amplitude and phase angles. It leads to the prediction and modeling of tropospheric scintillation effects for the accurate design of adaptive link control system in satellite communication systems. This new models give excellent agreement with ITUR model and is applicable to any Ka band satellite adaptive link control systems.

Keywords Scintillations · Ka band · Satellite signals · Tropical climate

1 Introduction

To estimate the atmospheric effects of scintillation in troposphere at radio frequency greater than 10 GHz and low angles of elevation less than 10º tropospheric scintillation is more dominant significant propagation impairment than rain. This is more affected on earth-space communication satellite adaptive link control systems. India has tropical climatic conditions means that the more humid, very high temperature, heavy rains and cloudy throughout year and also seasonally varied. Due to the heat energy from the sun rays incident on the earth's surface warms-up and atmospheric molecules are excited due to this the boundary turbulent layer created [1]. When the received signals are passing through this turbulence layer and mixed up and small

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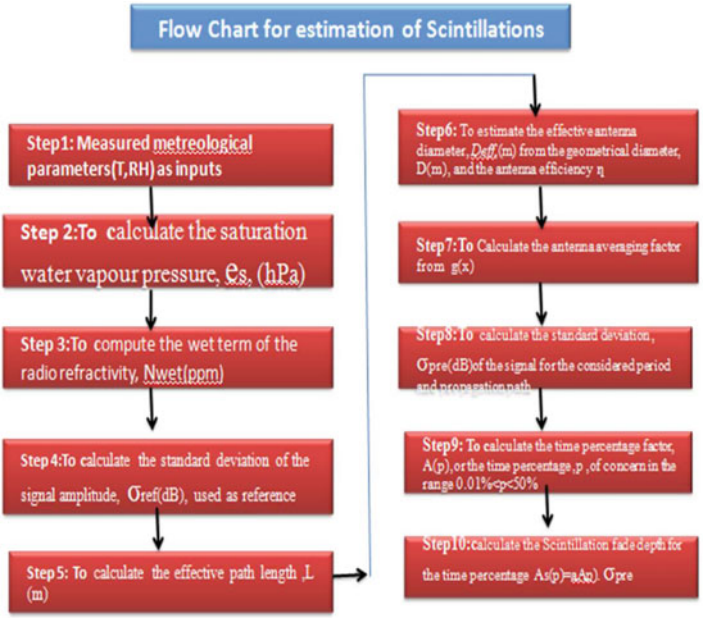
scale variations occurred in refractive index of troposphere and rapid fluctuations in amplitude and angle of the received Ka band frequency signals when propagating along path. Scintillation is occurred due to convective heating and gradients produces turbulences and apparent scintillation due to variations in rain drop distribution.



Meteorological Measurements

Experimental measurements done at the Rajiv Gandhi International Airport, Hyderabad, India.

Ground Station Specifications

- Station identifier: VOHY
- Station number: 43128
- Observation time: Jan 2016–Dec 2019 (4 years), 00z (AM time), 12z (PM time)
- Station latitude: 17.45 (°N)
- Station longitude: 78.46 (°E)
- Elevation Angle: 64.67°
- Station height: 545 m
- Frequency: Ka band frequencies at 20.2 and 30.5 GHz
- Height: Turbulent layer height from surface of the earth: 1000 m
- Earth radius: 8.5×10^6 m.

Signal enhancement The long term enhancement, $A_{lte}(p)$ exceeded factor, $p \leq 50\%$, given by:

$$A_{lte}(p) = -3.53691^{-4}(\log_{10} p)^3 + 0.00272(\log_{10} p)^2 + 0.02088(\log_{10} p) + 0.22 \quad (1a)$$

Minimum enhanced depth 0.0665 dB at time % factor 0.2004 (4.81 h) and averaged scintillation intensity $\sigma = 0.331897$ dB. Maximum enhanced depth is 0.0896 dB at time %factor 0.2701 (6.4824 h). Enhanced duration is 1.67 h.

The long term fade, $A_{ltf}(p)$ exceeded factor, $(q = 100 - p)$, $50\% \leq q \leq 100\%$given by:

$$A_{lt}(q) = -3.53691^{-4}(\log_{10} q)^3 + 0.00272(\log_{10} q)^2 + 0.02088(\log_{10} q) + 0.2285 \quad (1b)$$

Minimum enhanced depth 0.0665 dB at time % factor 0.2004 (4.81 h) and averaged scintillation intensity $\sigma = 0.331897$ dB. Maximum enhanced depth is 0.0896 dB at time %factor 0.2701 (6.4824 h). Enhanced duration is 1.67 h.

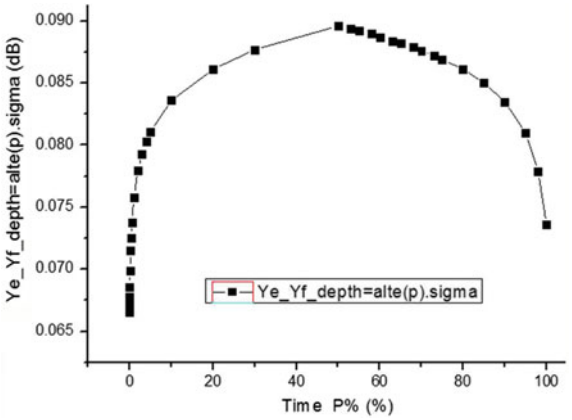
Minimum time p 50%, large time percentage factor is 0.2701 (6.4824 h). Maximum time p 100%, small. Time percentage factor is 0.222 (5.328 h). Fade duration is 1.15 h.

Estimation of enhanced and faded satellite signal depths

Time percentage factor $A_{lt}(p)$ for long period basis: This model measurements based on the range of time percent p from 0.01 to 100%. Enhanced scintillation (dB) calculations exceeded factor for given time percentage by averaged N_{wet}(ppm). For $p < 50\%$, the enhancement values. For $p > 50\%$ gives the fade of scintillation.

Scintillation faded and enhanced depths are:

$$A_{lt}(p) = \begin{cases} \sigma Y_e(p) & \text{if } q \leq 50 \\ \sigma Y_f(100 - p = q) & \text{otherwise} \end{cases} \text{(dB)} \quad (2)$$



$A_{lt}(p)$ scintillation attenuation is less than zero for time percent < 50% Attenuation signifies signals level in the enhancement.A general calculation method is used for sum of scintillation prediction statistics for monthly R_H and T averages for years. Reflections considered at a specific base station site climatic conditions. Since monthly averaged surface relative humidity (%) and monthly averaged surface temperature are changed from season to season. The seasonal surface R_H average and seasonal averaged temperature considered for the prediction of seasonal climatic variations observations. The test frequencies are 20.2 and 30.5 GHz. Both the enhancement and fade depths graph shown in Fig. 4.18. Here signal enhanced from 0.0665 to 0.0986 dB for the time percent range from 0.01% to 50 and signal faded depth decreased 0986 to 0.0736 dB with increasing time percent from 50 to 100. The signal enhanced stretched to 0.0231 dB and faded stretched to 0.016 dB. Estimated tropospheric scintillation statistics with local meteorological parameters as inputs. Estimated averaged scintillation intensity σ_σ is 0.331897 dB for minimum time percent p range 0.01% the time percentage factor $A_{lte}(p)$ is 0.2004 and enhanced depth Y_e is 0.0665 dB. And for maximum time p 50% the time percentage factor is 0.2701 and enhance depth of 0.0896 dB. For fade case, time percent q range is $50 < q < 100\%$, the time percentage factor $A_{ltf}(q)$ decreasing range from 2701 to 0.222 and decreased fade depth from 0.0896 to 0.0736 dB at Ka band frequency 30.5 GHz. The signal distribution done by log normal distribution and Gaussian amp distributions for long term distributions. Experimental measurements done at the atmospheric turbulence height of 1 km from the earth's surface. From the measured values the N_{wet} and R_H are directly proportional to each other and N_{wet} and T are inversely proportional to each other. In the mechanism of scintillation not absorbed any energy from radio signal but focussing and defocusing due to re distribution of radio signal causes a distribution of temporal and spatial signal enhancements and fades.

2 Improved Tropospheric Prediction Models

The quality of signal effected by tropospheric scintillations can be improved by using required availability and statistical knowledge of climatic scintillation effect.

Considered the cumulative distributed signal fade from Eq. (1) and normalized with standard deviation or scintillation intensity from Eq. (3). The resultant statistics were shown in Table 1. And graphical representation shown in Fig. 6.1. Considered probability range from 50 to 100%, the normalize with scintillation intensity σ is 0.331897 dB for signal decreased from 0.2699 to 0.2217 dB

The normalized distribution functions given by:

$$\gamma(p) = (Y_f(P) + Y_e(P))/2 \tag{3}$$

$$\delta(p) = (Y_f(P) - Y_e)(P)/2 \tag{4}$$

Table 1 Improved prediction model statistics

Improved parameters	Statistical values
Saturation water vapour pressure e_s(hPa)	31.33524
Averaged (N_{wet}) (ppm)	74.5657
Averaged σ_{ref} (dB)	0.055992
Path length (L) (m)	1004 m
Effective antenna diameter D_{eff}(m)	1.55 m
Antenna averaging factor g(x)	0.8143
Averaged scintillation intensity σ (dB)	0.331967
Averaged variance σ^2 (dB^2)	0.112858
Time % factor A(p),time percentage p, 0.01% < p < 50%	0.23525
Enhanced depth of scintillations Y_e(p)	0.07805
Time % factor A(q),time percentage q, 50% < q < 100% for faded signals	0.24605
Faded depth of scintillations Y_f(p)	0.0816
Normalized with std. dev. of enhancement Y_e(p)	0.23515
Normalized with std. dev. of fade Y_f(p)	0.2458
Normalized functions γ(p)	0.0808
Normalized functions δ(p)	0.00058

where γ(p) and δ(p) normalized distribution functions for signal enhancement depth and faded depth. From the analysis the at 0.01% of probability function γ(p) depth is minimum 0.07805 dB and maximum is 0.08355 dB at 70% .and δ(p) depth is maximum 0.01155 dB at 0.01% and minimum is − 0.00005 dB at 70% of probability (Table 2).

Scintillations at Ka band 30.5 GHz and 20.2 GHz frequencies.

Scintillation

$$\sigma = g(x)\, f^{7/12}\, \sigma_{ref}/(\sin\theta)^{0.047} \tag{5}$$

Variance

$$\sigma^2 = (g(x)\, f^{7/12}\, \sigma_{ref}/(\sin\theta)^{0.047})^2\ dB^2 \tag{6}$$

The frequency scaling factor a value in ITUR is 7/6, Karasawa value is 0.9 from their research, function $g(D_e)$ is 0.8569 for 20.2 GHz and 0.8143 for 30.5 GHz and the averaging factor ratio is 1.052 is the accurate antenna averaging factor approximated to unity and rationalized function will give unstable values, hence for analysis purpose above equation used. The frequency ratio r is given a constant that is 0.66229 for the total duration. In this section tested for scintillation dependence of frequency using measurements from RGI Airport. Advantages of having antenna size of 2.4 m and elevation angle of 64.67°. The ratios of averaging functions slightly depends

Table 2 Statistical relationship between scintillation and variance at 20.2 and 30.5 GHz

Month	Scintillation_20.2 GHz	Scintillation_30.5 GHz
Jan	**0.2147**	**0.2595**
Feb	0.2372	0.2867
Mar	0.2385	0.2883
Apr	0.256	0.3094
May	0.2927	0.3537
Jun	0.323	0.3903
Jul	0.3359	0.406
Aug	**0.3429**	**0.4144**
Sept	0.3154	0.3812
Oct	0.2592	0.3132
Nov	0.244	0.2949
Dec	0.2366	0.286
Mean values	**0.274675**	**0.3318967**
Stretches: 0.0573 dB		

Bold represents minimum and maximum scintillations and corresponding variances.

on height of turbulence layer. Generally height parameter is uncertainty function of averaging aperture factor. Here height is considered to be 1 km. The turbulence layer height changed from 800 to 1200 m then the ratio varied < 1%. This dependence for big antennas would be very stronger. Hence these aperture averaging factor ratios considered as constant. Studied on exponent factor *a* in Eq. (2). And the frequency f_1=20.2 GHz and f_2=30.5 GHz then ratio of averaging function $g^2(D_e, f_1)/g^2(D_e, f_2)$=1.0523. Because the ratio of variance is independent of height of turbulence layer and no seasonal significant variation expected. The joint distribution function of the variances at 20.2 and 30.5 GHz frequencies of signals verified for every averaged month of four years long period from Jan 2015 to Dec 2018. Observations expected seasonally small changing intensity of scintillation over various seasons. In Fig. B.1 gives the joint distribution of variances σ_1^2 and σ_2^2 at f_1=20.2 GHz and f_2=30.5 GHz frequencies. From the variance very low values determined these values will be give highest distribution.

In order to regulate the relative influence of different parts of the distribution, the data points have first been collected in bins, in the direction of the expected curve fit, by using the parameter r: Relative Humidity R_H and Temperature T are inversely dependent to each other, R_H and wet term radio refractivity N_{wet} Strongly dependent ot each other, R_H and scintillation Intensity σ are strongly dependent to each other, Temperature T and Scintillation Intensity σ less correlation, N_{we} and Scintillation intensity are very strongly dependent to each other because their correlation coefficient 0.9992, less correlation between Temperature and $N_{wet,}$ Saturation water vapour pressure and Scintillation Intensity less correlation, Time percentage p and Depths are strongly correlated to each other.

3 Future Scope

Investigations on scintillation at different locations of interest would be proposed. Investigations on short term scintillations prediction recommended. To predict the various parameters need in satellite links at higher frequency bands for tropical climate.

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Automation of Rice Cultivation from Ploughing–Harvesting with Diseases, Pests and Weeds to Increase the Yield Using AI

Uma N. Dulhare and Sheikh Gouse

Abstract Rice (Paddy) is an important crop to meet the food demands of the world. To ensure the health growth of the crop, it is essential to timely predict the soil fertility and to detect diseases, pests and weeds in the early stages which can improve the growth of yield. Since manual detection of diseases, weeds and pests costs a large amount of time and human resources. To automate the system, Artificial Intelligence (AI) plays a vital role. This paper presents the various challenges and algorithms used to solve by using Unmanned Aerial Vehicles (UAV's) and AI for image classification of soil fertility which improves growth of the yield. Rice crop automation from early growth stages to harvesting reduces the much usage of harmful pesticides and fertilizers, increasing the yield and producing quality products. Automation of rice cultivation using AI solves various rice crop challenges related to weather conditions, soil, plant health monitoring, limited pesticides and fertilizers to apply, loan subsidies, marketing information and demands to the farmer in time.

Keywords Agriculture · Rice · Paddy · Land fertility · Crop monitoring · Soil · Water · Diseases · Artificial intelligent · Machine learning · Deep learning

1 Introduction

Agriculture is the backbone of economies of many countries which includes India. Around 159 million hectares of area is cultivated and nearly 700 million tons of produce is acquired yearly worldwide. India is the second-largest producer of rice (Oryzasativa) in the world and almost one-fourth of production comes from this country. Rice is an essential food in south India. Rice production is affected mainly due to soil fertility, quality of seeds, fertilizers, monitoring, weed, disease control, field, yield and water management, storage, marketing infrastructure and

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rice machinery. By Identifying significant factors in the early stages of plant growth by using AI and Machine learning (ML) technology to increase the yield and prevent losses [1].

In India, a lot of agricultural issues are being observed in the ruler areas such as most of the farmers lack knowledge about which soil is most suitable for which crop, they continue cultivating the same crop throughout the year, without crop rotation, no proper seed quality management, excess use of fertilizers and pesticides which leads to decreases the soil fertility. There is no proper mechanism to guide the farmer in content with the crop monitoring system and the global marketing.

By using emerging technologies such as Computer vision, AI, IoT, Bigdata, UAV and Blockchain, the agricultural sectors can be automated to control and manage the cultivation of rice crop from facing challenges like diseases, pesticides, weeds, soil, and water [2–4]. Remote sensing plays a crucial role in smart agriculture by using big data and AI for future analysis. This data can be collected from satellites, UAVs, and Mobiles apps to visualize and take immediate action to control the crop and other factors that affect the precise cultivation yield [5, 6].

A detailed review of technologies that are available for automation needs are present in Sect. 1. The related work of rice yield and its challenges are elaborated in Sect. 2. The experimental results with various algorithms and models of technologies which help in rice production in Sect. 3 and acknowledging the different algorithms, and technical methods leads to betterment of rice production.

2 Related Work

There are various research issues related to rice or paddy cultivation from early stage to production stage. Overall challenges are categorised into four sections: 1. Soil management. 2. Pest management. 3. Weed management. 4. Disease management.

2.1 Soil Control Management

India's alluvial delta and clayey soil are best suited for rice production. Soil fertility plays a primary role in the growth of the plant and good yield production. For more production, heavy use of fertilizers and pesticides reduce soil fertility and nutrient. Paddy crop needs hot and humid climate 20–35 °C and 100–200 cm rainfall [7]. Paddy essential nutrients to perseveres fertility are Nitrogen (N), Potassium (K), Phosphorus (P), Aluminum (Al), Calcium (Ca), Iron (Fe), Zinc (Zn), and Sulphur (S). If soil pH is less deficient in nutrients, the fertilizers N-P-K and organic composted manure can increase. Soil nutrient deficiency was found with ANN and CNN where as color extraction from leaf growth was discussed with Drones and IoT [8].

Soil management for rice mainly deals with moisture, condition, temperature, and drying [9]. ML/AI, ANN (Artificial Neural Network), and CNN (Convolution Neural

Table 1 Rice soil control management

S. No.	Author	Strategies/model/algorithm	Important features	Results
1	Sure et al. [7]	GLDAS-NOAH, SMAP and AMSR-2	Prediction soil moisture	SMAP: 0.9 AMSR2: 0.65
2	Johann et al. [8]	MLP, AREF, MLR, RBF	Soil moisture	RMSE: 1.27–1.30% AREF: 3.77–3.75%
3	Yang. et al. [9]	Naïve Bayes, logistic regression and QDA (quadratic discriminate analysis)	Prediction cadmium (Cd) grains and soil. Soil pH and CEC improves performance	LR: 0.5% Cdsoil) LR: 4.1%. LR = 0.949 If $p < 0.01$. Threshold (0.1,04) Mean 5.75%

Network) algorithms like SVM (Support Vector Machine), Regression, Back propagation (BP), Naive Bayes help in predicting temperature and moisture, improving soil fertility and nutrients in Table 1 [7–9].

2.2 Pest Control Management

Pest management is mainly related to the rats and insects that cause damage to the paddy field [10]. There are two types of pest controls. First, primarily occurs in the nursery's early stage consists of Thrips, Green Leafhopper, Rice case worm, Paddy Stemborer, Swarming Caterpillar [11, 12]. Second, mainly occurs in the main field of nursery stage consists of Stemborer, Gall midge, Swarming caterpillar, Skipper, Leaf flower or roller, Horned caterpillar, Yellow hair caterpillar, Grasshopper, Spiny beetle, or rice Hispa, Whorl maggot, Green leafhopper, Brown leafhopper, White-backed hopper, Mealybug, Earhead bug and Thrips [12, 13].

Pest control management for rice mainly deals with pests-related diseases. The various algorithms and models of ML/AI, ANN, and CNN like VGG16, InceptionV3, ResNet-50, YOLOv3, CaffNet to detect pests-related issues and diseases to improve the crop yield from early stages to final in Table 2 [10, 11, 13–15].

Table 2 Rice pest control management

S. No.	Authors	Strategies/model/algorithm	Important features	Results
1	Rahman et al. [10]	CCN, VGG16, and InceptionV3. MobileNet, NasNet mobile and SqueezeNet	Detection of pest and diseases. Dataset: 1426 images and classes: 9	Accuracy: 93.3%
2	Li et al. [11]	DCNN, faster-RCNN, VGG16, ResNet-50/101 and YOLOv3	Video detection and analysis of pestsblurry videos with DL	Video detection metrics
3	Bisen et al. [13]	Pest affect in a different stage of growth with fortnight observation	Insects and pests harm the rice yield production	Major insects pests which decrease
4	Alfarisy et al. [14]	CaffeNet model	Data set images: 4511	Accuracy: 87.0%
5	Talaviyaet al. [15]	AI/ML	Crop monitoring and spraying	Reduce unnecessary pesticides and herbicides

2.3 Weed Control Management

Weeds are nothing but unwanted plants which grow and utilize the land and water with the desirable crop. Weeds are grasses, sedges, broadleaf, and algae. It can affect up to 45% of yield [16]. It is essential to control otherwise reduces the yield and rice quality which impact on price. Weeds are planting out of place, three forms of competition are light, water and nutrients. It can be managed by controlling the land preparation, water, hand weeding, hoeing, brushing bunds, crop rotations, and herbicides [17].

Weed control management for rice mainly deals with unwanted plants. The various algorithms and models of ML/AI, ANN, CNN, Fuzzy C-mean, SegNet, Fully Convolution Network (FCN), U-Net, SVM and Site-specific weed management (SSWM). There are three management systems TPR-CTW (Transplanted Puddled Rice-Conventional Till Wheat), DSR (Direct Seeded Rice) and DAS (Days After Sowing) to detect weeds issues control in early stages so improve the crop yield growth from early stages to final in Table 3 [16–20].

Table 3 Rice weed control management

S. No.	Authors	Strategies/model/algorithm	Important features	Result (accuracy)
1	Li et al. [16]	MCDC	Mono cropping with five cultivars	High-quality Rice and Healthy
2	Partel et al. [17]	GPUs. RTK GPS	A smart sprayer for a weed detection system	Jetson TX2: 90%
3	Ma et al. [18]	SSWM, SegNet, FCN, U-Net	Rice seedlings and weeds detection	SegNet: 92.7%. FCN: 89.5% U-Net: 70.8%
4	Baghel et al. [19]	TPR-CTW, DSR and DAS	Control measures in weeds on rice	DSR: 82%
5	Dian Bah et al. [20]	CNN	Weed detection with UAV images	SpinachField: 1.5% Bean field: 6%

2.4 Diseases Control Management

Rice disease control management is essential to minimize the losses. Diseases are caused mainly due to fungi, bacteria, and viruses [21]. It occurs in two phases, during the nursery and main field. The first phase includes five types of nursery diseases which are Bacterial Leaf Blight (*Xanthomonas oryzae*-pv. *oryzae*), Blast (*Pyriculariaia grisea–P. oryzae*), and Virus Rice Tungro (RSTV and RTBV) [22]. The second phase includes six types of main field diseases which are Leaf Streak (*Xanthomonas oryzae*), Sheath Blight (*Rhizoctonia solani*), Brown Spot (*Helmimthosporiumoryzae*), False Smut (*Ustilaginoidea virens*), Sheath Rot (*Sarocladium oryzae*) and Grain Discolouration (Fungal Complex) [23–26].

Rice disease control management mainly deals with fungi, bacteria, viruses, pests, and weeds. The various algorithms, models of ML/AI, ANN, and CNN like K-mean, SVM and R-CNN are used to detect disease issues, so the crop yield improves from early stages to final in Table 4 [21, 22, 24–26].

Table 4 Rice disease control management

S. No.	Authors	Strategies/model/algorithm	Important features	Result (accuracy)
1	Zhou et al. [21]	K-Mean (FCM-KM) R-CNN, 2DFM-AMMF, Faster 2D-Otsu	Rice blast, bacterial blight, blight Rice dataset images: 3010	Accuracy: 98.26%
2	Kora et al. [22]	Ag NP: 16.6 nm. Synthesis and Stabilization	Rice leaf disease detects with video	Ag NP: 20 and 10 μg/ml
3	Sethya et al. [24]	Image classification, segmentation, hyper spectral and thermal	Rice diseases detection	Rice growth improved
4	Kodama et al. [25]	SVM	Image classification for healthy crop	Accuracy: 90.00%
5	Islam et al. [26]	Noise deduction	Gaussian filtering	Accuracy: 98.63%

3 Discussion

The various emerging technologies use for the modernization of agriculture as shown in Fig. 1. The Various algorithms and models of machine learning and deep learning are used for every phases as shown in Fig. 2.

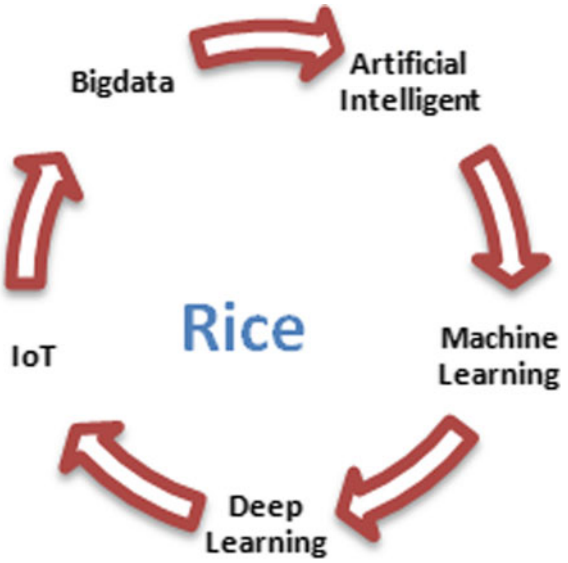

Fig. 1 Rice growth with modern technology

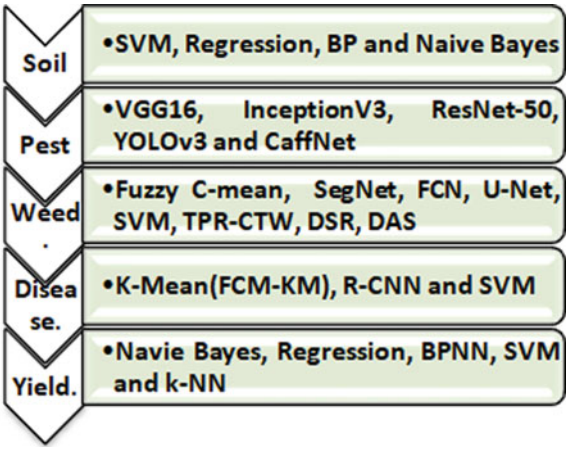

Fig. 2 Machine learning models and algorithms for rice crop

4 Conclusion

In this study, all issues related to rice or paddy crop fields from the soil, pest, weed and disease existing 24 papers have been identified with twenty types of different pests, eleven types of diseases and three types of weed management systems in various rice phases many rice cultivation issues can overcome and reduce the losses by the farmer from plowing the rice to till harvest. Modern technologies like Computer Vision, AI, ML, DL, IoT, Bigdata, remote sensing architectures models and algorithms to automate the rice cultivation system suggested. Automation in agriculture increases land fertility, quality of seeds, fertilizers, crop monitoring, weed, disease control, field, yield and water management, storage, marketing infrastructure and rice machinery. It allows farmers to do more with less cost, improves the quality and quantity of rice production. This Automation technique in agriculture, rice irrigation makes the solution is more affordable and rapid adoption and higher penetration. In future scope, design a automated robust framework which helps the farmer to do their activities on time from early stage to harvesting stage to improve growth of rice production by solving the rice related issues from plowing to harvesting modern technologies. Developing a simple mobile app which helps the farmer, monitor the crop from various challenges from weather conditions, day-wise plant health monitoring, soil analysis, pesticides to apply, marketing, and loan subsidies within a stipulated time through digitalization.

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Blockchain Technology for Assisting the Analysis of Viruses and Other Pathogens

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Abstract In this paper, we are trying to explore how blockchain technology can assist in the field of medical research. Here, we propose the use of this technology to store the records and observations after the research on various pathogens conducted by doctors and scientists. By this method we can create a data pool that is trustworthy, on which the researchers on this field can depend upon for the future studies of these pathogens and the diseases that they cause. This can also accelerate the process of developing a vaccine due to the abundance of accurate information from all over the world. The Coronavirus scenario showed us that our healthcare system could be made much better and we need to keep improving our technologies and methods to effectively identify, analyze and take necessary actions with life threatening pathogens in an early stage. By integrating the technique of blockchain to the framework of our healthcare system we can make the process of transferring information much more secure and efficient.

Keywords Blockchain · Distributed ledger · Cataloguing pathogens

1 Introduction

Blockchain is made up of blocks of data in a network, linked cryptographically. The data is time stamped, decentralized and highly resilient to modification. This makes blockchain technology a very effective ledger system. Each block contains a code called 'hash', which is generated using a cryptographic algorithm. It has the ability to share information in real time to different nodes in the network in a very secure method, making this an efficient shared database with several participants. If we had a Blockchain system which connected the World Health Organization, Health ministry and hospitals of each country that was actively sharing information,

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infectious diseases could be identified and isolated in its early stages and situations like the COVID-19 pandemic could have been avoided. The casualties could have been minimized. By storing the data after careful research and scientific analysis on individual pathogens by doctors and scientists in such a network, we can make valuable information easily available by authorized personnel on a global scale.

Blockchains can provide a large and secure network of tamper proof information. The registered doctors and scientists across the world can record and retrieve information on this network. Each viral strain is to be given its own unique code or Pathogen_ID and the doctors/scientists who conduct research on the same can add to the data pool of the same Pathogen_ID. New observations due to the mutations, or newly discovered mutated strands can be recorded in this network. This can provide reliable information in abundance in a very short amount of time to any doctors/scientists who require the same. This can help in understanding the pathogen seamlessly due to the easy availability of data and assist the researchers for developing a cure. The discovery of extremely dangerous strands can be alerted to the officials such as WHO, which could help in pandemic prevention and crisis management. It can also help to predict the possible mutations that could happen in the future, thereby helping us to prepare in advance.

Blockchain technology was developed by Satoshi Nakamoto in 2008. Since then, it has been an efficient method to keep records of transactions in a permanent and tamper-proof way. Currently its being used in different fields like Education, Healthcare, Agriculture, Financial Sectors etc. Various researches in the field of blockchain suggest that this technology has to be utilized in such a way that the latency in the network can be reduced with an impenetrable environment for storing and transmission of vital facts. There are studies that also claim that this technology can help in the route of this pandemic catastrophe by offering expanded solutions, outbreak tracking, user privacy, the overall performance of the scientific furnish chain, donation, tracking and invulnerable everyday operations. Blockchain technology along with rising applied sciences such as artificial intelligence, massive statistics and cloud computing can efficiently deal with pandemic like COVID-19 and help in cataloguing precise details about pathogens like bacteria, prions, viruses etc. Blockchain technological know-how is a digital ledger that consists of dispensed, redistributed and oftentimes public data. The blockchain technological structure has three familiar factors such as blocks, miners and nodes. The chains consist of more than one block and every block takes the records about the nonce and the hash. The miners can create a new block and append them to the chain with the aid of a technique called mining.

Currently there is no existing system which uses blockchain technology to catalogue information regarding pathogens. Dealing with pathogens can be quite tricky, especially viruses. Pathogens like viruses mutate rapidly and randomly. These mutations make them harder to treat, as their characteristics may vary over time and geographical area.

2 Literature Review

Pednekar et al. [1], proposed a Blockchain system in their paper which can help to prevent future pandemics by including functions such as tracking of medicines and deadly diseases and the management of patient records [1]. Torkey and Hassanien [2], introduced a system which works through Block chain technology for retrieving infected cases and estimation of the risks of COVID-19 in the society. Their system is based on some subsystems such as Mass surveillance system, Blockchain platform, P2P Mobile Application and Infection verifier subsystem [2]. Nguyen et al. [3], talks about an Artificial Intelligence (AI) based system collaborating with Blockchain Technology to combat COVID-19 like diseases [3]. Marbouh et al. [4] proposed a tracking system based on Blockchain technology with some cases such as clinical trial management, user privacy protection, data aggregation, medical supply chain, Donation tracking, contact tracking and outbreak tracking [4]. Sharma et al. [5], introduced a Blockchain technology-based system to show how to combat COVID-19 situation through some sort of function linked with the Government [5]. Krishnapriya and Linda [6], studied a system which is used to store student academic details using Blockchain technology, so that the students can avoid carrying so many academic papers [6]. Chattu et al. [7], discussed the scope and role of Blockchain technology in the healthcare system. They proposed a disease surveillance system for the strength of global health security [7]. Qian et al. [8] gives a brief description about Blockchain related technologies like distributed consensus, smart contract and data provenance [8]. Risius and Spohrer [9] gives an insight of the current research framework of Blockchain related technologies [9]. Cahill et al. [10] did an investigative study about the price reaction of various companies in response to blockchain related technology [10]. The study Tama et al. [11] focuses on the Blockchain's ability to decentralize markets. They also review various applications of Blockchain technology [11]. Lu [12] explains the different applications and future directions of Blockchain technology. It is a study on how Blockchain can be integrated into current systems to create much stronger versions of the same [12]. Cachin [13] talks about Hyperledger, which was an effort to create a very efficient open-source distributed ledger and Hyperledger Fabric which is an implementation of the same [13]. Kokina et al. [14], describes the opportunities of Blockchain in accounting firms. Future areas of research related to blockchain technology are also explored [14]. Huumo et al. [15] studies about the research topics and areas of future research related to Blockchain technology. This study was focused on figuring out the limitations of Blockchain [15]. Fedorov et al. [16] did a study on how quantum computers of the future might bypass security provided by the Blockchain technology in cryptocurrencies [16]. Ojo and Adebayo [17] explores the opportunity of Blockchain technologies in digital 5 countries like the United Kingdom, United States, New Zealand etc. [17]. The research done by Miscione [18] focuses on Blockchain based authentication systems for land registries [18]. An analysis of Blockchain related papers from 2011 to 2017 with separate datasets for individual literature sources were studied by Zeng et al. [19]. Filippova et al. [20] gives a brief description of

the future path for Blockchain and the possible ways of improving the technology [20]. The study by Ometov et al. [21] is based on a survey about the main application of Blockchain in mobile applications. Also, they compared the Proof of Work (PoW), Proof of Authority (PoA), Proof of Stake (PoS) applications in smartphones in order to increase the efficiency and reduce the battery usage. Their result shows that they couldn't increase the efficiency through those processes and it also affects the battery severely [21]. Unalan and Ozcan [22] tries to transfigure a system of innovations through blockchain by analysing and interpreting its all areas. Their main findings were the increase in networks and collaborations distribution, emerging of new platforms, the increase in significance of technological drivers etc. [22].

Gamage et al. [23] describes the problems and improvements required in Blockchain platforms. They used survey methods to identify and analyze the improvements and issues with Blockchain technology [23]. Allen et al. [24] tries to replicate the institutional innovation by making a dynamic model. They also propose some suggestions for its innovation policy [24]. Kim et al. [25] proposes a new model called Word2vec and also compared it with probabilistic LSA. Their observation was that the proposed model showed much more accuracy and it will be a better alternative for modelling which will be useful in future trend analysis [25]. Bell et al. [26] studied about the recent areas in the medical field where Blockchain has been used. They also discussed data sharing, details storing etc. in the medical field [26]. Michael et al. [27] describe the wide range of Blockchain applications. They also discussed its safety, commercial use, its role in virtual currency etc. [27]. Hyland-Wood and Khatchadourian [28] proposed new standards to the works related to blockchain by pointing out the irregularities or mistakes in the existing international standard [28].

Filippova [29] covers up the gaps in the features of acknowledged GPT and also describes the new scopes in the worldwide patent Statistical Database (PATSTAT) [29]. Brilliantova and Thurner [30] studies the role of blockchain technology in the energy sector, mainly in the market of transformation of energy. Their paper is based on literature reviews and interviews of experts [30]. Podgorelec et al. [31] tries to implement a machine learning method for automated signing for blockchain transactions, through experiments and analysis. The result shows improvements and can be made possible in the future [31]. Holotescu [32] also describes blockchain, its working and its applications in different areas and fields [32]. Zhidanov et al. [33] discusses the possibilities of using different systems in support of each function in blockchain in order to increase the efficiency and also to attract more users to the platform. They also created an algorithm for this purpose [33].

3 Characteristics

The reason we propose the use of blockchain for this purpose is its set of characteristics are as follows,

Immutability. This feature makes this technique a super secured platform to interact with. Blockchain technology uses 'cryptographic hashing technique' with

a structure similar to a linked list to achieve this security. Each block contains a hash value (which is generated by cryptographic algorithms). The hash value for the succeeding block will be linked with the preceding block's hash value, which makes the data secure and tamper proof. Whenever someone tries to alter the data the hash changes and creates irregularity and issues with the next block. Thus, immutability is ensured.

Security. This platform resembles the database itself. But apart from other databases it has a strong security base, which helps to store any kind of information. We don't need any centralized party to secure our data, so it's much secure compared with other databases which are basically monitored or secured by third party or centralized security systems.

Decentralization. As mentioned earlier in this platform there is no need for a third-party monitoring, here each node or block is capable of securing the transactions. So, it becomes a decentralized platform.

3.1 Structure

In blockchain, as the name implies, blocks are its building units. Each block carries the information about transactions inside it. Thus, the blocks make this technique more secure. Whenever a new transaction occurs new blocks will be created (which are tamper proof). Here in this technology, we can't delete blocks, only new ones can be created. So, if we try to tamper or edit it will affect the whole system, I.e., no tampering is possible inside the block. Each block will carry its version, hash value, preceding block's hash value and especially, the timestamp. Time stamp makes the platform immutable, helps in maintaining the merkle root (it's the hash of all the hashes of transactions in the blockchain network) possible and nonce (number only used once). The elements of a block and its working are depicted in Figs. 1 and 2 respectively.

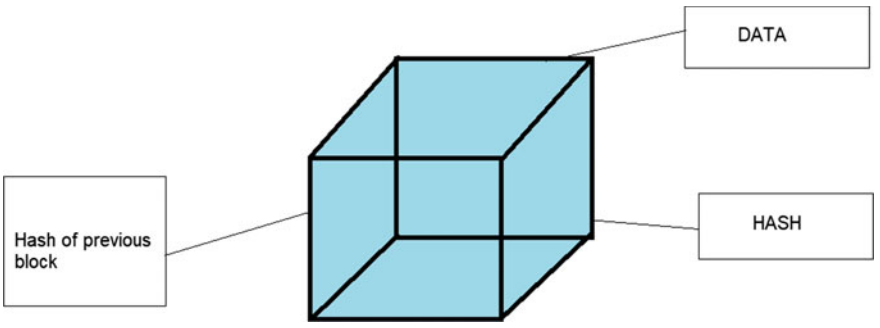

Fig. 1 Elements of a block

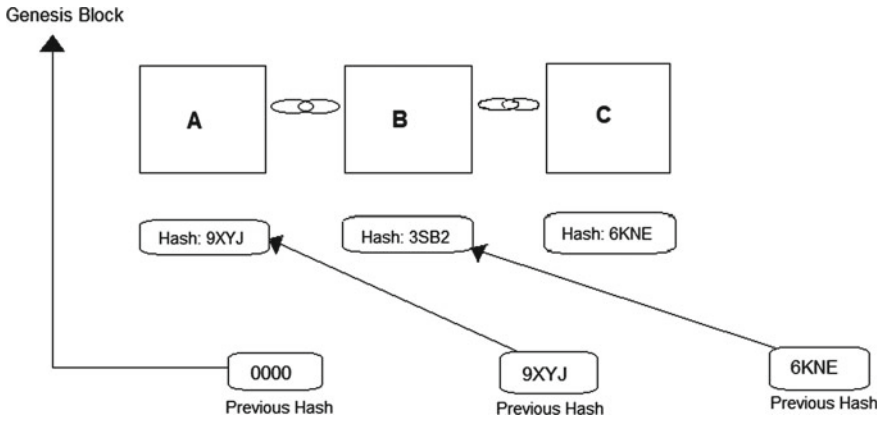

Fig. 2 Working of blockchain

Here, each block will carry its own unique hash value which is generated by passing its data through cryptographic algorithms. We can't decrypt the hash, but the same data will always give the same hash. Along with its own unique hash, the blocks will carry the preceding block's hash value which will create a link between the blocks. Thus, a chain is developed. That is why it's called a blockchain. The root or first block in the chain is called Genesis block.

Due to the connection between all the blocks, if anyone tries to tamper or change the data in any block, it will immediately result in generation of a new hash which is different from the value stored in its successor block. This will result in contradiction of all successive blocks. Figure 3 represents the modified state of the blockchain after tampering.

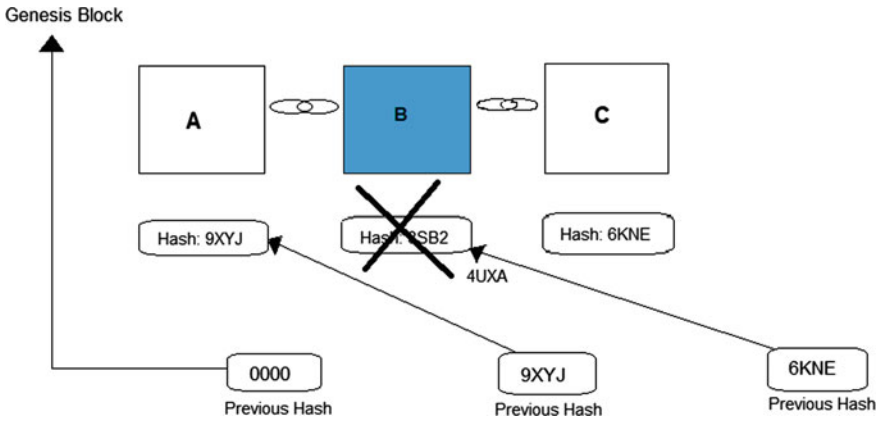

Fig. 3 Modified state of blockchain after tampering

4 Proposed System

The verified researchers across the globe can have their own unique User_ID and each of the known pathogens can have its own unique Pathogen_ID. First, a block is created for each pathogen based on their Pathogen_ID by a registered user which contains all known information about the pathogen like its structure, characteristics, methods of treatments for the diseases caused by that specimen. New blocks can be created by the researchers who are working in the field to record newly discovered information about the same.

Viruses can be a bit tricky to deal with because of their ability to mutate. So we need a function that can catalogue the new genetically evolved variations of the already existing virus. Information such as new changes in their structure, behaviour, symptoms, method of transmission and measures to counteract them. Continuous study of the other pathogens like bacterias, prions, protozoans etc. also leads to new discoveries that were previously unknown. So, the system should also have the ability to create a new block of data which contains a reference to the original block with the previously known information about the pathogen. In the new block, the documents containing the newly discovered data are added.

Registered doctors and scientists who require information about a particular virus, can use their User_ID to access the network and search using the Pathogen_ID to easily avail all the known facts about the pathogen and the results of the latest studies of the same from verified doctors and scientists across the world. This can make the process of information retrieval much easier and can accelerate research thereby effectively reducing the time required to develop a viable cure.

4.1 Proposed System Algorithm

```
Function create_Account() // creates a user account
Check the authenticity of the user
Assign unique UserID
End function

Function add_new_Pathogen(consists of documents and research data)
//creates a new block for storing the information about newly
discovered pathogen
Check(Requester = = valid UserID) if yes
Generate new unique Pathogen_ID
Create new block for the specific Pathogen_ID
Insert the Documents and data to the block of the specific
Pathogen_ID
Else
Abort session
End check
End session
End function
```

```
Function add_new_information(consists of documents and research
data) //function to add newly discovered information about a
specific pathogen
Check(Requester = = valid UserID) if yes
Check(Pathogen_ID = = true) if yes
Create new block with the specific Pathogen_ID
Insert the Documents and data to the new block
Else
Abort session
End check
End check
End session
End function

Function retrieve_information(Pathogen_ID) //to retrieve informa-
tion from the network
Check(requester = = valid UserID) if yes
Check(Pathogen_ID = = true) if yes
get documents and research data from stated Pathogen_ID
return (documents and research data) to the account that requested
for the documents
else
Abort session
end check
end check
end function.
```

5 Result

The function add_new_Pathogen() can store the details of newly discovered pathogens. Initially, our algorithm had a separate process for dealing with viruses by initially creating a block with the initial state of the viral strain and then adding on blocks with the data of the mutated strains. But, since we keep discovering new information about all types of pathogens, a universal function to add new information was the next logical step. So, the separate functions for viruses were removed and we added a function add_new_information() which could be used to add any sort of information about any pathogens. These newly added blocks must contain the same pathogen_ID, so that when a user asks for information, the data in all blocks with the same pathogen_ID can be returned. Therefore, in theory, this algorithm can store the details of pathogens in an immutable way, which can easily be accessed by authorized researchers and healthcare personnel from all over the world, thereby providing a much faster and efficient method to transfer sensitive data.

The current limitation for the development of such a system is the factors like processing power and cost. The systems that integrate blockchain technology into their framework can slow down when a large number of simultaneous users. To overcome this issue, we would need more powerful processors than those that are easily available in the market. The cost of implementing the same is also high. More

advanced and economic technology would be required to implement such a system with maximum productivity.

Through our paper we managed to convey the logic and idea about the application of blockchain in the field of analyzing viruses and pathogens. Our main idea was to make an easier way to access sensible and validated data (about virus and pathogens) in emergency situation like current corona virus pandemic. And theoretically we succeeded in development of an algorithm for that.

6 Conclusion

Currently, there is no existing system that provides such a service. The type of data we are dealing with is highly sensitive and therefore the secure and tamper proof nature of the blockchain networks come in handy. This system ensures the confidentiality, reliability and easy availability of the data to authorized personnel. Such a system can help to avoid future pandemic scenarios and keep casualties minimal, as the identification of new and potential threats could be notified to the officials like WHO. They can take necessary precautions in time to isolate the pathogen and quarantine the area before it can be of any risk to the public. Such a system can also be a great helping hand for the researchers in the medical field who are trying to develop a cure for the diseases caused by these pathogens, as the system can provide them with large amounts of reliable information which helps to accelerate their research. In the abundance of such information from different perspectives, there is a possibility that one may predict certain mutations or characteristics of pathogens such as viruses.

This algorithm is open to modifications and can be implemented using much more powerful systems and huge datasets.

Acknowledgements We would like to express our sincere gratitude to those who have helped us directly or indirectly for this work. We could not have done this without the constant support of Dr. Maya L. Pai, who provided us the opportunity to work under her guidance with constant motivation, support and mentoring.

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Smart Trolley Based on RFID

Meyyappan Chindamani, C. Keerthi, M. Madhumitha, and P. Khreethi

Abstract In this present scenario, the purchasing and shopping have become a routine practice for the people all over the world. After the completion of shopping the bill will be prepared by the cashes using the bar code reader. This process consumes lot of time has led to the long queue in the shopping malls and markets. The short reading distance, visibility, changes to be impaired by the moisture operation, packaging counters, reduces the reliability of the bar code. In spite of these detriment, requirement of the human resource adds to the overall expenses of the existing system. To overcome these defects, we have proposed "Smart Trolley based on RFID" to assist people in shopping. The Automatic billing of product is a low cost technology which is easily scalable and rugged also. The proposed system consists of EM-18 RFID reader, At mega 328 micro-controller, GSM SIM800 module, LCD display. RFID tag has unique number which is confined to each product in the market. Once these information are fed to database RFID becomes readable and are read by the reader and information is displayed in LCD through micro-controller. At the each time when product is added to the cart, the amount of the product gets added to the bill. Finally the total bill is sent to the buyer's registered number. So that the buyer can pay their bill in cash counter and check out. Thus saves the time for both seller and buyer. The time to time upgradation of the bill is shown in the LCD display which makes the shopping feasible. The prototype developed can be commercially deployemented.

Keywords ATMEGA328 · EM-18 RFID reader module · GSM SIM800 modules · Smart trolley · Shopping feasible

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1 Introduction

Gathering of people at a common place or shop for buying the products of their need is known as shopping. The shopping method have evolved over the years. In olden days it is the manufacturer or seller user to take products and roam in search for the buyer. But in present with the growing demand of the people and advent of technology the shopping pattern have changed largely. The concept of shopping paved the way for the growth of the business. From such traditional practise, today the mode of shopping has gained new form and process. In the past the number of shops was much lesser. The cheaper availability of the product and the increasing purchasing power of the man kind laid foundation for the growth and blooming of the markets. Then due to such increasing markets, increased the theories and researches in the field of shopping. People started crowding at the stores, the managerial level started to identify the smart way to control and manage these huge people in a efficient manner. Thus the different techniques were used at the stores to save time of the customer and owner such as door delivery [1]. This system is more advantageous because it is easy to implement, account information, transmission is secured, disputes related are easy. The proposed system can be made to interface with wireless technologies [2]. In 1970s arrived the new concepts of clustering the stores in a building called malls with that came into existence the bar code technology. This made a vital change in the existing system. The efficiency of the system increased [3]. Since the effective technology is combined with the wireless network the system has been produced with reliability, eliminating an overhead to the communication. LCD can be provided to get the exact information of the product.

It greatly helped the industries in the movement of the goods from one place to another. It made a convenient way to maintain records in digital and software format. As it was used friendly, many companies relied upon this. With the advent of supermarkets in the large cities to sophisticate the shopping, the trolleys were introduced. Shopping became as one regular chore of the human in which he spends his considerable amount of time. As per the report of US Bureau of Labour [4] on an average human being spend 1.4 h everyday on shopping. A survey by Visa in 2005 points out that an amazing 70% customer will walk out of the queue if the line is too long, and 10% are "seriously annoyed" the moment they step in queue [5]. In the current scenario shopping classified into two types as Shopping in-person and shopping in absentia. The later represent the internet shopping, tel-shopping etc. It is the type of shopping where the physical presence of humans are not required. Shopping in person means personally approaching a shop to buy various products based on the needs, convenience, etc. The proposed system assist people in shopping by minimizing the time spent in the shopping and assist the management of the larger shops with the faster update of the product information. The new technologies such as RFID, GSM module, makes the process of the shopping easier, efficient and reliable. To overcome the such mentioned problems during shopping, we have proposed this system that can be employed in the shopping malls. For the identification of product the RFID is employed. To aid the customer in the server related into GSM module is

used. The LCD display is equipped in the smart cart to assist the shopper in product related information such as name, price and bill. During the purchase of the customer, whenever he/she drops or picks out product from the cart, the RFID scanner quickly detects the product. Then according to the will of the customer that product can be added to the bill or eliminated from the bill. As soon as customer finishes his/her shopping, the end button can be pressed which indicates the end of the shopping. After this the total bill will be displayed in the LCD and same will be sent to the customer's registered mobile number and the server of the shop. Thus shopping completes by just making the payment. "This shopping cart will change the way people shop as radically as ATM's changed banking". The expected positive outcomes are that it would reduce the number of staff, increase the operational efficiency of the shopping process friendly, time saving, and even smarter.

2 Methodology

The RFID tag is attached to every product and each RFID tag has its own unique Id. The details of the items to which the RFID tag is attached is stored in the database. So each tag is confined each product in the supermarket. The details of each item is updated in the micro-controller memory with the unique number of the RFID tags. SIM in the GSM Module acts as an owners mobile number to which the user number will be registered and the total bill will be sent. Each item in the market is attached with the RFID tag to which all the details of the product are confined. This database is stored. The micro-controller used as a storage for database. The comparison of the scanned and stored items also can be performed. It also act as a temporary storage for the bill being generated. On the scanning of the each product, the details of the scanned tag is compared to database. If the scanned item already stored it is recognized and added to the bill. If the item does not exist it will be rejected. There is a provision for the addition and delete of the items according to the desire of the customer. After the completion of the shopping, by pressing the "end" Push button the final bill is sent to the customer for the easy paying of the cash. The block diagram is shown in Fig. 1. The methodology is shown in the Fig. 2 as flow chart.

3 Implementation

3.1 Registration of Mobile Number

When the customer switches on the micro-controller and GSM the "welcome" will be displayed in the LCD screen. Then, the mobile number of the shopkeeper will be displayed in it (see in Fig. 3). The user has to send his mobile number as a message

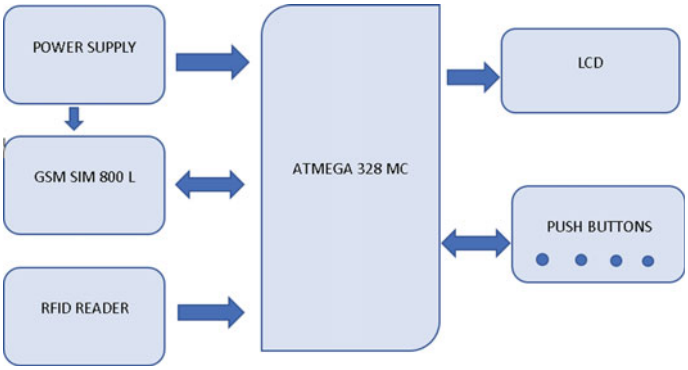
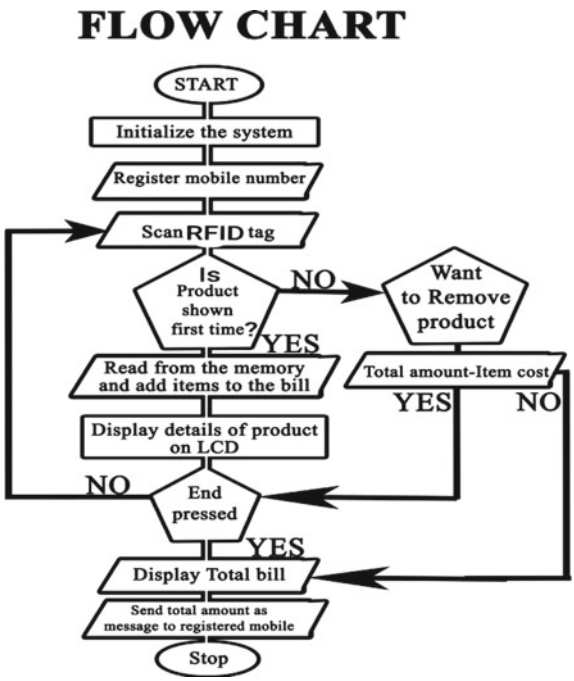


Fig. 1 Block diagram

Fig. 2 Flowchart



to the owner's mobile number which is displayed in the LCD. The registration of the user mobile number is confirmed through a reply message as "registered" to the user mobile (see in Fig. 4).

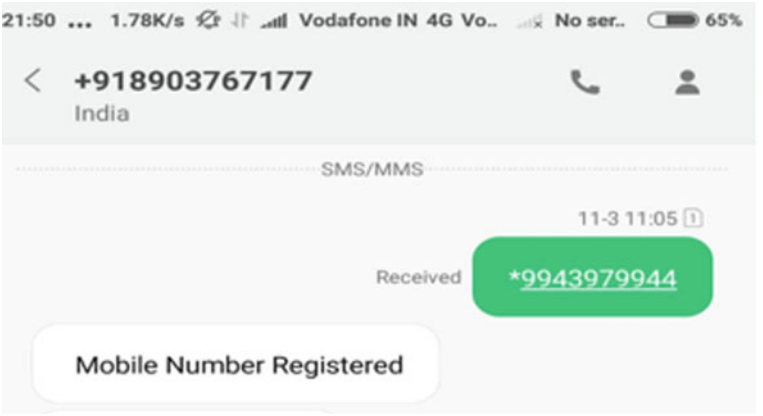


Fig. 3 Customer mobile display

Fig. 4 Implementation

3.2 Shopping Process

After the registration, the customer can start shopping. The RFID tag in each product has to be scanned in the RFID reader attached in the trolley. There is a unique ID for every RFID tag. These unique IDs contains the details of very unique product. Then these details are fed to the database. When the shopper drops any products the RFID reader detects that product with the attached RFID tag. In the LCD screen the product information is display which has been extracted from the memory. Whenever the product is added, the bill gets updated automatically. Once the tag is scanned the details of the product such as name, cost will be displayed in the LCD display. On the addition of ever consecutive products to the cart, the price of the same product will be added to the total bill. The above process is repeated until the customer completes

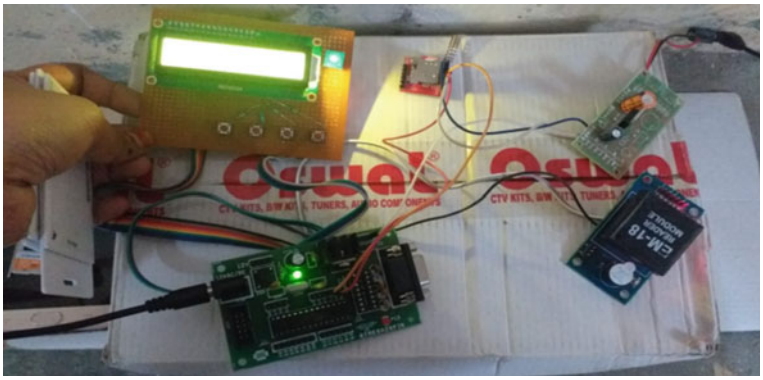


Fig. 5 Snapshot

the shopping. If the buyer wishes to delete any item from the cart then same has to be scanned again in the RFID scanner then the message will be displayed asking as "whether to remove" so that item will be removed after the confirmation.

3.3 Generation of the Bill

After the finishing of the shopping the "end" button has to be pressed. Then the total bill will be sent as a message to the customer. By showing the message the buyer can pay the bill and check out of the store. The implementation is shown in Fig. 5

4 Hardware Description

4.1 ATmega328

ATmega328 is an micro controller which belongs to the type of Advanced virtual RISC. 8 bits data will be supported to At mega 328. It is one of the cost efficiency micro-controller. As it has low power dissipation, it is employed in the many real time projects for the security purposes, programming lock is used. It has real time counter with separate oscillator which adds to its feature. All these parameters makes the Atmega328 best suited micro-controller for the proposed project.

4.2 EM 18 RFID Reader Module

The ID information that are stored in RFID tag are read by this module. Each tag contain unique information, that are not replicate of any other. It is also used like sensor module. Before switching power to the system, the mode of communication between MODULE and CONTROLLER has to be programmed to receive data from the module**.** For detecting the products with RFID tag this module is employed.

4.3 SM800L Module

This module is known as the GSM modem's miniature. The central part of the module is a SIM 800L GSM cellular chip. The module usually comes with a **Helical Antenna**. At the back, there is a SIM socket, an 2G micro sim card which is activated will work it. It can be used to Send and receive SMS messages. To show the status of cellular network, there is an LED on the top right side of SIM 800L cellular module. So, it is chosen for transmitting data of the bill after shopping in this project.

5 Results and Conclusion

Each RFID were used to represent the each distinct products that are being shopped. The RFID card reader reads the each RFID tags during the scanning of tags. By doing so the details of the products such as name, price will be displayed in LCD and will be stored temporarily. Once shopping is over and "end" button is pressed, the LCD will display the total bill by extracting it from memory and copy of the same is sent to the customer's initially registered mobile number (in Fig. 6).

The following test was carried out to prove the working of proposed system.

1. Identify product based on the RFID tag
2. Process of automatic billing
3. Displaying the correct details of the products
4. Complete listing of the purchased products
5. Total bill calculation and being sent to the customer
6. Automatic upgradation of bill during the addition or removal of the product from the trolley.

All these criteria were successfully tested. The developed system is friendly to adapt and use. It doesn't require any special training for the usage. The aimed objectives were achieved in this developed prototype model. This proposed system can be used in malls, supermarkets and can be employed in both retail and wholesale stores as it saves time, energy for both customer and shop owners.

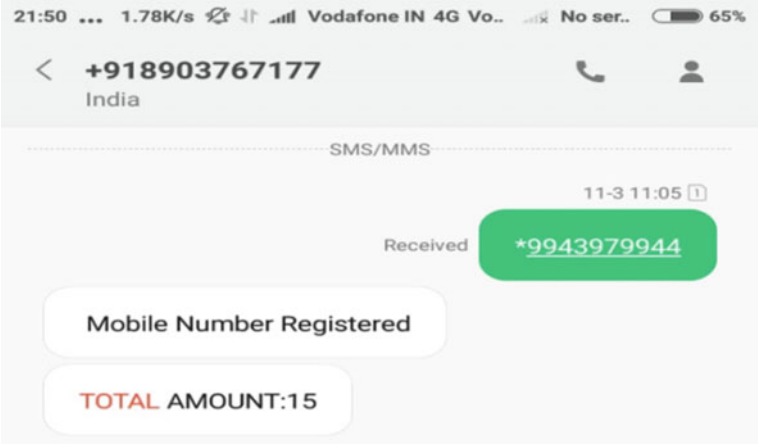


Fig. 6 Output

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A Review on Distributed Data Vending Through Blockchain

Stephen Dias, Shubham Gawade, Pranav Goel, Piyush Bhujbal, Balaji Bodkhe, and Mahesh Shinde

Abstract The paradigm of Data vending has been one of the most innovative concept that have been implemented on the distributed system scenario. The Data vending approach is highly beneficial for the purpose of enabling effective and efficient usage of the data throughout the world. But there are a few downsides that have been noticed about the concept of Data vending As the Distributed systems have a lot of sensitive and personally identifiable information, it is problematic to share with untrusted institutions. Therefore, this creates mistrust between the Data vendors and Data Aggregators. To eliminate this effect and provide a solution for this problem, this research article outlines related works on the paradigm of data sharing. The devised approach overcomes the security concerns through the implementation of an effective access control mechanism through the utilization of the Distributed blockchain framework. The technique is designed to implement NLP protocols along with the RCC Encryption algorithm to achieve effective and secure access control mechanism for the Data Vending platform. This approach will be elaborated in the future researches.

Keywords Blockchain · Distributed systems · RCC symmetric encryption

1 Introduction

This research article has analyzed a number of approaches for the purpose of enabling private and reliable techniques for data sharing. These approaches have been instrumental in reaching the design of our approach for effective data sharing and access control mechanism that is private and highly reliable. To improve the privacy and security of the data the implementation of the distributed blockchain framework has been envisioned. The blockchain platform is a distributed ledger system that utilizes blocks of data that are chained together to the use of hash keys. This allows the data to be effectively stored in the form of a chain. This chain is made up of hash keys

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of the previous blocks of data combined with the consecutive blocks of data. This allows for effective tamper-proof protection of the data being shared with the data requestor.

Data is the most useful resource in this day and age of information. Data is one of the most valuable resources that allow for the effective implementation of various approaches in a plethora of different applications. Due to the introduction of the internet platform, there has been an increasing amount of data that is been generated all over the globe. This data is being generated on various web portals and other web pages such as social media platforms, e-commerce websites, and other Web Services offered on the internet. These services are highly essential and have been utilized by a large number of users across the world. These uses except the platform and generate massive amounts of data every day.

The increased affordability of the internet platform has also been one of the prime reasons for this increase in the users of these Web Services. These services have now become highly essential for enabling communication and Commerce along with various other objectives for the users. The ease and the convenience offered by these approaches have been the primary reason for the massive user base on these web applications. The data being generated on these platforms reaches the maximum amount every single day. This data is in the form of media textual and other file formats.

This data is highly valuable in various applications especially for use in machine learning or artificial intelligence approaches. Machine learning approaches are one of the most vital and essential techniques to enable an in-depth understanding of a particular problem or occurrence. The full potential of the machine learning algorithms these algorithms need extensive amounts of data. With the massive amounts of data being generated, there isn't a shortage of data for implementation in various approaches. This data can provide valuable insight into the inner workings of the process which can be useful for the implementation of various improvements and enhancements on those procedures.

To provide a solution to all of these problems a large number of researchers performed for enabling effective data vending strategies have been analyzed in this research article. These approaches have provided an assessment of the conventional approaches to be utilized for sharing the data between the data vendors and the data requested. This procedure has assisted in the further development of an approach that implements natural language processing and RCC encryption along with the distributed blockchain platform. The blockchain approach is significant in providing tamper-proof security to the data that is being shared with the requester. The distributed framework utilizes hash keys that provide very high integrity to the data which can be easily assessed by looking at any presence of the Avalanche effect. The presence of the avalanche effect in the hash key is generated by the blockchain is an indicator of any tampering being done to the data which can be easily detected hence protects the data and provide a reliable and useful data vending approach.

This literature survey paper devotes Sect. 2 for analysis of past work as a writing study, lastly, Sect. 3 finishes up the paper with hints of future improvement.

2 Related Works

A. Lertpiya et al. presents assessing five basic Thai NLP undertakings on a UGWC corpus. Using Thai NLP algorithms called entity recognition, sentence segmentation, word segmentation, word error detection and word variant detection, these errands are created. For future exploration execution between their informational collection and others are contrasted as direction and attempt to make the framework work all the more effectively [1]. The NLP thesis is currently working on real web details and focuses on words or phrases that are formally written texts with nearly correct spellings and boundaries. For named object recognition and term variant/error detecting functions, the scheme yields an accuracy of 0.93 and 0.53.

G. Zhuo et al. states in recent year's smartphones phones are getting increasingly advanced. Because of this headway of smartphones portable publicly supporting conceivable where the undertaking proprietor can demand information from the laborers by utilizing the smartphone [2]. When information volume is amazingly immense the issues emerge, for example information accumulation, information assortment and information investigation. Set operations like union, intersection and complementation are processed in most big data analysis. In the proposed framework the creator actualized clump check and information update techniques which assist with decreasing the computational expense.

K. Yang et al. portrays that to perform assignments with the human association and amazing smartphones the standards of publicly supporting apply a promising organization engineering by utilizing a mobile crowdsourcing network (MCN) [3]. They additionally tackle the issues, for example, basic security and protection issues MCNs. In proposed paper researchers planned casing by involving both publicly supporting detecting and publicly supporting registering then after they took care of a few basic security and protection challenges. The author's point is to bring more heed to security and privacy ideas for mobile crowdsourcing networks.

J. Zhou et al. presents for decentralized applications blockchain advances have given energizing chances, for example, blockchain-based smart contracts empower valid exchanges without approval by outsiders. Lately, numerous specialists have acquired an interest in the field of blockchain [4]. In the proposed study individual information can be safely traded in appropriated information distributing by utilizing blockchain. Appropriated information distribution can be utilized in healthcare by empowering data distribution from proprietors and its accumulation. They have executed the system of distributing electronic medical records on a blockchain.

J. An et al. characterize that crowdsensing has become an inexorably conspicuous element due to advantages such as high convenience, low cost, and rapid speed in completing tasks. It is extremely hard to assess the nature of the information gathered through crowdsensing. As of late actualized crowdsensing framework is generally founded on a central platform that can't be completely trusted and furthermore numerous issues [5]. Subsequently, the mentioned paper followed a response by applying methods of node matching (MNM) and quality grading evaluation (QGE) techniques solely to help task distributors acquire higher-quality sensing knowledge.

D. Peng et al. presents crowdsensing as one of the quickest developing applications that open numerous ways for mobile devices with improved detecting capacities to gather and to share local data [6]. To understand the capability of crowdsensing numerous applications are grown, for example, noise pollution assessment, environmental quality monitoring, bus approach time prediction road-side parking demographics and road and traffic condition monitoring. Crowdsensing applications require manual labor and physical resources for processing, sensing, and transmitting data. The analyst expresses the proposed paper is intended to enhance and approve our component for real-world applications.

A. Azaria et al. proposes to deal with electronic medical records EMRs epic, decentralized record the executive's framework is actualized utilizing blockchain modernization [7]. The framework provides patients with a far-reaching, uniform record and easy access to their clinical information across locations for purveyor and treatment. Privacy, responsibility, and information sharing is overseen by the MedRec by utilizing the blockchain properties. The design of the system indicates providers' existing, facilitating interoperability, local data storage solutions and making their system suitable and flexible.

J. Huang et al. accuses the conventional unified design of crowdsensing frameworks confronted the issue, for example, security spillage and single purpose of disappointment [8]. Because of malignant clients' involvement denial of service (DDoS) and Sybil assaults were achieved. The creators planned a group detecting framework dependent on a blockchain that can eliminate the security and protection give well. Just to beat the conventional group detecting frameworks which as low security and low assistance they executed a blockchain-based crowd-sensing system (BCS) by giving a solid blockchain-based answer for a known logical issue.

R. Ouyang et al. presents in quantifiable crowdsourcing applications including large or streaming information to address the successful and adaptable truth disclosure issue. It is convincing and adaptable to the proposed parallel algorithm and a streaming algorithm [9]. The complexity of time and space of the presented methodology is calculated. They also evaluated the performance of these presented truth discovery algorithms on both real-world and non-natural human made datasets. Along these lines they have actualized new equal and streaming truth discovery algorithms for quantifiable crowd-sourcing applications.

H. Duan et al. describes crowdsensing frameworks for a wide variety of people and Internet of things technologies are useful in terms of entering the knowledge of the crowd and the sensing capacity of smart phone devices that can be applied for environmental monitoring, medical control and smart transportation [10]. For data collection and distribution, traditional crowdsensing solutions have to rely upon a centralized third-party platform. The arising blockchain innovation comes as an elective plan space for building crowdsensing frameworks. A blockchain is a structure of distributed and immortal data superintend by a consensus algorithm that is running over a convolution network.

Jinliang Xu et al. clarifies by using the knowledge of groups or circulated PCs swarm insight attempts to assemble, measure, derive, and discover huge helpful data that has extraordinary capability in the Industrial Internet of Things (IoT). The

ecosystem of crowd-intelligence involves three collaborators that include individuals, sensors, or processors. The proposed paper introduces an inaccurate crowd-intelligence ecosystem focused on the fundamental focus on decentralization by the use of edge registration and blockchain innovation [11]. The presented ecosystem using blockchain automation and deploy it in a real mobile.

D. Dang et al. provides a general algorithm for assessing labor efficiency that can be requested without pre-created solicited for any crowdsourcing tasks. In the Hadoop platform, they have actualized the proposed algorithm using the programming model MapReduce to satisfy the interest of fair assessment for concurrent evaluation for a multitude of breadwinner in a big data frame of reference. The proposed model of the algorithm is thus precise, with better reliability and performance in a big data environment [12]. In this aspect, the distributed problem solving and development paradigm. Just because of this, the crowdsourcing framework has started to be used for more investments and ventures.

3 Proposed System

The presented system for the purpose of achieving an effective and useful implementation of the Data Vending approach through the use of the Blockchain Framework (Fig. 1).

The System consists of a collection of modules that facilitate the approach in reaching its goals for the purpose of effective data vending. These modules are elaborated in detail in the section given below in the form of steps that are performed sequentially.

Step 1: Registration and Activation of the System—The proposed methodology is designed to be implemented in a distributed system with multiple machines. The system can also be based on a simulation that is implemented on a single machine. There are roles that are designated in this approach which need to be fulfilled to achieve the effective data vending approach. The three roles namely, are the Decentralized Server, the Worker and the Task Provider. The administrator is in charge of maintaining the decentralized server. An effective Graphical user interface is designed for the admin as well as the various actors of the approach to interact with the system.

Step 2: Uploading Task and RCC Encryption—The task publisher utilizes the Graphical user Interface to authenticate and gain access or authorization to the image. The task publisher can now select the task to be provided to the workers and upload it using the Publisher Interface. Once the task has been uploaded in the form of a text file, the contents of the same are encrypted effectively using the RCC or Reverse Circle Cipher approach. The effective encryption allows the data in the task to be secured against any tampering or disturbance. The uploaded and encrypted file is provided to the distributed system for circulation and distribution to the workers.

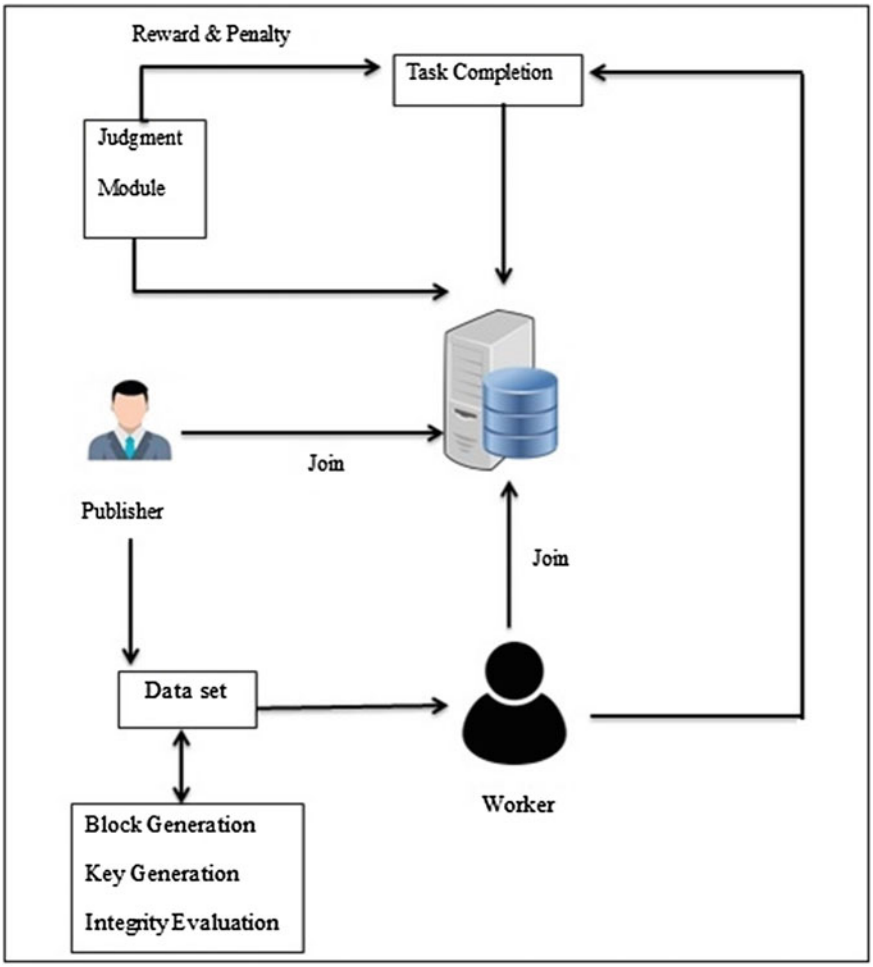

Fig. 1 Proposed system

Step 3: Blockchain Creation and Integrity Maintenance—This is the most essential module of the entire procedure which can be used for the purpose of achieving a secure system for the purpose of data vending. The Encrypted task is provided as an input to this module. The name of the file and the contents are provided as an input to the decentralized server. The contents of the file are effectively segregated and the hash keys are calculated for the same. These hash keys form the head key of the blockchain. These hash keys are utilized for the purpose of performing integrity evaluation and are effectively stored in the database for future use to detect the presence of an avalanche effect.

Step 4: Task Accessing—The worker utilizes the Graphical user Interface to access the system. The worker provides the username and password for the authentication. After successful log in, the worker then searches a particular task that he/she can perform. The query is passed to the system which effectively preprocesses through the use of 4 steps, namely, Special Symbol Removal, Tokenization, Stop word Removal and stemming. After effective preprocessing, the linear search is performed to search the appropriate task.
Step 5: Reward, Penalty assignment—The task after being uploaded by the task publisher and the requisite task after being accessed by the worker. The smart contract approach will be utilized for the decryption of the encrypted task for the worker and the respective keys are shared between the worker and task publisher. Based on the performance of the worker and the completion of the task, a requisite reward or penalty is issues using Shannon information gain and classified using the Decision Tree approach.

4 Feasibility

The feasibility of the system refers to the effective implementation and deployment of the system. The ease with which the system can be deployed and its ability to execute in the desired target. The feasibility can also be defined as the capability of the system to meet the needs of the user and work as intended. This type of analysis is necessary to achieve effective and useful information about the real life execution of the system. This analysis is also highly useful to achieve an effective realization of the practicality of such an implementation that is needed to realize the workability of the approach. There are certain segregations when.

Technical Feasibility: The technical feasibility is one of the most important parameters to determine the technical outcomes of the approach. The technical limitations are highly necessary to achieve an effective and useful implementation in different environments. The technical feasibility needs to take into account the minimum requirements of the system for the deployment purposes. The NetBeans Integrated development Environment is used to implement the approach.

Economic Feasibility: The proposed methodology has been designed using the NetBeans IDE and the database responsibilities are covered by the MySQL Database server. These software are open sourced or have an effective free version so the implementation is highly economical.

Deployment Feasibility: The prescribed approach utilizes Java Programming Language which is environment independent. Therefore, the installation of the approach is straight forward and can be understood and operated by a layman effectively and in a very short period of epoch time.

Time Feasibility: The time feasibility discusses the time that is required to complete the project and get the results effectively. The project has been elaborated with all

the requirements that have been chosen to be highly time specific and to achieve the goals in the least possible time with high accuracy and low chance of failure.

5 Conclusion and Future Scope

For the purpose of data proliferation, the various data vendors and aggregators accumulate data on a particular paradigm that can be provided for different implementations in algorithms and other insightful processes. But there are certain inconsistencies and problems with this approach the various data vendors and data requesters have a very low amount of Trust between them. This leads to an obstacle for effective data sharing that can be detrimental to the paradigm of data vending. Therefore there is a need for an effective approach that can provide a useful security privacy and access control mechanism for the data being shared through the data vending approach. Therefore, an approach data sharing is being formulated Blockchain and RCC encryption. The envisioned idea will be expanded in our future researches.

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Ear Recognition Using ResNet50

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Abstract Deep learning techniques have become increasingly common in biometrics over the last decade. However, due to a lack of large ear datasets, deep learning models in ear biometrics are limited. To address this drawback, researchers use transfer learning based on various pre-trained models. Conventional machine learning algorithms using traditional feature extraction techniques produce low recognition results for the unconstrained ear dataset AWE. In this paper, an ear recognition model based on the ResNet-50 pretrained architecture outperforms traditional methods in terms of recognition accuracy in AWE dataset. A new feature level fusion of ResNet50 and GLBP feature is also experimented to improve the recognition accuracy compared to traditional features.

Keywords ResNet50 · Ear recognition · GLBP · KNN · Deep learning

1 Introduction

In today's society, establishing an individual's identity through authentication is a major issue. Traditional authentication credentials are primarily knowledge-based or token-based. Biometrics is a mechanism for individual authentication using his/her biological or behavioral characteristics. Research in biometrics is based on various modalities like face, gait, iris, and palm print. The ear has emerged as a reliable biometric among various physiological biometric traits in recent years. Traditional ear recognition uses mainly geometrical, holistic, local or hybrid ear features. The major problem with classical machine learning approach is the selection of suitable features and classifiers. Traditional features and classifiers gave low recognition accuracy for unconstrained dataset AWE. Deep learning have shown notable performance in a variety of tasks in recent years [1–3].

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The number of deep learning models in ear biometrics is comparatively smaller due to the lack of large ear datasets. To solve this, many researcher's devised models focused on transfer learning using pretrained networks and the concept of data augmentation [4]. In transfer learning, the model used for one problem can be reused for another problem. In image processing, convolutional neural networks are the most common and efficient deep learning architecture used. Several CNNs that have been pre-trained are now available for various recognition tasks [2, 5, 6]. In this paper, the ear recognition is performed using the pretrained model ResNet50 on AWE dataset.

2 Related Works

This section explain ear recognition using classical features and deep learning methods. Feature extraction using classical methods are mainly classified into four [7]. Geometrical methods use shape and structure of ear for recognition. These methods were used in early contributions of ear recognition [8, 9]. Edge information is mainly used for classification in these approaches. Geometrical methods are simple but studies reported low recognition results using these features. Holistic approaches extracts features from the whole ear and example include principal component analysis and linear discriminant analysis etc. [10]. When using unconstrained datasets, holistic methods have poor recognition accuracy. Majority of ear recognition works is based on local and hybrid methods. In local methods, ear image is first divided into different regions and local features are extracted from these regions. Different local features include HOG, LBP, LOOP, LPQ etc. Hybrid approach uses combinations of various features and methods for better results. Several ear recognition studies reported high recognition results using local and hybrid methods [11–13]. The main problem with handcrafted methods is the selection of proper features and classification methods. In [7], the authors experimented different local features like LBP, BSIF, DSIFT, RLPQ, POEM etc. for feature extraction in AWE database. POEM feature reports maximum of 49.6% Rank1 recognition accuracy on AWE dataset.

CNN-based deep learning approaches have recently been used in a variety of applications. For transfer learning, pre-trained CNNs are used. AlexNet [2] is the first CNN model to achieve greater accuracy in the ImageNet challenge. Deep learning models in ear biometrics are few in comparison to other biometric modalities such as face and finger print. The first CNN architecture focused on ear is presented in [14]. Transfer learning is done on the pretrained architectures AlexNet, VGG-16, and SqueezeNet. The experiments is conducted on combinations of images from CVLED, AWE, and 500 images from internet. SqueezeNet architecture reported the highest rank1 accuracy of 62% on these dataset. In 2017 [15] and 2019 [16], two unconstrained ear recognition challenge (UERC) were conducted for recognizing people in an uncontrolled setting. The goals of the challenges is to find a descriptor that fits well in unconstrained datasets. Many researchers took part in both challenges, creating models based on traditional features and deep learning approaches.

Hansley et al. [17] developed an ear recognition system by combining features from a CNN model with handcrafted features. The experiment is conducted on different constrained and unconstrained datasets On the AWE dataset, fusion of CNN + HOG generated the highest Rank1 recognition rate of 75.6%.El-Naggar and Bourlai [18] used deep architectures AlexNet, GoogLeNet, SqueezeNet and MobileNetV2 for ear recognition. The experiment was conducted on WVU dataset and MobileNetV2 reported maximum accuracy of 95.67%

3 Selected Features and Models

This section describes the selected features, models and the dataset used for feature extraction and classification.

3.1 GLBP

Gradient local binary pattern (GLBP) is a variant of LBP feature extraction method used mostly for human detection [19]. GLBP feature is obtained by combining gradient and texture information together. Since GLBP is a local feature, the input image is cut into several blocks for feature extraction. GLBP uses both pixel and gradient values for encoding local texture information and the final feature vector of GLBP is of dimension 5880.

The $GLBP_{P,R}$ operator is defined as follows:

$$GLBP_{P,R}(x_c, y_c) = \left[\sum_{p=0}^{P-1} \left(s\left(g_p - g_c \times 2^p\right)\right) \sum_{p=0}^{p-1} \left(\left(s\left(m_p - m_c\right) \vee f\left(d_p - d_c\right)\right) \times \left(128 + 2^p\right)\right)\right] \quad (1)$$

where

gp and gc	denotes the surrounding 8 pixels and centre pixel.
mc and mp	denotes the magnitude values of 8 surrounding pixels and centre pixel.
dc and dp	denotes the direction values of 8 surrounding pixels and centre pixel.

3.2 Resnet-50

ResNet is the short form of Residual Network [6]. Residuals are subtraction of feature learned from input of that layer. ResNet does this using shortcut connection and is easier to train. ResNet50 is a variant of ResNet model that consists of 48 convolution layers along with 1 Max Pool and 1 Average Pool layer. The input to ResNet50 model is of dimension 224 × 224. In the proposed work ResNet50 is used for both feature extraction and classification.

3.3 KNN

K-nearest neighbours (KNN) algorithm is a simple supervised learning algorithm that is most commonly used for classification problems [20]. The KNN algorithm assumes that element of same class exists in close proximity. The idea of similarity is captured as distance, proximity and closeness. The experiment used the "brute" algorithm in KNN for a brute-force search to compute the nearest neighbors. The proximity calculation is done by measuring the distance using the Euclidean distance. Different values of K is experimented to find the optimum value.

3.4 Data Set

Available dataset for ear recognition is classified into two types constrained and unconstrained. In constrained dataset, the images are captured using controlled settings and there is limited variation in rotation, illumination and occlusion. Recent works in ear biometrics uses the unconstrained datasets. In this paper, the unconstrained ear dataset AWE is experimented [7]. AWE include 1000 images of 100 subjects. Each subject contains 10 images with different size, illumination, occlusion, gender and quality. Figure 1 shows sample images in AWE dataset. When deep learning is considered, the size of AWE is very limited. Data augmentation techniques are used to increase the size of training data. ImageDataGenerator class in

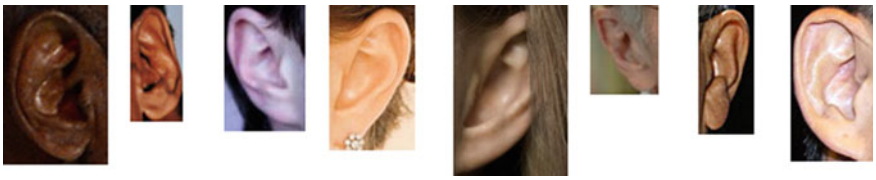

Fig. 1 Sample images from AWE

keras is used for data augmentation. Data augmentation includes rotation, change in width, height, zoom, shear, horizontal flip, and fill mode ('nearest').

4 Experimental Results and Discussion

The experiments were conducted using the deep learning architecture Keras with Tensorflow on Intel i5 processor with 4 GB RAM. The pretrained deep CNN architecture ResNet-50 is used for transfer learning. The images from AWE dataset is of different dimension. All images in the dataset are size normalized to 224 × 224 as a preprocessing phase before being fed into the ResNet50 model. Classification is done in two ways using the pretrained model ResNet50. In the first method, Resnet50 model is used for feature extraction and classification. The last dense layer in ResNet-50, softmax is changed with 100 neurons instead of 1000. This is because AWE dataset used has 100 class only. The model runs for different epoch range [100, 1000] and batch size [20–60] to get the optimal result. The maximum accuracy was obtained with batch size 60 and an epoch of 500. Table 1 shows Rank1 accuracy of ResNet-50 using deep features with different epoch and Batch size.

In the second method, a feature level fusion is performed using ResNet50 and local feature GLBP. For each image in AWE, a feature vector is obtained by combining the features extracted from the average pool layer of ResNet50 with size 2048 and the features obtained using GLBP. After PCA reduction, the feature is fed to KNN for classification. The dataset is splitted randomly in to training set with 60% and test set of 40% for all the experiments. Table 2 shows the Rank1 recognition accuracy for different features using KNN classifier. Features are experimented in isolation and combination. For the batch size 60 and epoch 500 the accuracy attained is highest.

Table 1 Rank1 accuracy ResNet50 using deep features

Epoch		100	200	500	800	1000
Accuracy						
Batch size	20	52.3	53.31	53.71	55.11	18.44
	40	53.11	55.71	55.31	54.71	23.25
	60	52.91	54.71	**56.11**	55.51	20.04

Table 2 Rank1 recognition accuracy AWE for different features using KNN classifier

Feature extraction	Classification model	Accuracy (%)	Parameter
GLBP	KNN	46.3	K = 10
RESNET50	KNN	46.67	K = 12
GLBP + RESNET50	KNN	**49.72**	K = 10

The results obtained using the feature level fusion in AWE dataset gives a slight improvement in recognition accuracy compared to the maximum accuracy of 49.6% reported in [7] using traditional features. Better results can be obtained by further increasing the dataset with more augmented data or by using different pretrained models. The GLBP and RESNET50 feature extraction method along with classification model KNN produces the highest accuracy as shown in Table 2.

5 Conclusion

The paper presents a study on ear recognition using ResNet-50 architecture on the unconstrained ear dataset AWE. The accuracy obtained is higher than the traditional feature extraction and classification approaches. Further the study can be expanded by either fine tuning the applied algorithm and by using other pretrained architectures.

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ANN Based DSTATCOM for the Harmonic Current Mitigation in a PV Based DG System

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Abstract This paper talk about the power quality concerns for distributed generation systems centered on non-conventional resources such as solar energy. A comprehensive argument about power quality concerns is mentioned here. The paper begins with power quality concerns, supported by conversations of current harmonics. An inclusive analysis of current harmonics mitigation is performed in this work. Mitigation of harmonics using DSTATCOM is elaborately presented. A novel control technique using adaptive PQ theory is demonstrated using MATLAB and the results are validated using the experimental setup of DSTATCOM using FPGA Controller. Total Harmonic Distortion (THD) improved significantly after the compensation.

Keywords Solar power · Power quality · Current harmonics · DSTATCOM and THD

1 Introduction

A solar electrical structure may be entirely grid-autonomous or built primarily to supply power into the grid. The incorporation of renewable poweralong with the grid and the application of power electronics has intensified the power quality issues. The rising popularity of distributed solar generation threatens the voltage regulation of the distribution system, not only since its presence reconfigures the power flow in the distribution network, however most current methods of voltage management, i.e. the application of online load tap change (OLTC) transformers and shunt capacitors do not even have prompt response to the rapid instability due to mechanical restrictions [1]. In industrial practice, the inability to control voltage has triggered the spillage of solar tracking (or even the restraining of a distributed solar plant), which ultimately

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delays the creation of a renewable power system. It initiates voltage management problem is PQ issue while solar power linked to distributed grid [2, 3].

Power quality (PQ)-associated problems are of greatest interest today. The extensive use of electronic devices, such as IT kit, power electronics like Variable Frequency Drives (VFD), Programmable Logic Controllers (PLCs), and energy-effective lighting, has resulted in a total shift in the design of electrical loads. At the same time, these quasi loads are the basic causers and the key victims of problems with power quality. All these quasi-loads trigger disruptions in the voltage/current waveform owing to their non-linearity [4–6].

Monitoring may expose the root of complications within a production, residential or domestic unit and provide the relevant details for their solution. Effective monitoring of power quality can provide the requisite information to verify regulation, boost device reliability and reduce system failures. For incapacitating PQ issues FACTS mechanisms like STATCOM/DVR/UPQC assist to reinstate or uphold PQ within restrictive standards [7].

This tracking has become an extremely efficient way of identifying, fixing and even preventing problems in consumer power delivery networks with the use of the latest technologies and software now available. Not only does a tracking system provide understanding of system disruptions and their potential causes, it can also identify trouble situations in the system before they affect equipment misfires, and even equipment failure or malfunction. Surveys have shown that inside customer facilities, most power quality concerns are localized [8–10].

2 Highest Priority PQ Issues

The Power Quality issues are prioritized, and major issues are listed in Table 1. Table presents the basic description, causes and consequences of the PQ Issues. According to Schneider Electric, 48% of issues related to Voltage sag/swell and 22% constitutes current harmonics.

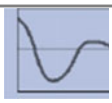
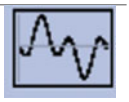
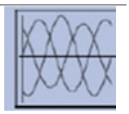
3 Proposed PQ Theory Using ANN

Harmonic current mitigation:

- Switching of the capacitors, loads, starting of large motor, the proliferation of power electronic equipment based nonlinear loads in residential, commercial and industrial applications creates current harmonic issues.
- Such type of issue leads to the failure of sensitive equipment's used for controlling and protecting of the plant, which further causes lower efficiency and power factor.

The usage of nonlinear loads the load current non-sinusoidal, as this harmonic current is drawn from the source the source current also becomes non sinusoidal.

Table 1 Highest priority PQ issues list

Type of PQ issue	Description	Causes	Consequences	Wavefonn
Voltage sag	A reduction in the usual voltage level from 10 to 90% of the standard rms voltage just at power frequency over a period of 0.5–1 min	Faults on the network for transmission or delivery (most of the times on parallel feeders). Faults in deployment for users. Operation of heavy loads and start-up of motor drives	Misfire of IT equipment, i.e. microprocessor-based control systems (PCs, PLCs, AFDs, etc.), which may respond to process cessation Contactors and tripping electromechanical relays	
Voltage swell	Increased voltage instantly, at power frequency, beyond standard tolerances, lasting longer than one cycle and usually less than a few seconds	Heavy loads start/stop, badly configured power sources, poorly operated transformers (primarily during the offhours)	Data loss, illumination and screen blinking, stopping or harming sophisticated equipment when the voltage values are too large	
Harmonic distortion	In shape, voltage or current waveforms are often non- sinusoidal. The waveform refers to the number of various sine-waves with distinct amplitude and phase, of frequencies which are multiple frequencies of the power system	Electro-machines operating above the magnetization curve knee (magnetic saturation), arc furnaces, welding machines, rectifiers, as well as engines with DC brush. All quasi loads, including ASDs, switched mode power supplies, data machine tools, high performance lighting, like power electronics devices	Increased likelihood of resonance incidence, neutral overburden in 3-phase systems, excessive heat of all cables and machinery, decrease of efficiency' in electrical machines, electrical noise with communications systems, measurement errors in the use of reading comprehension meters, interference caused by thermal protection	
Voltage unbalance	In a three-phase system, a voltage iteration under which he three voltage amplitudes or the variation in the phase angle among them are not similar	Big single-phase loads (induction furnaces, traction loads), inappropriate spread of all single-phase loads between the three device phases (this may be also due to a fault)	The presence of a negative sequence that is detrimental to all three-phase loads is inferred by unbalanced systems. The most influenced loads are three-phase induction equipment	

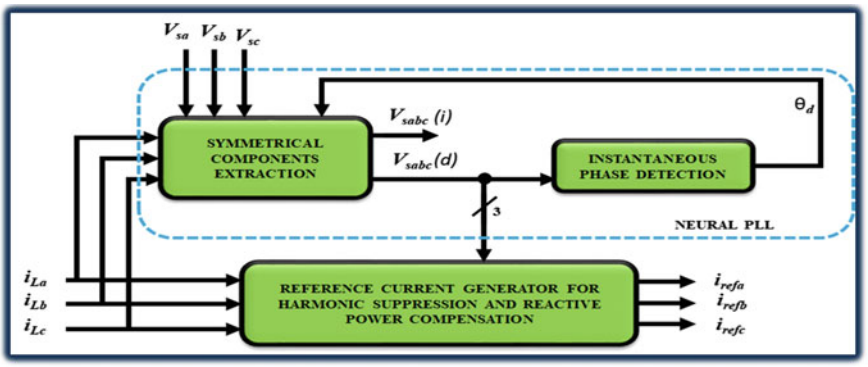


Fig. 1 Schematic diagram of harmonic current extraction

Objective of the proposed strategy is to inject the required amount of harmonics to the load using DSTATCOM and making the source current pure sinusoidal. The load current is sensed and feedback to the ANN based controller, using the adaptive PQ theory the reference currents are generated using these reference currents pulses are generated for the voltage source inverter through hysteresis controlled PWM generator. The output of the voltage source inverter is connected to the PCC using coupled inductor. This voltage source inverter will inject the required harmonic current PCC to the load.

The DC link voltage given to the voltage source inverter from solar panel, here in this paper only ANN based PQ theory is demonstrated, the MPPT and DC-DC Converter or not explained here.

Harmonic current determination is realized using adaptive PQ theory as shown in Fig. 1, the three phase currents converted d-q axes components and these currents will be considered as the d-axis component reference current and q-axis component reference current. Choosing the DC link voltage reference value and matched with obtain value error is generated, and this will act as input for the ANN network on the other side the AC terminal voltage reference value is equated with the obtain value and error is generated. This error will act as input for the second ANN network.

In this adaptive PQ theory, two neural networks are used. Each neural network is having two layers one is input layer and the other one is hidden layer. Applying the back propagation algorithm, the least mean square of the error is calculated using this error, the actual d-axis current and the q-axis current components are calculated, these currents are compared with the reference currents and the error is generated finally, these d-q currents are converted into 3 phase abc currents using transformation matrix. These currents are compared with the reference currents and error is generated as shown in Fig. 2. This error will be acting as input to the hysteresis current controller based PWM generator to obtain the pulses for the voltage source inverter.

Table 2 reflects the configuration details of the neural networks used for the ANN based adaptive PQ theory.

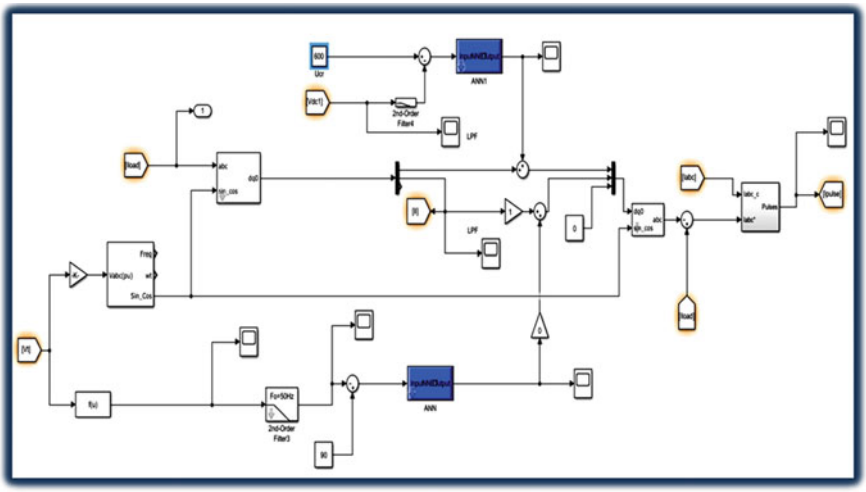


Fig. 2 MATLAB model of harmonic current extraction

Table 2 ANN parameters for training

S. No.	Parameters	NN1	NN2
1	No. of training data	200	200
2	No. of testing data	40	40
3	No. of neurons in input layer	01	01
4	No. of neurons in hidden laver	10	10
5	No. of neurons in output laver	01	01
6	Training function	Back propagation algorithm	
7	Performance function	Mean square error	
8	Activation function	Tanhyp/PureLIN	
9	Maximum epochs	250	
10	Normalized range	− 1 to + 1	

Figure 3 reflects the layout of the ANN structure used in the controller. In an ANN network, 10 neurons are used, and each neuron is associated with some random weights using the backpropagation algorithm and tan hyperbolic activation function these neurons are trained, and their weights are updated. After multiple iterations appropriate least mean square error is obtained and given to the output layer, through which the reference currents are generated as shown in Fig. 4.

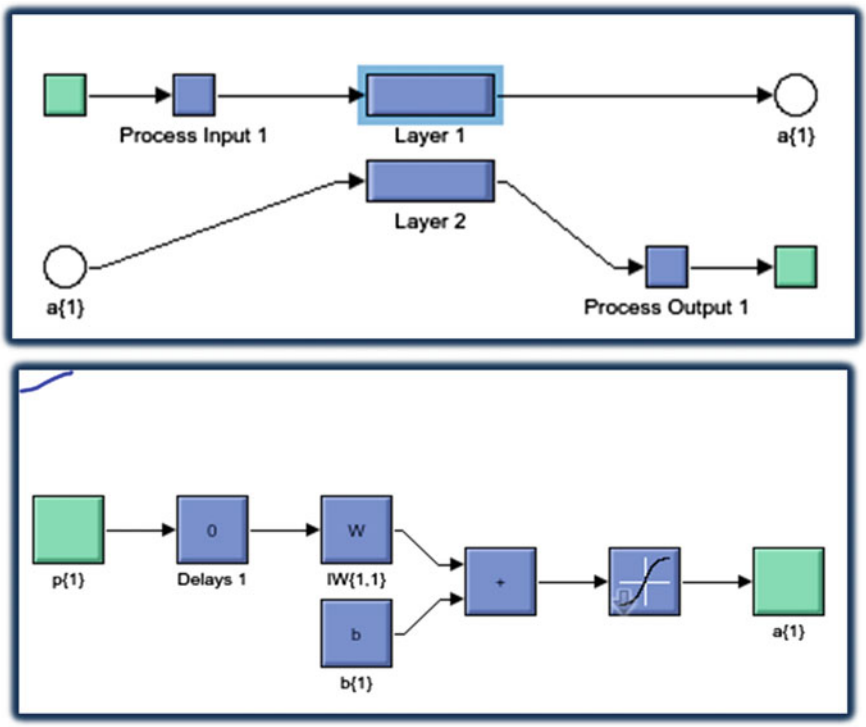


Fig. 3 Layout of ANN structure

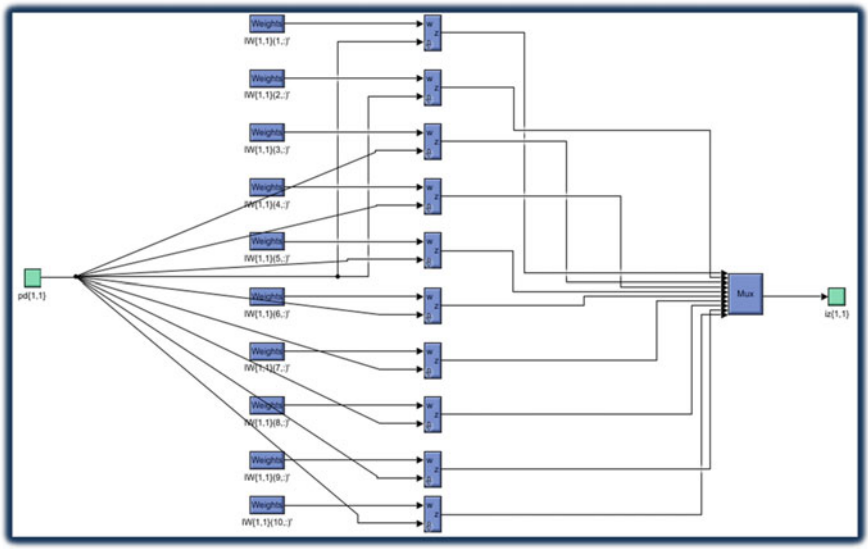


Fig. 4 MATLAB model of ANN

4 Comparison of Simulation and Hardware Results

The proposed model is simulated in the MATLAB software, as per the load demand 100 V AC supply is given to the non-linear load shown in Fig. 5, Due to non-linearity in the load current, source current gets distracted. DSTATCOM activated at 4 ms and it injects required harmonics to the load making the source current sinusoidal. The source current is shown in Fig. 6, harmonics can be observed till 4 ms and after that pure sinusoidal current is obtained.

The current injected at PCC using VSI is shown in Fig. 7. This current acts like the harmonic current required for the load. Now the load current is the combination of

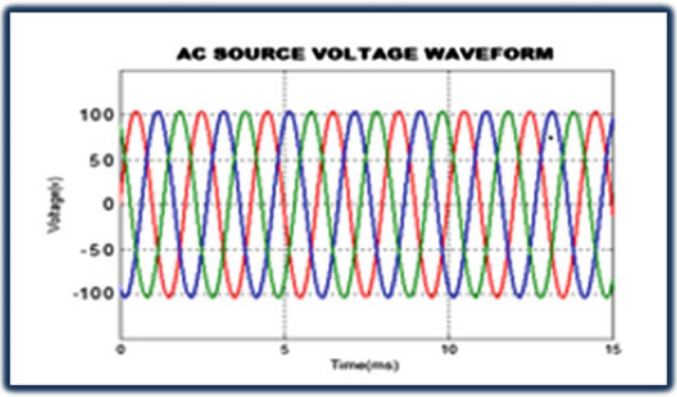


Fig. 5 Source voltage waveform

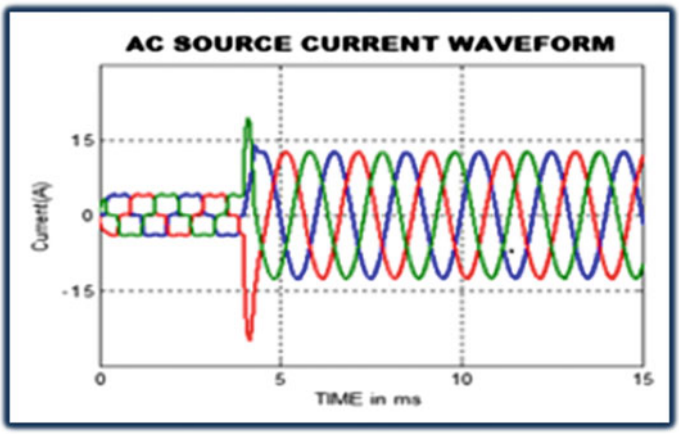


Fig. 6 Source current waveform

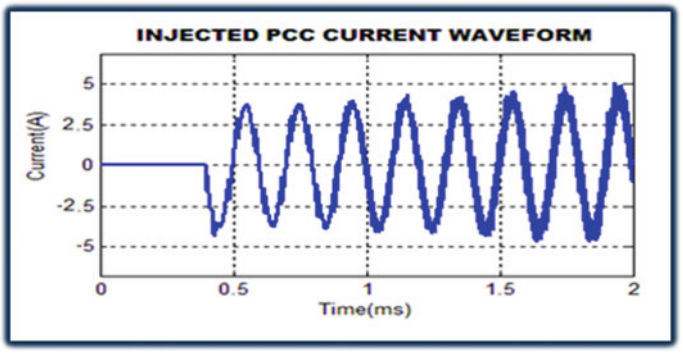


Fig. 7 Injected current waveform

source current and injected current. This injected current obtained from VSI, Pulses to VSI are generated using ANN based PQ theory.

The simulation results are validated using the experimental setup. The setup consists of 3-phase shunt active filter with a FPGA Controller. The results captured through the digital storage oscilloscope are Source Voltage, Source Current and Injected current are shown in Fig. 8.

According to Wikipedia, "The total harmonic distortion (THD) is a measurement of the harmonic distortion present in a signal and is defined as the ratio of the sum of the powers of all harmonic components to the power of the fundamental frequency".

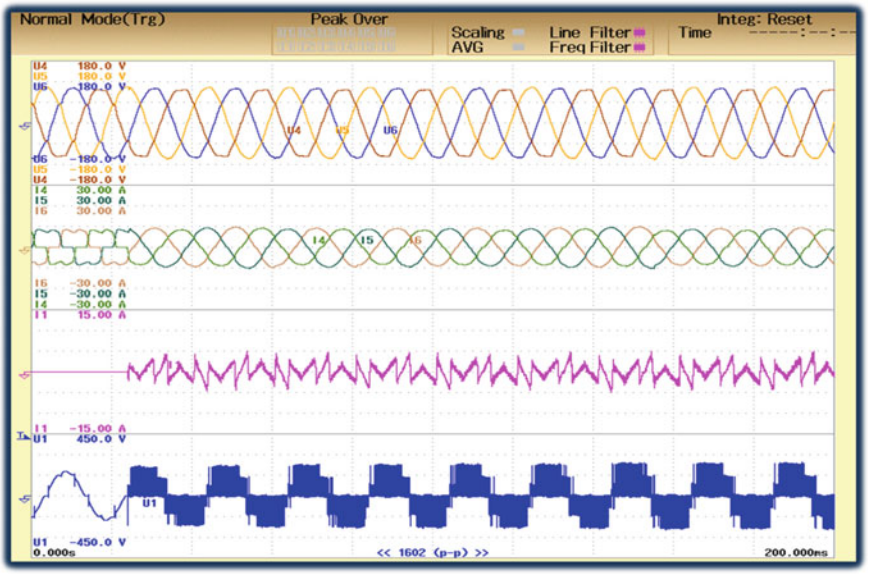


Fig. 8 Experimental results of source voltage, source current, injected current and VSI voltage

THD obtained using MATLAB simulation is shown in Fig. 9 and THD obtained using experimental setup is shown in Fig. 10. Table 3 shown reflects that the proposed DSTATCOM improved the performance of the system by mitigating the current harmonics from 34.2 to 4%.

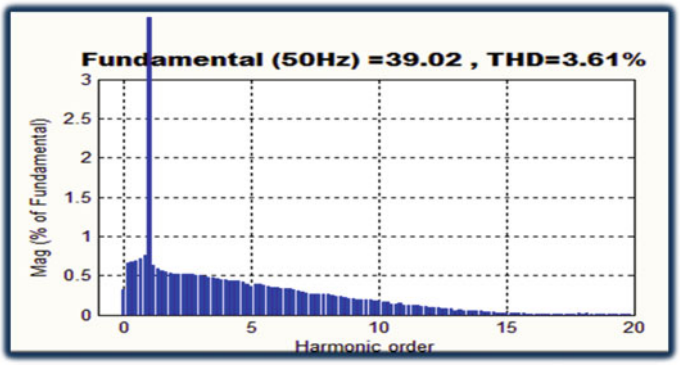


Fig. 9 Source current THD (simulation)

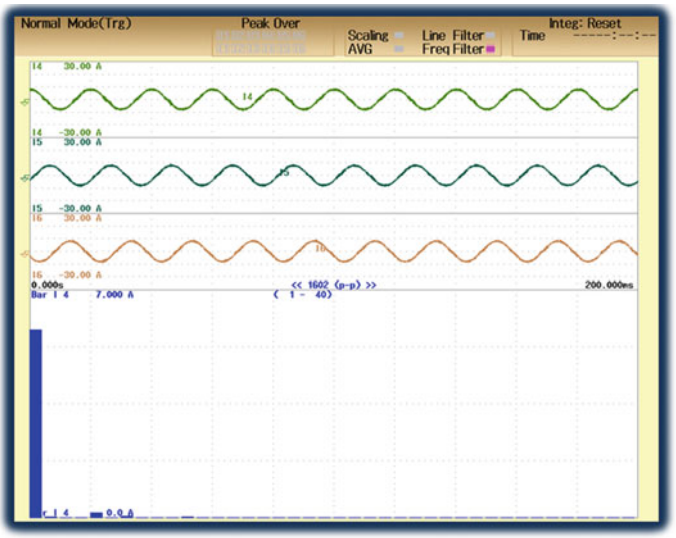


Fig. 10 Source current THD (experimental)

Table 3 THD comparison

Source current THD	Simulation value (%)	Experimental value (%)
Before compensation	26.4	34.2
After compensation	3.61	4

5 Conclusion

Power quality regulating methods and appropriate resolutions of power quality concerns for distributed systems are extravagantly available in the industry. For non-conventional energy resources, DSTATCOM can be a prospective option due to its numerous benefits, whereas spinning backup can improve the power quality in conventional systems. In this paper we proposed custom power device D-STATCOM with an ANN based controller. It will provide the required harmonics to the non-linear loads connected to the system maintaining the source current pure sinusoidal.

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Analysis of Supervised Machine Learning Techniques for Predicting Vehicle Clutch Status

Sachin Vanjire and Sanjay Patil

Abstract Today, the automotive world uses various electronic components to inspect vehicle health. Data generated from the vehicle component can be utilized for different applications, such as diagnostics, maintenance, and prognostics (predictive diagnosis). There are satisfactory actions taken from the automotive world for vehicle On Board and off-board diagnostics to perform vehicle diagnostics and maintenance time. Due to human limitations for faster analysis and maintenance predictions, automizing electronics and data science can provide many possible solutions, such as various predictive diagnostics based on historical data. Many researchers are currently working with the different domains on machine learning, data science gives better results in medicine predictions. This can also apply to the automotive world and its applications. This paper contributes to the method based on regression models to predict clutch status based on different parameters acquired from the vehicle CAN bus system and electronic sensors. Various supervised machine learning methods like support vector machine, logistic regression, decision tree, and polynomial regression are used. The results obtained for these models are compared using the accuracy level to predict the vehicle clutch status.

Keywords Vehicle clutch status · Vehicle maintenance · Supervised machine learning · Support vector machine · Logistic regression · Decision tree · Polynomial regression

1 Introduction

The automotive world is upgrading day by day with various forms of electronics. With different aspects, vehicle components are maturing sharply and perform intelligently based on the smart electronics system. Vehicle safety should be a significant

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factor in this regard. Every element in the vehicle needs to be validated and confirm safety on high priority. Vehicle security should not compromise and need strong regulations for many vehicle safety standards created like ISO 26262 [8]. Processes with the different countries may differ, but safety in the vehicle is on high priority. These vehicle components generate extensive data through electronics architecture integrated with them. This data is usually processed for different purposes, such as vehicle maintenance reports and vehicle diagnosis, used in the form of historical data. Such existing manual data processing methods have increased awareness and hence need to atomize such processes with the help of machine learning, data science, statistics-based approaches. This has shown many possibilities for researchers, engineers, and scientists. Efficient prognostics operations are the primary outcome of these advancements.

The vehicle clutch is a critical component in the manual transmission system. Operations like gear changing, Ignition start-stop, and the impact of direct vehicular load in these operations lead to tear and wear. During such an operation, heat is dissipated due to mechanical frictions. Coupled operations between clutch disc, flywheel, and pressure plate results in the wearing. The degradation is directly proportional to the frequency of operations and respective heating. An increased temperature of the clutch is directly related to the wearing of the clutch parts. Also, it is observed that as the load in journey are the main considerable impacts that degrade the clutch and its related parts. These events may constitute acceleration decelerations in totally nonlinear ways.

As per the design specifications, the clutch is supposed to handle specified torque levels. Every clutch has its power rating, depending on the application. As this is an essential and most affected vehicle part, it is required to be monitored continuously. This paper contributes to the methods of supervised machine learning techniques used to analyze clutch status. Also, a comparative study is performed by considering the accuracy of the prediction of clutch status.

2 Literature Review

A detailed survey of machine learning-based techniques applied in the field of component diagnostics and maintenance systems with various researchers [1–4]. Jan Furch, ZdeněkKrobot discussed proactive preventive maintenance, which eliminates unwanted failures [5]. Barry Dowdeswell, Roopak Sinha, Stephen G. MacDonell carried a fault identification and analysis study from the existing literature. It includes different diagnostics approaches, analysis of the trends. From a traditional physics-based system to data-driven techniques, knowledge-based systems, hybrid techniques, prognostics features are covered in this study [6]. The researcher discussed prognostics process by estimating the remaining useful life (RUL) of lithium-ion batteries. The internal battery parameters indicate the state of health (SOH).Here the authors proposed a new data-driven approach for embedding diagnosis and prognostics of battery health [7]. Sharma, Y. ElHaj, Mohamed Z. Youssef, Jing Ren, and

Mohamed Orabi explain An experiment carried out for a fault detection technique for the open circuit fault in voltage source inverter. Asemiclustering approach can be used for this. The author also proposes an algorithm to detect open circuit faults [8]. Qian Shi and Hui Zhang discuss data related to fault diagnosis and its imbalanced nature and propose an improved support vector machine framework. The author also suggests using a multi-class SVM approach [9]. Swapnil K. Gundewar and Prasad V. Kane explain different research findings to recognize the faults in the major components of Induction Motor. The researcher recommends different condition monitoring techniques in combination with artificial intelligence (AI) techniques. experimentation with the neural network, Fuzzy logic, and support vector machines perform distinctively. The author also emphasizes diagnostics' importance with the upcoming era of electric vehicles and their early fault detection [10]. The estimation of RUL implements with the help of the machine learning method. This methodology helps to learn the degradation behavior of lion cells. If not identified timely, battery degradation generates issues such as spontaneous combustion, explosions precisely when the state of healthcan assess correctly. The author has suggested a data-driven approach that will use RUL prognostics. This paper discusses different RUL predictions methods for lithium-ion batteries [11]. The experimentation with state of charge (SOC) of the lithium-ion phosphate battery pack issue has been discussed and how it is getting solved with machine learning methodologies. The researcher proposes the SCO estimation method based on the fuzzy least square support vector machine [12]. A data-driven approach for autonomous underwater vehicles (AUVs) is discussed, which uses polynomial repressors. The experiment identifies that data-driven control does not seek modeling for the system. The authors of this experimentation propose improving existing data-driven control by polynomial repressors, which control AUVs' performance [13]. The researcher found Limitations of the data-driven method that can be applied to predict the remaining useful life (RUL) of lithium-ion batteries' potentials are not fully exploited. Anew data-driven method is discussed in this paper. They are using feature enhancement and adaptive optimization. It uses gradient boosting decision trees to establish the RUL prediction model. The researcher presents the method that establishes the RUL prediction based on a machine learning algorithm and improves RUL prediction accuracy [14]. Regression tools can be used for predictive load analysis. The author of this experimentation proposes a vertical time approach that uses a particular holiday period. KNN and RF repressors were used with autoregression as well as autocorrelation and correlation. The author explains how to load prediction analysis is useful for distributed power network operations, demand-side management, and regression tools. There is much scope to improve accuracy with the help of deep learning [15]. The researcher proposes the PdM approach for small steam sterilizers. The author of this experiment explains the approach that detects small steam sterilizers' unexpected failures from two critical components. In this way, it is possible to reduce maintenance costs, the cost associated with overtime. The author mentioned that how the RUL-based and knowledge-based methods are difficult for applying the PdM strategy. An ML approach may use to obtain a PdM strategy. This paper explores SVM, K-NN, DT, RF, and LR algorithms. From the experiments, the RF

algorithm achives a remarkably good classification accuracy for the data set used [16]. Rune Prytz, Sławomir Nowaczyk, Thorsteinn Rögnvaldsson, Stefan Byttner discussed a data-driven approach for the RUL estimation. Data collected from the onboard and service records are used as input for the machine learning models. The author also discusses data preprocessing challenges that contain highly noisy class labels, irrelevant time-based data. In the experimentation, the author uses the Random forest as a data-driven method to predict the upcoming air compressor failures and provide a dynamic solution for predictive maintenance [17]. Eman Magdy Moawad, Mohammed Diab, and Mohamed ElHelw explains Experimentation with Advanced driver assistance system (ADAS) which uses remaining useful life predictions. However, the author used a support vector machine (SVM) for the prognostic experimentation and found that the Least square support vector machine (LS-SVM) is more suitable than the SVM method [18]. Predictive diagnosis of the v-ribbed belt is done on the Censored monitor test rig. Researcher of this experiment found that the k nearest neighbor method shows the most significant potential [19]. Lea [20] have given consideration of temperature variations in fuzzy manner for fuzzy rule finalization. The fuzzy rules are implemented in controller to finalize the temperature change to predict the vehicle conditions based on which course of actions was expected to be defined.

3 Proposed Work

Figure 1 shows the block diagram of the proposed end to end system. The system consists of CAN-based protocols and sensors to collect parts related to different parameter readings to record on remote servers. Design blocks focus on the data

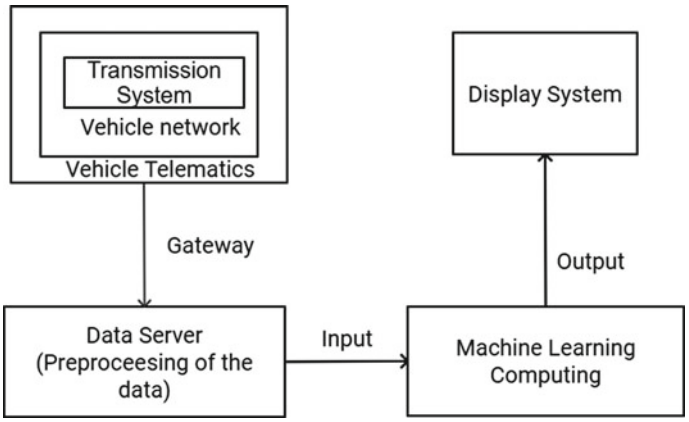

Fig. 1 Block diagram of end to end system design

fetching from the vehicle network. All the sensors will transfer the specific information to the intelligent system installed with vehicle components. Further, this information can be processed to the gateway vehicle CAN network. Through vehicle telematics, the vehicle data will be fetched and stored on the data server. The data server plays a vital role in the storage of this data. This stored data requires preprocessing before feeding to the machine learning computing part. The output of the machine learning model will be fed to the display system.

The data processing and prediction system with the machine learning model's help is shown in the block diagram in Fig. 2. The fluid temperature in the transmission system is obtained using an electronic sensor unit via communication links. The temperature sensors used can operate within the range of − 40 to + 210 °C. The CAN bus system in the vehicle is used to transmit the collected readings data to store at the cloud-based server. The preprocessing task is then performed on obtained data to train the model, which includes labeling and obtaining numerical data, which then fed to the machine learning model.

The classifiers used for predicting the part's status are shown in Fig. 3 according to their types of processing and type of input data. In the multiparameter classifiers,

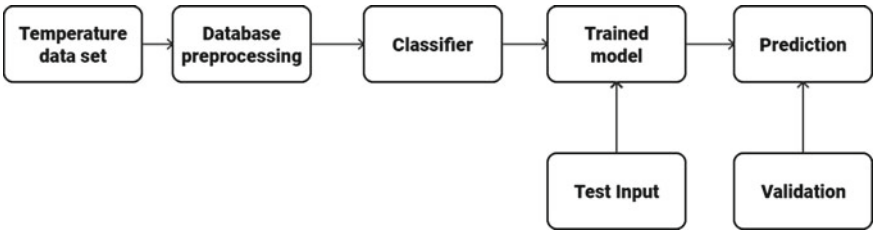

Fig. 2 Block diagram of data processing and prediction system

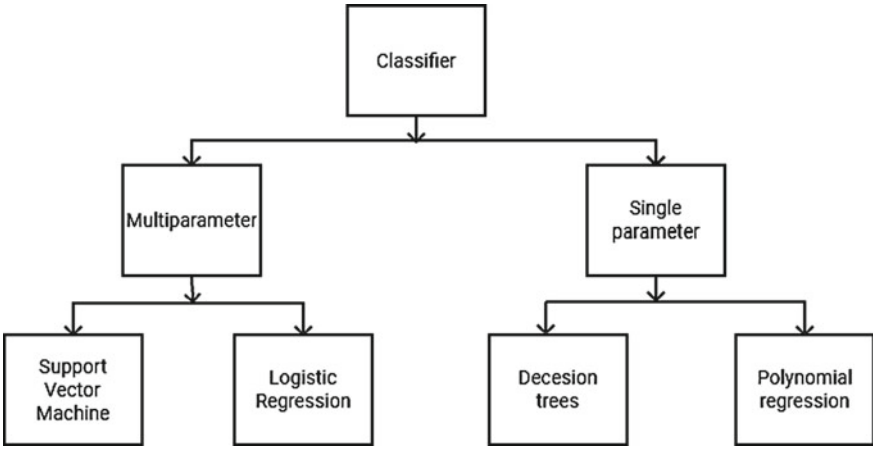

Fig. 3 Tree diagram for used classifier

support vector machine (SVM) and logistic regression (LR) platforms are used in which the parameters such as transmission oil temperature, engine torque feed are used. In the single parameter based models, decision trees and polynomial regression models are used in which only one parameter that is transmission oil temperature, is fed as input. The linear kernel function-based SVM is used as a classifier in the SVM model. This task is accomplished by using the SVC library function from sci-kit-learn. The sample size for the experimentation consists of 1000 readings. The entire dataset is randomly split into train and test in 70–30 form. The threefold analysis method is used for validating the predicted results on the test set.

4 Dataset Design

Data fetched from the vehicle is getting preprocessed—defined the feasible parameters that id independent parameters and dependent parameters. Transmission oil temperature shows vital signs of vehicle clutch health status and is considered an essential parameter for the input. The parking brake, environmental temperature, engine torque, and vehicle speed parameter data could reflect the nature of vehicular data under which vehicle operations are carried out. For the experimentation purpose, Engine torque and Transmission oil temperature parameters are used as input parameters. Based on the vehicle clutch health, the preprocessing part created four output statuses mapped in Table 1 with their respective meaning.

Figures 4 and 5 show the scatter plot, which helps to understand the nature of different initial parameters considered input in single and multiparameter forms, plotted on the x-axis, and the output vehicle clutch status parameter y-axis. Moreover, vehicle clutch status is a dependent parameter. Analyzing clutch status through

Table 1 Vehicle clutch status

0	Low
1	Normal
2	High
3	Critical

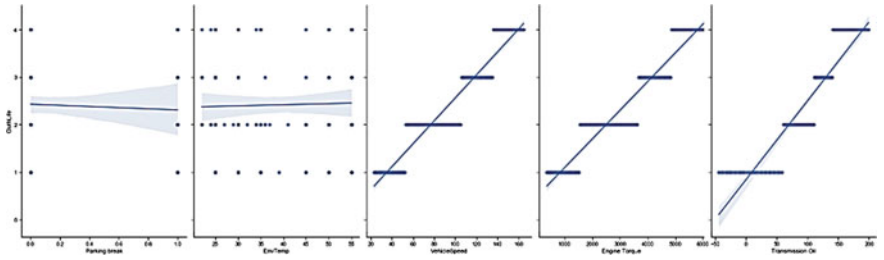

Fig. 4 Preprocessing of the dataset for multiple inputs

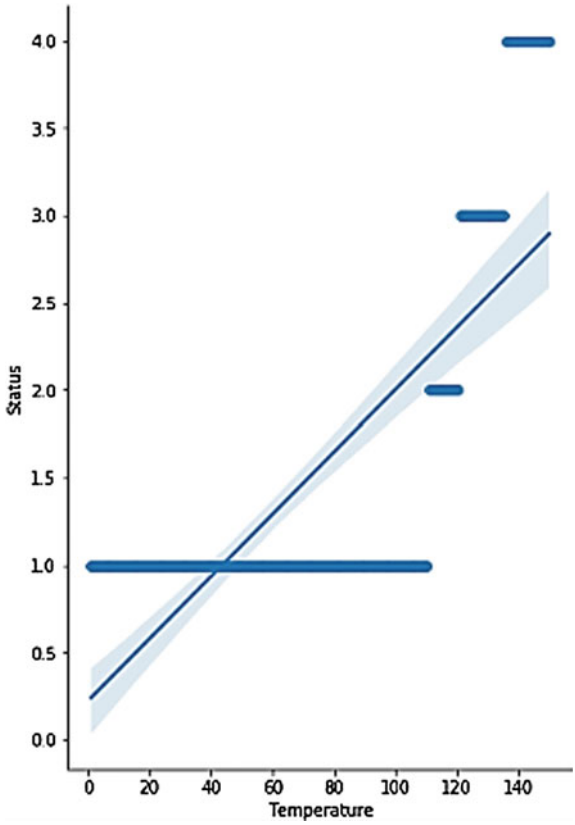

Fig. 5 Preprocessing of the dataset for Single input

the polynomial regression dataset is varied according to temperature status with significant linkage amongst them. The algorithms that are multiparametric dependent make use of a large dataset with sample size. The sample dataset used in the experimentation is as shown in Table 2.

The flow chart shown in Fig. 6 explains the different steps covers to achieve machine learning operations for the predictions (Table 5).

(1) Hardware and software requirement used for the experimentation

5 Results and Analysis

The system is designed and implemented with machine learning algorithms like SVM, Logistic Regression, Decision Tree, and Polynomial Regression. Ten attempts of experimentation are performed for each type of classifier, and the average of all is taken to analyze the performance. The below table is used for calculating accuracy based on the different nomination status as shown in Table 4.

Table 2 Sample dataset

Parking brake	Env. temp. °C	Vehicle speed km/h	Engine torque Rpm	Transmission oil temp. °C	Clutch status
0	25	33	750	− 9	1
0	55	51	1470	54	1
0	25	52	1510	58	1
0	55	53	1550	61	2
0	30	54	1590	62	2
0	24	105	3630	110	2
0	45	106	3670	111	3
1	55	109	3790	114	3
0	50	135	4830	140	3
1	35	136	4870	141	4
0	30	155	5630	179	4

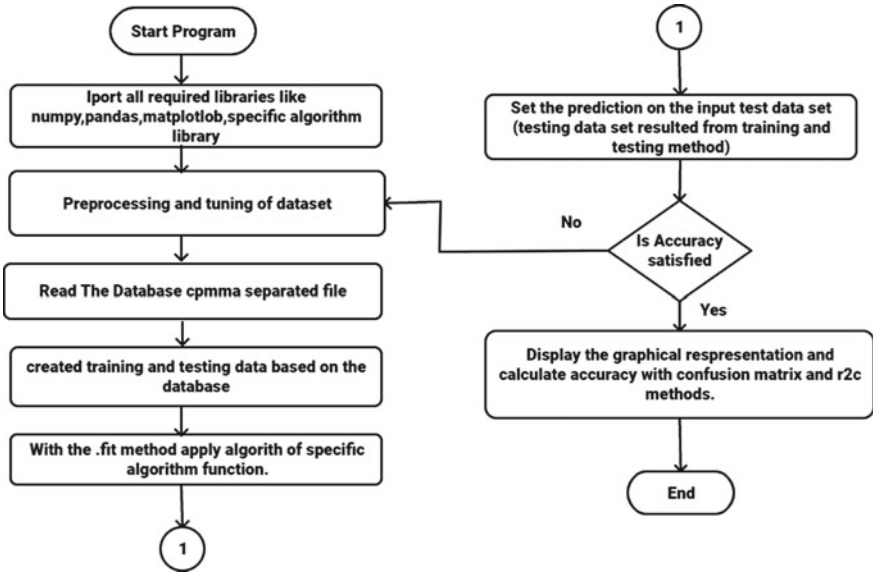

Fig. 6 System flow chart

Table 3 Experimentation platform

Hardware	Multicore fast CPU, bigger ram size (minimum 16 GB), GPU, descent ethernet, decent screen resolution
Software	With Python 3.7, Numpy Pandas, MatplotLib, SkLearn, Mlextend, Confusion Matrix, Seaborn Libraries, Jupiter Notebook

Table 4 Nominating clutch status

Input	Detected	Nominations
Faulty	Faulty	TP
Faulty	Normal	TN
Normal	Faulty	FP
Normal	Normal	FN

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FN + FP}$$

5.1 SVM Model Result Analysis

Equation (1) shows the mathematical model for the SVM regression analysis.

$$\begin{aligned} &\text{w.xi} + b \geq 1 \quad \text{for } yi = +1 \\ &\text{w.xi} + b1 \leq -1 \quad \text{for } yi = -1 \\ &\qquad combining\ above\ two\ equation, \\ &\text{Yi(w.Xi + b)} - 1 \geq 0 \quad \text{for yi} = +1, -1 \end{aligned} \tag{1}$$

From the dataset, values are 26 true positive + 8 (real negative) = 34 are positively correct predicted values, and 0 (False positive) + 2 (False negative) = 2 are negative predicted values. Thus obtained accuracy is 94.44%.

The SVM regression-based scatterplot is shown in Fig. 7, which shows the classification results for each level of damage to the clutch part.

5.2 Logistic Regression Model Result Analysis

$$\ln\left(\frac{p}{1-p}\right) = b0 + b1x1 + b2x2 + b3x3 + \cdots bnxn \tag{2}$$

Equation (2) shows the mathematical model for LR. The 3D plot of classification data is shown in Fig. 8 from which clutch status and its damage levels can be understood.

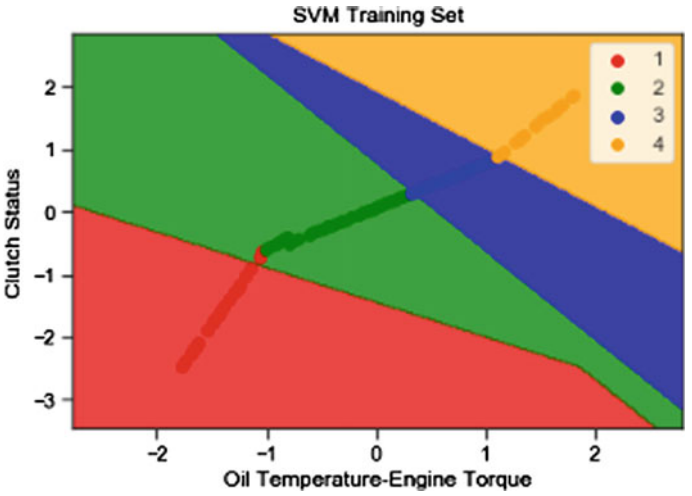

Fig. 7 SVM plot

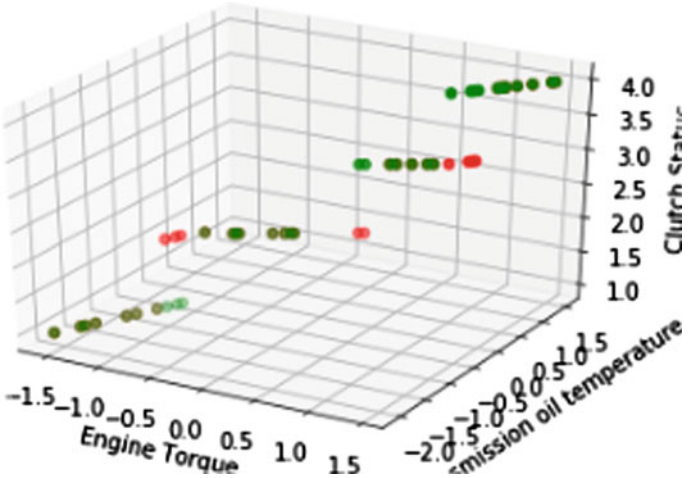

Fig. 8 Logistic regression 3D plot

5.3 Decision Tree Result Analysis

The mathematical equation for DT model can be given as in Eq. (3).

$$\text{Entropy} = -\sum_{i=1}^{n} pi * \log(pi)$$

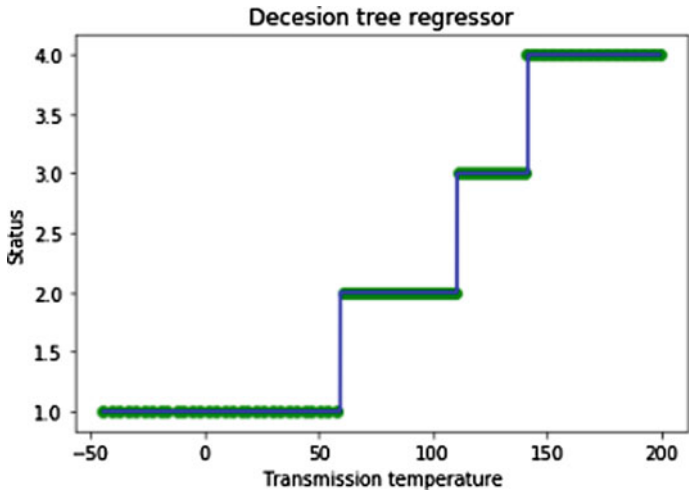

Fig. 9 Decision tree prediction level

$$\text{Gini Index} = 1 - \sum_{i=1}^{n} pi^2 \,\text{i} = \text{number of classes} \tag{3}$$

Figure 9 shows a clutch status prediction level 1, 2, 3, 4 with a transmission temperature, like SVM and LR. The parametric correlation of the clutch status concerning temperature can be understood in Fig. 9.

5.4 Polynomial Regression (PR) Result Analysis

The mathematical equation for the polynomial regression-based model can be given by Eq. (4).

$$\text{Y} = a + b1\text{x} + b2x^2 + \cdots + bnx^{\text{n}} \tag{4}$$

The PR model is based on a single parameter as oil temperature, which predicts clutch status. Here we have used library function of scikit learn to calculate clutch status accuracy. R2 score is the regression score function used for actual value vs. predicted value. This leads to gives correct vehicle clutch status. The accuracy of 94.34% is obtained from this analysis.

In Fig. 10 graph line for polynomial regression graph and a linear regression model is shown. The comparison of the polynomial regression model with a linear regression model can be well understood from the graph.

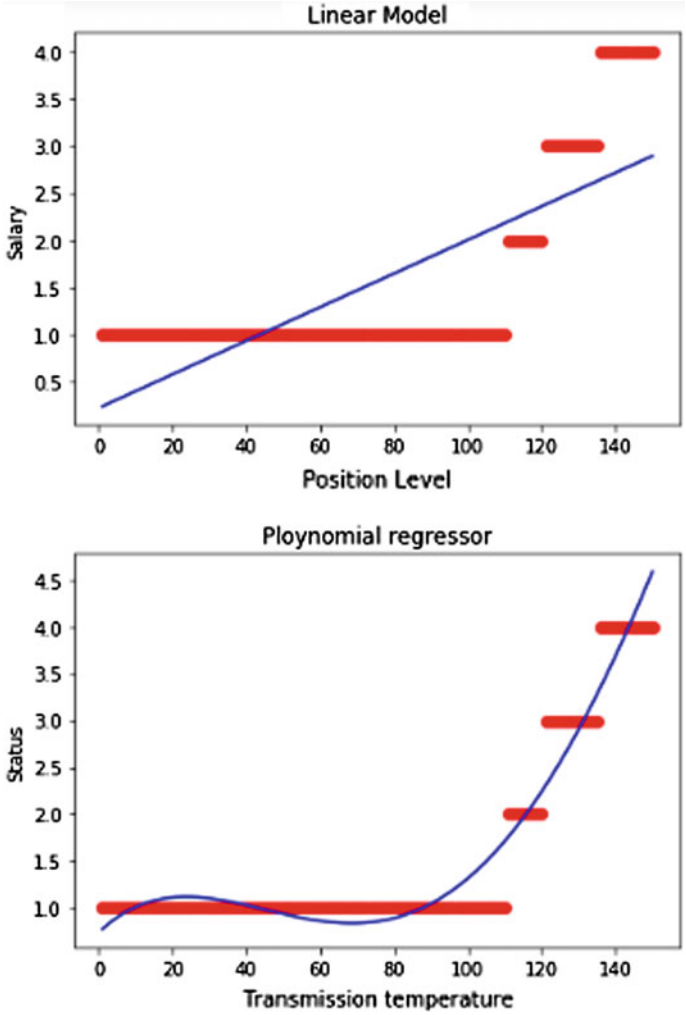

Fig. 10 Poly regression versus linear regression model

5.5 Accuracy

The above system's accuracy is calculated using two different methods: the confusion matrix method and the R2 score method. For SVM and logistic regression, multiple parameters are considered during predicting clutch status, so here confusion matrix method is used to calculate accuracy. So respective accuracy is 84.30 and 82.34%. For Decision tree and polynomial regression with single parameter R2 score or regression, the score function is used to calculate efficiency. So respective accuracy is 98.03 and 94.34%. Combined accuracy chart of all the above-applied algorithms

Table 5 Accuracy chart

S. No.	Algorithm	Accuracy (%)	Parameter considered
1	SVM	94.44	Multiple
2	Logistic regression	82.34	Multiple
3	Decision tree	98.03	Single
4	Polynomial regression	94.34	Single

with the number of parameters considered during system development shown in Table 5.

The comparative graphical plot is shown in Figs. 11 and 12 for multiparametric and single parametric algorithms. These graphs represent achieved accuracy for prognosis

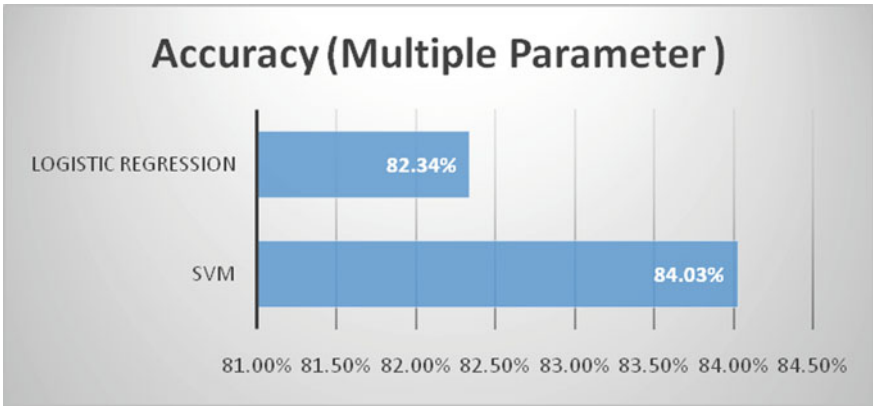

Fig. 11 Accuracy (multiple parameter)

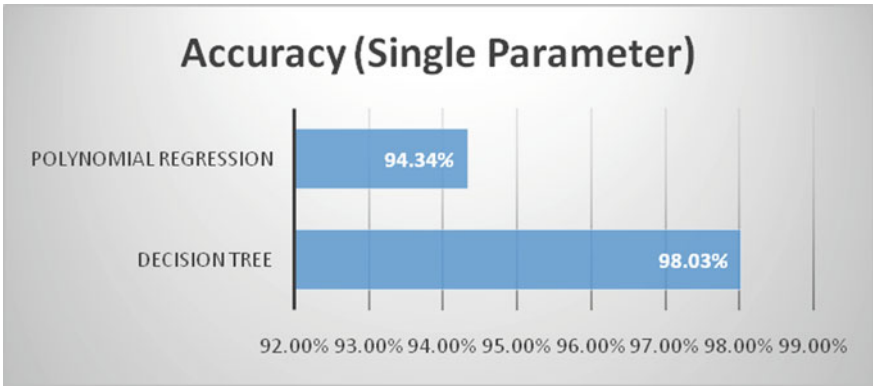

Fig. 12 Accuracy (single parameter)

and predicting vehicle clutch status through supervised machine learning algorithms such as SVM, LR, DT, and PR.

6 Conclusion

Supervised machine learning models such as Support Vector Machines (SVM), Logistic Regression (LR), Decision Trees (DT), and Polynomial Regression (PR) are considered for the prediction of clutch status. The recorded dataset is extracted from vehicle sensors, preprocessed this data, and defined dependent and independent parameters. This set of information is used as an input dataset for the machine learning model. As mentioned in the design flow, carried out the process, and improved the accuracy with these different algorithms. The accuracy of 82.34%, 84.03%, 94.34%, 98.03% is obtained for the four classifiers, respectively. In the multiparametric regression model, SVM accuracy is better than LR, and in single parametric regression models, the accuracy of DT is better than PR. The clutch status prediction as the challenging task and sparseness in its manual observation shows the requirement of authorizing the system and the proposed system in this paper contributes to the vehicle maintenance automization domain with considerable performance. There is still scope for the multiple parameters based regression models on achieving higher accuracy levels and more sensors for data acquisition from a vehicle.

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Error Detection in Fault-Tolerant Reversible Circuit Using Fredkin Gates

Premanand K. Kadbe and Manisha G. Waje

Abstract Reversible logic design has advantages such as loss less energy, small size, ultra fast quantum computations. The research found this field very much applicable in a wide area including signal processing, computer graphics, communication, cyber security etc. The error detection and correction in communication channel and receiver is always being a thrust area of research in the field of communication systems. Error detection can be done by parity checking and Hamming codes are more suitable for this purpose. Various error detection circuits are implemented and synthesized in this paper and tried to reduce the size requirements. All the reversible circuits synthesized in this paper are verified with the help of their respective truth table.

Keywords Reversible circuits · Hamming codes · Fredkin gate · Qubit · Parity preserving

1 Introduction

Reversible digital logic is identified as a future in the development of computing as the higher energy efficiency compared to irreversible one, including industry CMOS gate circuits and the most developed Single Flux Quantum logic. The different states of the input vectors are uniquely reconstructed from the states of output vectors. The reversible circuits have reversible primitive outputs like functional and garbage outputs which achieve reversibility. A digital computer performs various operations like arithmetic and logic unit performs processing of data on the basis of various arithmetic and logical operation over various data. A combinational circuit which adds three binary digits including two bit data and a carry providing sum and carry as output is a full adder. A ripple carry adder consist of n number of such one bit adders

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by cascading each full adder as a single weighted column for a long binary addition. A ripple effect can be observed from least significant bit to the most significant bit. The speed of such parallel adders is improved using binary adders with carry look ahead. The overall functionality of the digital computer can be destroyed if a single fault occurs. The diagnosis of each individual fault can be done by testing the sum and carry outputs.

2 Literature Review

Reversible circuit design is possible with the use of Fredkin gates and multiple controlled Toffoli gates. The greedy synthesis algorithm is developed and applied for applying the hamming codes or hamming distance with smaller overheads [1]. One can device the partial as well as missing faults, bridging faults or stuck at faults with the help of random search and directed search which also avoids the need for exhaustic search [2]. The strategy of post synthesis reduces the limitations of primal energy for field connected logic gate fan-outs and can be embedded [3]. The proposed structure of parity preserving ALU with Fredkin and two fold Toffoli gates suggested is scalable up to N-bit operations providing full error coverage occur due to single bit flip fault [4]. Further the 3 × 3 Fredkin gates as parity preserving gates are constructed with the help of 2 × 4 decoder with enable. An arbitrary circuit conversion into related testable design was proposed for large reduction in operating cost. The strategy of post-synthesis reduces the fundamental energy limits for field coupled nano computing circuits by embedding fan-outs in logic gates [5]. The parity preservation can be used for the fault tolerance computations [6]. The 4 bit ALU can be applied in nano processors using QCA is faster and area efficient [7]. The Gray to binary and vice versa has shown better results in terms of various performance analysis [8]. The parity checker and parity generator are compared which are widely used in data communication [9]. The logic generator block which is generally used in one bit comparator/adder/subtractor is constructed in a single layered design [10, 11]. The 32 bit carry skip adder is constructed and compared with TSG and modified TSG gate [12].

3 Methodology

3.1 Implementation of Reversible Logic Gates

Different reversible logic gates and their implementation of the decomposition in to primitive logic gates are described as below.

CNOT gate has one-qubit gate with output as a complement of the input. A single gate is required having the quantum cost as 1. Toffoli gate is a 3 × 3 gate with

Fig. 1 CNOT gate

Fig. 2 Toffoli gate

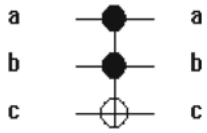


Fig. 3 Fredkin gate

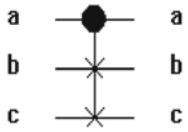
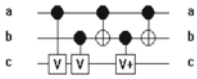


Fig. 4 Toffoli gate using primitive gates



five two-qubit gates having quantum cost as 5. Fredkin gate is a 3 × 3 gate with five two-qubit gates having quantum cost as 7.Peres gate is a 3 × 3 gate with four two-qubit gates having quantum cost as 4. Figures 1, 2, 3, 4 and 7 shows these basic gates whereas Figs. 5, 6 and 7a shows the synthesized circuit implementation of these gates using primitive gates [1].

The various types of gate used to construct different adders are the MCT, MPMCT and MPMCF.

Fredkin gate can be represented using primitive gates by using toffoli gates as below.

The various type of gates are used to construct different adders like MCT, MPMCT and MPMCF.

Fig. 5 Fredkin gate using primitive gates

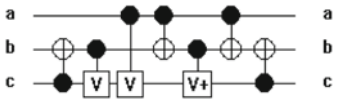
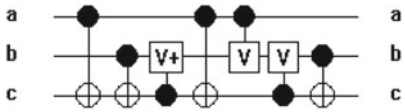


Fig. 6 Fredkin gate using Toffoli gates and representation with primitive gates



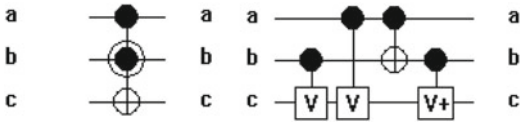


Fig. 7 Peres gate. **a** Peres gate using primitive gates

4 Synthesis and Results

The error detection for odd number of output errors can be achieved by using the single parity preserving. A one bit full adder circuit with inputs a, b, c and outputs sum and carry are shown in Fig. 8a. The circuit consist of one constant bit added at input whereas two garbage outputs on the output side. Output c is acting as a sum output which is logic 1 if only one of the three inputs or all the three inputs are at logic 1.

The output transition can be occurred if there is a switching fault or transition at the input from 0 to 1 and from 1 to 0. The parity preserving property can be used for a single parity full tolerant one bit adder as shown in Fig. 8b. A parity bit is added as an extra bit to form the above full adder as fault tolerant. Then an extra gate is added for every gate. An extra MCT gate is added resulting in Fig. 8b and verified with the truth table.

In next step, Hamming-3 encoding based error detection and correction circuit is constructed. Here three parity lines are added.

The circuit outputs are c which is a sum output, Cout which is a carry output and p1, p2, p3 as the parity outputs as shown in Fig. 9. Here the target is the first gate.

The final form of the Hamming 3 encoding based error detection and correction circuit targeting the second, third and fourth gates. The further simplification of the circuits as shown in Fig. 10b can be done with two cases, first the gates and their

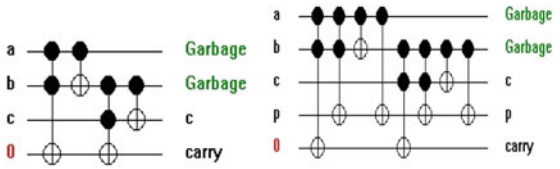


Fig. 8 **a** Implementation of one bit adder. **b** Implementation of a single parity fault-tolerant 1-bit full adder

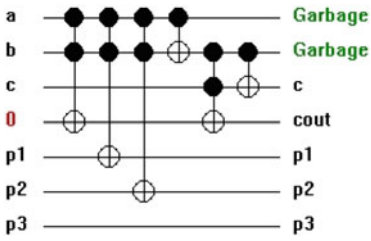


Fig. 9 Implementation of hamming 3 encoding parity adder

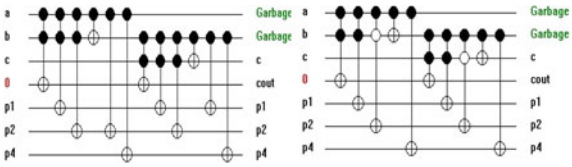


Fig. 10 **a** Implementation of final hamming 3 encoding parity adder. **b** Simplified hamming 3 encoding parity adder

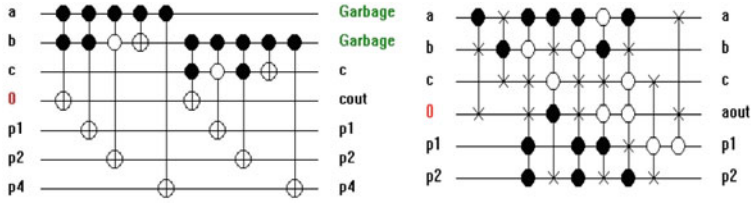


Fig. 11 **a** Reduced hamming 3 encoding parity adder. **b** Perfect error detection using Fredkin gates

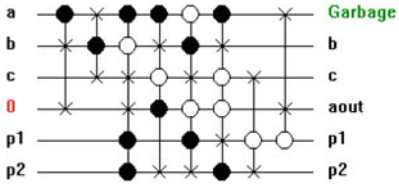


Fig. 12 Reduced implementation of perfect error detection using Fredkin gates

locations are alike having same control bit and targets and then one of the gates contribute all the control and target lines of the former, with one extra control.

Figure 10b shows a simplified Hamming 3 Encoding Parity Adder which can be further reduced as shown in Fig. 11a.

The 100% error detection can be achievable with the use of Fredkin gatesas shown in Fig. 11b.

Further reduction is also possible in above circuit as shown in Fig. 12. The third and fifth gates are the same and hence the reduced form of the above circuit can be constructed by using only one of them which also reduces the quantum cost by 248, gate count by 8, and the number of two qubit gates as 70.

5 Conclusion

All the above circuits are synthesized and verified using the truth tables. The comparison of all these circuits on the basis of various metrics like number of input/output, gate count, quantum cost and the number of two qubit gates is as shown in Table 1. As per this table, there is overall 11% reduction in number of gates, 17.65% reduction in the number of two qubit gates and 20.25% reduction in quantum cost.

Table 1 Comparison of adders using various metrics

S. No.	Name of circuit	No. of inputs/outputs	Gate count	Quantum cost	No. of two qubit gates
1	Synthesis of optimized one bit full adder	4	4	8	12
2	Synthesis of a single parity fault-tolerant 1-bit full adder	5	8	20	24
3	Hamming 3 encoding parity adder	5	6	18	22
4	Final hamming 3 encoding parity adder	7	12	32	36
5	Simplified hamming 3 encoding parity adder	7	10	32	34
6	Perfect error detection using Fredkin gates [1]	6	9	311	85
7	Reduced implementation of above gate	6	8	248	70

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Smart Book Reader for Visually Impaired People Using OCR and Raspberry Pi

Anil W. Bhagat, Balasaheb H. Patil, and Premanand K. Kadbe

Abstract This paper presents the smart book reader for visually impaired people. As per data published by World health organization, 285 million individuals are evaluated to be superficially impeded around the world; visually impaired peoples are 39 million and low vision has 246. The greater part of the understanding materials accessible for the visually impaired is Braille. A greater part of the outwardly disabled use Braille for understanding archives and books are hard to make and less rapidly accessible. An individual needs to get the hang of utilizing Braille only for perusing, and if an individual is incapable to learn Braille then he will be notable perused. For visually impaired peoples book and papers are arrangements in Braille which is less in contrast with the huge group of books, printed day by day. Consequently, a gadget to help the visually impaired in perusing is a need. To defeat this issue looked at by visually impaired individuals we are attempting to build up the OCR Based Smart Book Reader for visual impaired persons, This reader used everywhere because of camera is capturing the image and it converted into word by using OCR. This converted data read in the form of voice by using speech synthesizer. Why this device more useful because of easy to work, consume less power, low in weight, small in size, good quality of voice and storage the read data. Which will assist dazzle with peopling in reading? It won't spare the time yet additionally the vitality, just as improves life for the outwardly hindered as it expands their independence.

Keywords OCR · Speech synthesizer · Visually impaired · Raspberry Pi · Text to speech

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1 Introduction

As per the world health organization data published, around 285 million peoples roughly the globe are evaluated to be outwardly harmed, near about 90% visually impaired peoples are live in creating nations. In this way there is a squeezing need to build up a book peruse gadget that is reasonable to the low salary segments of the general public [1]. This venture tends to a total content read out framework based on an implanted system [2]. The proposed deliberation utilizes the rule of a camera put together assistive gadget actualized with respect to a system board [3]. The incorporated framework comprises of a camera module, Tesseract OCR Engine, Text to Speech Engine, speakers or headphones and python as programming for picture preparing with good quality [4].The prepared picture fills in as a contribution to the OCR, which digitizes the picture and performs character acknowledgment [5]. At long last, the Text to Speech motor peruses out the content to the client. The extent of this undertaking is promising. Optical character recognition discovers its applications in Medicine, Online Retails, Education, and the sky is the limit from there [6]. The proposed framework functions admirably for both English and Hindi contents. Our focus on future work is to broaden a similar usefulness for other Indian provincial dialects, for example, Tamil, Kannada, Telugu, and so on [7]. This devices widely use as CAPTCHA, OMR, HD, IM, AND [8].

2 Motivation

To help Blind individuals and Low vision individuals we have Concept of a keen book peruser which can perform content identification in this manner produce a voice yield [1]. The inspiration to build up this item is to urge every single visually impaired individual to peruse normal books. Our framework will assist society with building solid future for everybody that implies there will no more contrast between the visually impaired and typical individuals [9]. The framework should simple to work; it motivates us to built such type of System.The created Smart Book Reader will help dazzle and outwardly weakness individuals in perusing. This framework will be useful for outwardly impaired peoples to get to data on composed constitution and in the encompassing [10].

3 Proposed System

3.1 Block Schematic

Figure 1 shows the block diagram of proposed system. It consists of boards, keys, camera module, power supply and LCD. This system works as per square chart of a

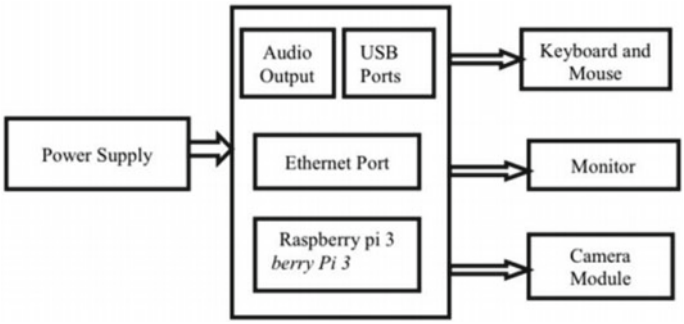

Fig. 1 Block schematic of proposed system

book per user, a proto composed framework which peruses the printed content available held articles on helping the visually impaired people. In the model frameworks two adjustment were done to get ready for the framework test.

First we train the visually impaired individual to put the hand held protests inside camera see. Second, in a relevant visually impaired assistive framework, a content restriction calculation may incline toward higher review by relinquishing some exactness [6].

The graphical user interface has discretionary mark for showing the picture from the camera, a status box for speaking to the picture. The Raspberry board accompanies coordinated peripherals like USB, ADC and Serial [7].

3.2 Circuit Diagram of Proposed System

Figure 2 shows the connectivity and flow of actual hardware. This circuit is simulated in Proteus Software (Fig. 3).

Main objective of this software to capture the image of page and it convert into readable form using the program and save it in location. Firstly it converting the image in color to gray with suitable range which is best view of letters. In gray scale image found the white or black content. The white content is majority part in letter because of his blank space. Therefore the output of the OCR is sent to the TTS module which will produce the audio output.

3.3 OCR Process

OCR is an optical character reader. OCR is process used to convert electronic different type of image format for examples handwritten, print into readable for as character (Fig. 4).

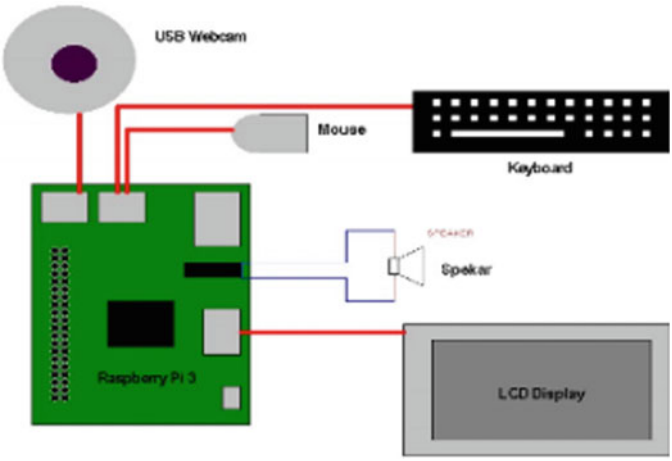

Fig. 2 Circuit diagram of proposed system

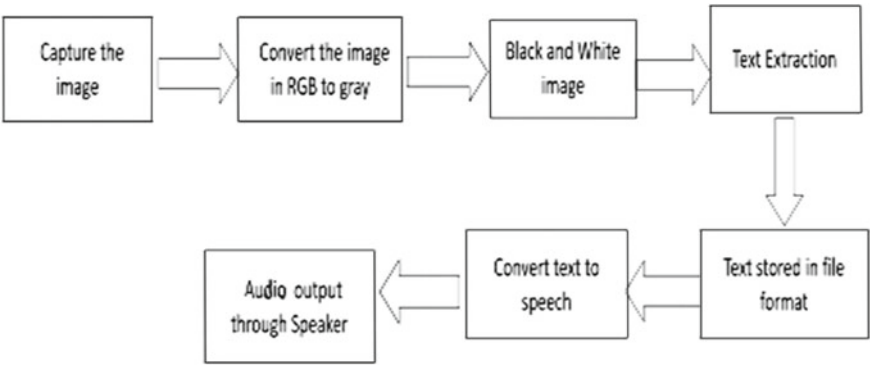

Fig. 3 Design process

Fig. 4 OCR process

3.4 Tessteract

Made by HP-UX at HP in 1985 and actual worked as scanner 1994.Tesseract is a free programming for optical character frameworks work as motor. A picture with the content is given as contribution to the Tesseract motor that is direction based apparatus. It is prepared by Tesseract direction. In basic pictures with or without shading, Tesseract furnishes results with 100% correctness. Tesseract gives better precision results if the pictures are in the dim scale mode when contrast with shading pictures. In spite of the fact that Tesseract is direction based device however as it is open source and it is accessible as dynamic link library, it tends to be efficiently made easy to get to in designs mode.

4 Algorithm

1. Image capturing: In the first step the machine is shift over the in print page and camera capture the image of the book.
2. Image to Text conversion: Clear recognition due to high resolution of camera. Letters will be extracted and converted into digital form.
3. TTS conversion: This is used to convert the content as txt file into audio.
4. Audio output: We can listen the audio output from printed page as an input.

5 Implementation Results

5.1 Experiment Setup for Proposed System

Above picture shows that hardware connection of project. We are utilizing raspberry Pi3 module. The keyboard, mouse, monitor, web camera and 5v power supply associate with the raspberry Pi. Here, one switch button is associated with GPIO3 and GPIO4 pin of raspberry Pi. In this machine general purpose input and out pins of raspberry Pi board is used for webcam and for that we use OS that is compatible for raspberry Pi 3 as Raspbian OS (Fig. 5).

5.2 Execution Process

When code execute, we can test the process. First on the terminal of raspberry Pi we keep in touch with certain directions to begin the procedure. The framework was based on a board running on Linux and Python in Open CV libraries (Figs. 6 and 7).

Fig. 5 Experimental setup

Fig. 6 Execution process

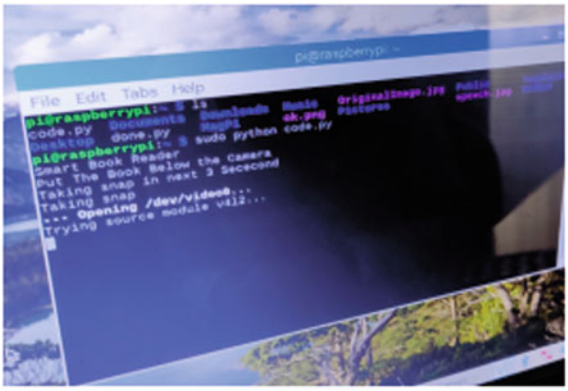

Fig. 7 Original text image

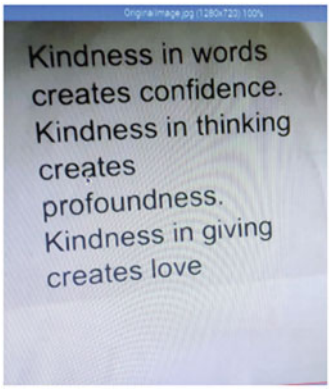

Fig. 8 Speech result

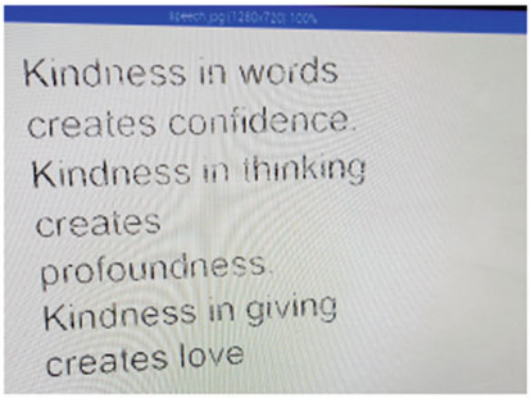

Table 1 Test results

Number of letters in image	15
Objects	Letter
Words detected	15
Error found	0

5.3 Speech Result

Above picture appears, yield result. After taking picture of book, Tesseract programming used to convert image captured into content of text and Text to speech is used to convert content text to audio, So as to read the one by one words in correctly, Tesseract and OCR play an important role to do this required task. Whole system will give you the accurately and high quality audio output (Fig. 8; Table 1).

6 Conclusion and Future scope

The sign cant objective of this task was to give a reasonable handheld gadget to the visually impaired and outwardly impaired individuals of the general public. In this task we are utilizing different advances, for example, Optical Character Recognizer (OCR), image preparing and Text to discourse engine. The picture pre-handling part takes into account the extraction of the necessary content area from the intricate foundation and to give a decent quality contribution to the OCR. The text, which is the yield of the OCR, is send to the TTS motor which delivers the discourse yield very effectively. Our center of attention on future effort is to broaden a similar usefulness for other Indian provincial dialects, for example, Tamil, Kannada, Telegu, and so on. Also this will be utilized for book reader in many festivals.

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Effect of Pilot Density on BER Performance of Mobile WiMAX

S. K. Malave, D. M. Yadav, and A. S. Shirsat

Abstract Mobile WiMAX, IEEE 802.16m, is widely used for high-speed internet access. It is based on the cyclic prefix OFDMA (CP-OFDMA) technique, employing many pilots. Utilizing a large number of pilots increase the pilot overhead and reduce the data rate and spectral efficiency of a mobile WiMAX system**.** This paper proposes the incorporation of time–frequency training OFDMA (TFT-OFDMA) symbol with an optimum number of pilots. The proposed technique embeds a different density of pilot subcarriers and employs a compressive sampling-based channel estimation technique. This paper compares Mobile WiMAX's BER performance for different densities of pilot subcarriers for vehicular speed upto 350 km/h. System performance is analyzed in terms of pilot overhead. Simulation results demonstrate that reducing the number of pilots compared to the pilots used in the legacy WiMAX system gives a comparable bit error rate (BER) performance for low vehicular speed. Employing an optimum number of pilots reduces the pilot overhead by 5.5% and 4.17% for type II and type III pilot density, respectively.

Keywords CP-OFDMA · Mobile WiMAX · Time–frequency training (TFT)

1 Introduction

Mobile WiMAX, IEEE 802.16m operates in a multipath environment. Due to resiliency to the multipath environment of an OFDMA technique, it is employed by Mobile WiMAX, IEEE 802.16m [1]. OFDMA technique transmits pilot tones for the channel estimation purpose. The performance of a wireless communication system greatly depends on channel behaviour and its equalization [2]. As there is a trade-off between channel estimation accuracy and number of pilots used for it, deciding an optimum number of pilots is a great challenge. More pilots utilization improves

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BER performance at the cost of data rate and spectral efficiency of the communication system [3]. Legacy WiMAX system employs a large number of pilots. These pilots have fixed transmission power, and their position in the OFDMA symbols are also fixed [4]. Compressive sensing based channel estimation techniques provide a channel estimation accuracy comparable to the techniques based on non-compressive technique with fewer pilot subcarriers. Due to the wireless channel's sparsity, a compressive sampling technique is a suitable technique to get link parameters with less pilot overhead [5].

2 Related Work

Several techniques have been proposed to insert the pilots in an OFDMA symbol to reduce the pilot requirement. Pilot insertion techniques mainly emphasize deciding the optimum number of pilots, their position in an OFDMA symbol and their transmission power. Generally, two types of pilot patterns are considered, single and grouped pilots.

Grouped pilots are inserted in the OFDM data symbol. Adjacent two pilots are averaged to get link parameters more accurately. The grouped pilot technique performs better than the uniformly spaced single-pilot pattern in terms of bit error rate without hampering the bandwidth efficacy [6]. Highly dense pilot symbols are used to calculate interference. This information is utilized to cancel the interference of low-density pilot symbols. Employing variable density pilot symbols decreases the number of pilots required for channel estimation and provides good channel estimation accuracy [7]. The key parameter that decides the number of pilots to be interleaved in the OFDM symbol is the number of adjacent resource blocks allotted to the user. It provides the optimal pilot requirement for the desired accuracy of channel estimation. The proposed method is suitable for advanced antenna technique upto 4×4 for the 802.16m system. It recommends inserting the pilots with 12 subcarriers apart and time symbol spaces of 3 [8]. The proposed technique does not consider the wireless channel's sparsity to determine the number of pilot tones. Grouped pilot pattern, as well as single-pilot pattern, is incorporated for IEEE 802.16m. The grouped pilot technique shows superior BER performance compared to the single-pilot design at 3 and 350 km/h of terminal speed [9].

In the compressive sampling-based channel estimation method, the pilot tones' location in the measurement vector affects channel estimation accuracy. The DFT matrix forms a measurement matrix. The proposed method chooses the pilot places having minimum coherence. It is obtained by finding the highest absolute cross-correlation between the measurement matrix's normalized columns [10]. CS-based channel estimation is carried out to find path gain and delay. Pairs having minimum mutual coherence of the sampling matrix are selected to ensure the channel's reconstruction [11]. The author proposes to decide the pilot positions and their power by reducing the measurement matrix's coherence. The proposed method requires fewer computations. It provides MSE and BER performance comparable with available

methods with fewer pilots [12]. In sparse channel estimation, the estimation accuracy is greatly affected by the measurement matrix's mutual coherence. Modified Adaptive Genetic Algorithm (MAGA) decides the pilot locations by minimizing the mutual coherence of measurement matrix. It outperforms compared to random search, GA techniques in terms of MSE and BER performance [13].

The survey concluded that embedding an optimal number of pilots into the OFDM data symbol improves average throughput and spectral efficiency. Compressive sensing based channel estimation techniques are used to reduce pilot subcarriers. Work reported that the legacy WiMAX system employs many pilots and calculates the link parameters using the MMSE method.

This paper's main contribution is incorporating TFT-OFDMA as a modulation and multiplexing technique with less pilot overhead for the WiMAX system. It also employs a compressive sampling technique to find channel response enhancing spectrum utilization with the data rate.

3 System Block Diagram

A block diagram of the IEEE 802.16m transmitter physical layer based on TFT-OFDMA is given in Fig. 1. A TFT-OFDMA symbol is formed by adding a training sequence to a data symbol. A convolutional turbo encoder is used as a forward error correction technique. A baseband modulation technique generates complex data symbols from encoded information bits. QPSK is employed as baseband modulation technique. Multiple antenna system of 2×2 configurations is set to enhance the data rate twice. MIMO encoder generates two data streams for each antenna. Each data

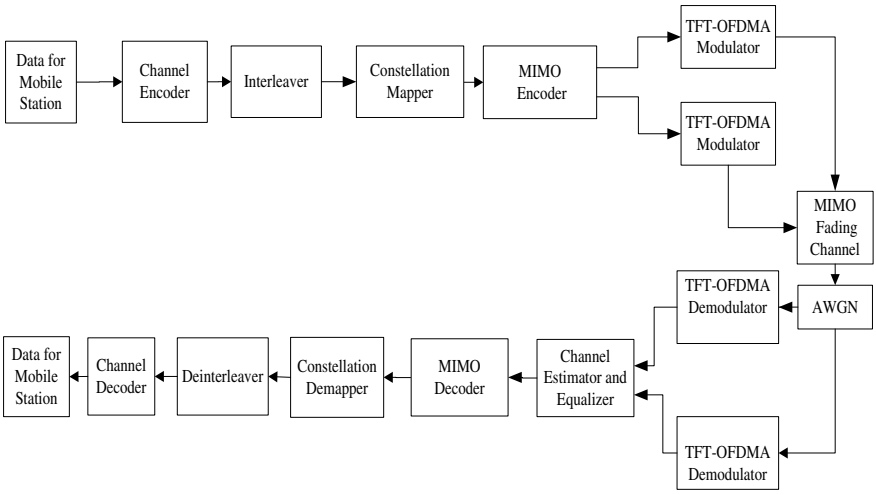

Fig. 1 Mobile WiMAX IEEE 802.16m transmitter using TFT-OFDMA and receiver

stream modulates the subcarriers of the IFFT modulator separately and is transmitted by two antennas independently. After the IFFT operation, guard subcarriers are added to the left and right of the data symbol. To avoid interference between consecutive OFDM symbols, a guard band is provided in terms of a PN sequence in the time domain.

The ith OFDM signal containing OFDM block of length Q and PN sequence of length P is given by

$$o^i = \left[o_0^i, o_1^i, o_2^i, \ldots o_{P+Q-1}^i\right]^T \tag{1}$$

The OFDM data block of length Q in the frequency domain is

$$\tilde{M}^i = \left[\tilde{M}_0^i, \tilde{M}_1^i, \tilde{M}_2^i, \ldots \tilde{M}_Q^i\right]^T \tag{2}$$

PN sequence which acts as guard band represented as

$$g = [g_0, g_1, g_2, \ldots g_P]^T \tag{3}$$

Pilot subcarriers are inserted into the data symbol. TFT OFDM symbol contains the J number of pilots interleaved in data subcarriers ${}_M\tilde{}\,i\,|\Gamma$, and given by

$$\Gamma = \{C_0, C_1, C_2, \ldots C_{J-1}\} \tag{4}$$

Where

Γ is a pilot location set.

The ith OFDM signal is given as

$$o^i = \begin{bmatrix} g \\ M^i \end{bmatrix}_{(P+Q)X1} = \begin{bmatrix} g \\ F_{QXQ}^H \ \tilde{M}^i \end{bmatrix}_{(P+Q)X1} \tag{5}$$

The signal travels through a vehicular channel and experiences a multipath fading.

The receiver finds the path delays using transmitted and locally generated PN sequence. After removing the left and right guard subcarriers, the signal is converted to the frequency domain by applying FFT operation. Compressive sampling-based channel estimation is done by employing received frequency-domain pilots and calculated path delays. Rough channel path gain is calculated using pilots. Exact channel parameters are acquired by using the Auxiliary Subspace Pursuit algorithm (A-SP) [14]. Then channel equalization is performed on the OFDM data symbol in the frequency domain. After demodulation, data subcarriers are decoded using the Viterbi decoder.

4 Methodology

802.16m system performance is assessed in terms of error bits for different pilot density. OFDMA is configured to transmit information for a single user in every symbol. OFDMA symbol transmits 1024 subcarriers. It considers a channel bandwidth of 10 MHz with 2.5 GHz as a carrier frequency. Simulation is carried out for the QPSK scheme. Symbol 1, 3 and 5 are transmitted by antenna 1. Antenna 2 transmits symbol 2, 4, 6. It considers a pilot density of 96, 48 and 36 in type-I, type-II, and type-III method, respectively. Simulation is carried out for ITU vehicular channel model B with a terminal velocity of 30, 250, and 350 km/h. For vehicular speed of 30, 250 and 350 km/h, a Doppler shift f_d of 69.4, 578.0 and 810 Hz are set. Vehicular channel B has a maximum path delay of 20 μs < the guard interval of 22.46 μs [15, 16].

5 Results and Discussions

Figures 2 and 4 gives a BER comparison of the WiMAX system with QPSK as a baseband modulation scheme with different pilot density considering user mobility of 30, 250 and 350 km/h. Figure 2 shows that reducing the pilot density at low vehicular speed has less effect on BER performance. It gives a comparable performance.

For a target BER of 10^{-3}, the system needs a 2.64 dB SNR value when 96 pilots are inserted in an OFDMA symbol for user mobility of 30 km/h. To achieve the same performance with 48 pilots and 36 pilots, it requires 2.71 dB and 2.74 dB SNR, respectively. With fewer pilots, it consumes very little extra power to achieve the same target BER.

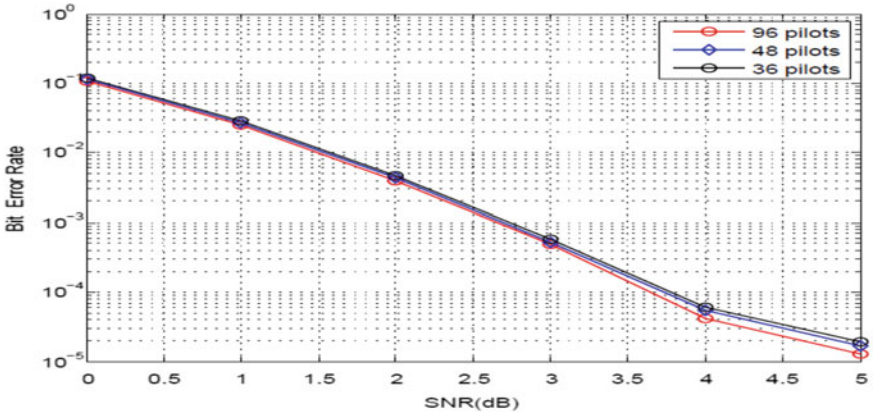

Fig. 2 WiMAX BER comparison at 30 km/h for QPSK scheme

Figure 3 tells that for vehicular speed of 250 km/h; the system achieves a target BER of 10^{-3} with an SNR value of 16 dB when 96 pilots are embedded in an OFDMA symbol, whereas it requires 16.29 dB SNR with 48 pilots and 16.30 dB with 36 pilots respectively. It requires more transmission power to achieve the same target BER with fewer pilots.

At high vehicular speed reducing the pilot density in the OFDMA symbol has considerable degradation in BER performance. Figure 4 reveals that for a target BER of 10^{-3}, the OFDMA symbol having 48 pilots shows a performance loss of 0.43 dB over 96 pilots. Reducing the pilots further to 36 indicates a loss of 0.28 dB over 48 pilots. At high vehicular speed, intercarrier interference increases more, demanding accurate channel estimation.

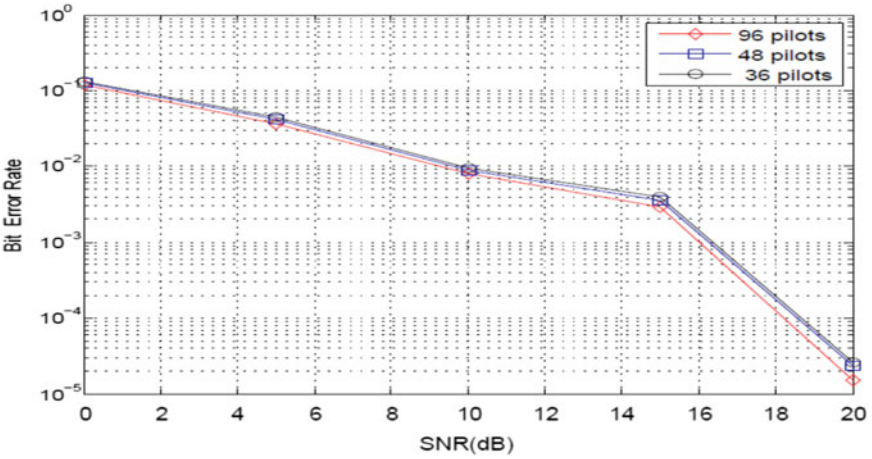

Fig. 3 WiMAX BER comparison at 250 km/h for QPSK scheme

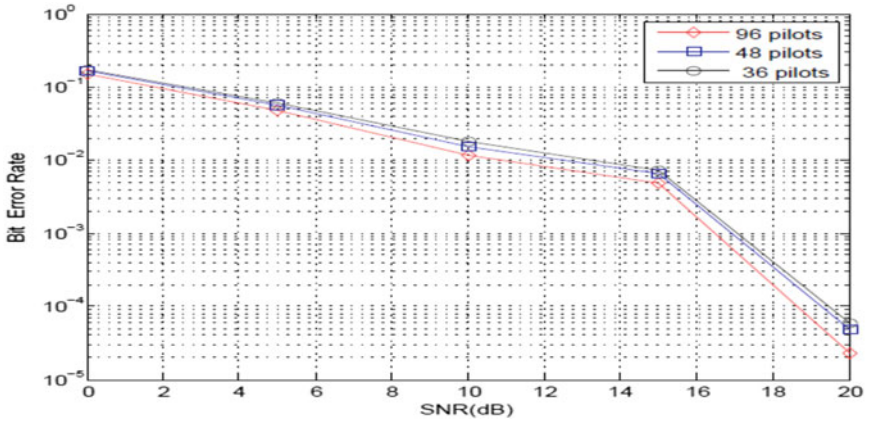

Fig. 4 WiMAX BER comparison at 350 km/h for QPSK scheme

Table 1 Pilot overhead

Pilot pattern	Pilot overhead (%)
Type I	11.11
Type II	5.5
Type III	4.17

6 Performance Evaluation Metrics

The performance of the system is evaluated in terms of pilot overhead. Pilot overhead is calculated using Eq. 6

$$\text{Pilot Overhead} = \frac{J}{Q_d + J} \tag{6}$$

Where,

J Number of pilots per OFDMA symbol.
Q_d Number of data subcarriers in OFDMA symbol.

Table 1 shows the pilot overhead of the implemented method for different pilot density for two transmit antenna.

It is observed from Table 1 that the pilot requirement for the type I method is 11.11%. Type-II has a 50% less pilot requirement compared to the type I method. Type III method utilizes only 4.17% of pilots, providing extra subcarriers for data transmission.

7 Conclusion

Mobile WiMAX IEEE 802.16m is used for broadband internet service with mobility. In this work, Time–Frequency Training OFDMA (TFT-OFDMA) is used as a modulation and multiplexing scheme. A compressive sampling technique provides comparable results at low vehicular speed with less pilot overhead. System performance degrades at high vehicular speed. Embedding an optimal number of pilots in an OFDMA symbol optimizes the WiMAX performance in terms of pilot overhead and BER.

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Evaluation of Digital Circuit Methodologies in Nanotechnology Using QCA - Quantum Dot Cellular Automata

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Abstract Quantum dot Cellular Automata (QCA) has more popularity in the near market due to its advantages over CMOS technology such as high device density, low power consumption and high computing efficiency. The major concern in circuits is to achieve improvement in QCA parameters like number of QCA Cells, cells area, total area, delay, energy consumption and single or multilayer layout. In this paper we will discuss about various techniques or methodologies to achieve improvement in these parameters. Different methodologies need to be designed to have optimization, automation and verifications in design. These techniques are primarily based on Logic synthesis, layers, clocking in QCA, feedback in QCA, QCA cell arrangements, use of tools to design the circuits, use of 3 × 3 or 5 × 5 QCA tiles etc. In today's era, less energy consumption is also a very important parameter. The main objective of this paper is to get the details of these techniques to improve the parameters. QCADesigner 2.0.3 and QCADesigner–E software are used to get the implementations in QCA field.

Keywords QCA (quantum dot cellular automata) · SRAM (static random access memory) · MV (majority voter) · 5-input majority gate (MV5) · PPDD (priority-phased decomposition-driven) · CLA (carry look-ahead adder)

1 Introduction

International Technology Roadmap for Semiconductors (ITRS) [1] has devised Nano devices like Carbon nanotube transistors (CNT), Single Electron Transistors (SET), Resonant Tunnelling devices (RTD), Quantum dot Cellular Automata (QCA) etc. as shown in Fig. 1. These are used to overcome the limitations of CMOS devices scaling. QCA is the best nanotechnology device among all these Nano devices.

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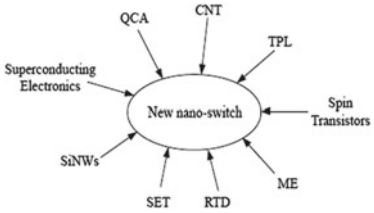


Fig. 1 Nano devices [1]

QCA is efficient, has very high device density and low power consumption. It is transistor less and can operate at Terahertz (THz) range. CMOS technology works on current switching whereas QCA represent binary information on the cells.

QCA is now used to design digital circuits in almost all the fields. Researchers have designed the circuits with different methodologies in QCA. In this paper, these different methodologies are discussed with their method and achievements in terms of various parameters.

In the remainder of this work, in Sect. 2, earlier reported work on QCA methodology is reviewed and compared. Section 3 shows the implementations of different methodologies for different circuits. This paper is one umbrella under which different methods are compared and analyzed. In Sect. 4, the work is concluded.

2 Methodologies

Till now, researchers have proposed different ways to design digital circuits to achieve optimization in terms of circuit area, number of cells, speed and complexity. In this section, these different methodologies are studied, analyzed and compared with standard parameters of interest. Various methodologies used are coplanar, multilayer, novel input technique, Bottom up design approach with special cell arrangements, keeping fixed input cells, inter cellular effect technique, PPDD technique, using 3 input standard MV gate and 5 input MV gate, using only one type of cell, tile based, models based, with simplified Boolean expressions, using different clocking etc. Circuits like NOT gate, XOR gate, the one used in building almost all the complex circuits, multiplexer, full adder, parity generator, latch, RAM etc. are implemented with these methodologies. Tables 1, 2 and 3 shows the comparison of all methods with respect to parameters and circuits implemented.

Comparative table for the methodologies shows that cell interaction or intercellular effect technique is the best to implement XOR gate and parity generator (4 bit, 8 bit, 16 bit and 32 bit) with low power consumption, less number of cells, less area and increased speed. Novel input technique is the best way to implement 2:1 multiplexer. Many implementations are seen for full adder but using MV5 is the best method with least cells, area and delay as indicated in Table 4.

Table 1 Different methodologies used to implement XOR gate

Methodology/technique	Cell count	Area (μm^2)	Delay	Circuit implemented
Multilayer crossover [2]	24	0.03	0.75	XOR, multilayer
Novel input technique [3]	29	0.02	0.75	XOR
Bottom up design with special cell arrangements [4]	54	0.08	1.5	XOR, coplanar wire crossing
With fixed input cells [5]	55	–	1	XOR gate with 1 fixed cell, different phases, single layer
Cell interaction technique [6]	9	0.009	0.25	Low power XOR gate, no crossover

Table 2 Different methodologies used to implement multiplexer

Methodology/technique	Cell count	Area (μm^2)	Delay	Circuit implemented
Multilayer crossover [2]	24	0.02	0.75	2:1 mux, multilayer
Novel input technique [3]	15	0.01	0.5	2:1 mux
Priority-phased decomposition-driven (PPDD) [7]	27	0.04	0.75	2:1 mux using gate level method
With fixed input cells [5]	41	–	1	2:1 mux, no crossover, 1 fixed cell, single layer
With fixed input cells [5]	1 81	–	3	4:1 mux, 3 fixed cells, single layer, no crossover

3 Implementations

This section shows the implementations of best methodologies for various circuits. QCADesigner tool is used to build the layout of various circuits and to observe the simulation result. Cell interaction method is the best method as per as cell area is concerned. Table 1 clearly indicates that, with the other methodologies the parametric values are high for XOR gate. As a case study the XOR gate implementation with other best methods is as shown in Fig. 2a–c.

Graphical representation indicates that cell interaction or intercellular effect technique [6] is the best methodology among the all as it shows the optimization in all the parameters with respect to the other methodologies. This methodology can build all other circuits using this XOR gate with best optimization. Cell count is indicated in Fig. 3, device density in Fig. 4 and delay in Fig. 5 for all methodologies considered here for different circuits.

Table 3 Different methodologies used to implement full adder

Methodology/technique	Cell count	Area (μm^2)	Delay	Circuit implemented
Using majority gate and inverter [8]	165	0.1932	1.25	Full adder
Using minority gate [8]	60	0.065	0.75	Full adder
Using multilayer wire crossing [8]	108	0.0884	1	Full adder
Using 5 input majority gate [8]	80	0.0352	0.75	Full adder
Circuits with MV5 [9]	54	0.04	0.75	Full adder, coplanar
Tools to reduce simulation time [10]	772	–	–	Full adder
Single layer, one type of cells and the interference of clocking phases [11]	95 494	0.09 0.68	1.25 4.25	1 bit and 4 bit Full adder
Tiles based design approach for QCA circuits [12]	576	–	8	1 bit full adder with 64 tiles
Tiles based design approach for QCA circuits [12]	1400	–	15	1 bit full adder with 56 squares
Tiles based design approach for QCA Circuits [12]	396	–	–	Gate based 1 bit full adder
Simplification in majority expressions [13]	143 742	0.17 1.3	1.25 4.25	1 bit and 4 bit Full adder
Standards [14]	190 NA	0.2 NA	No clock NA	1 bit and 4 bit Full adder

Table 4 Best method analyzed

Methodology/technique	Cell count	Area (μm^2)	Delay	Circuit implemented
Cell interaction [6]	9	0.009	0.25	XOR gate
Cell interaction [6]	26	0.029	0.5	4 bit even parity generator
Novel input technique [3]	15	0.01	0.5	2:1 mux
Circuits with MV5 [9]	54	0.04	0.75	Full adder, coplanar
Multilayer crossover [2]	32	0.02	0.75	D latch, multilayer

4 Conclusion

Optimizing key metrics like delay, cell count and cell area will help improving logic computation and information flow at the physical level implementation. Although QCA logic components can be designed with QCA gates, extra delays will be introduced, which can lead to incorrect timing relationships. These timing issues present difficulties for interconnection and feedback which can affect the performance of QCA circuits. Therefore, assigning correct and efficient clocking zones to circuits is

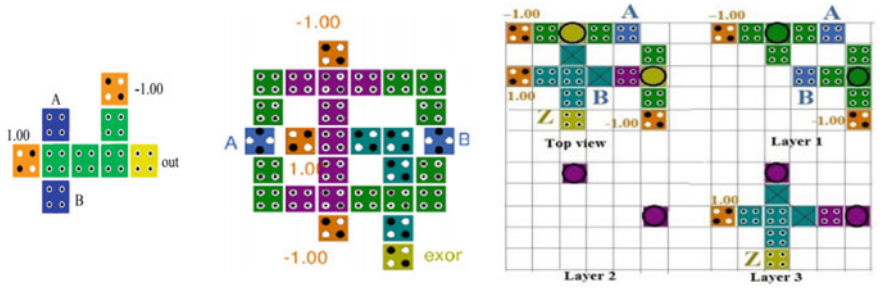


Fig. 2 XOR gate layout with the best methodologies **a** [6], **b** [3], **c** [2]

Fig. 3 Cell count

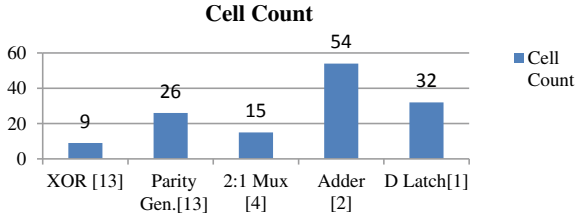


Fig. 4 Device density

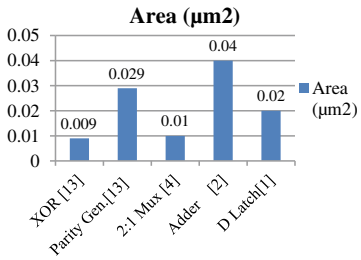
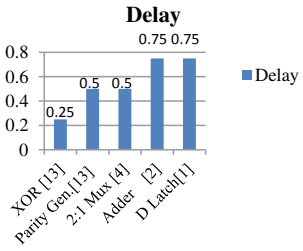


Fig. 5 Delay



a major challenge in QCA circuit design. These all issues lead to design an efficient methodology to optimize all the parameters especially density, speed and less power consumption.

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NeuraIC—Neural Image Caption Generator for Assistive Vision

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Abstract High-accuracy Image Captioning models have been developed as a result of recent breakthroughs in object detection using Deep Learning. Although these models are quite precise, they tend to rely on expensive calculation, making them challenging to apply in real-time applications. In this paper authors follows certain heuristic strategies and core ideas of Image Captioning and its common methods. A specific sequence based implementation with a remarkable transformation and efficient beam search instead of greedy search carried out on low-end hardware. The proposed system compares the results calculated using a variety of metrics with high-quality models and analyses the reasons behind the model trained on the MS-COCO dataset that are because of the trade-off between rapidity and eminence of computation. In this proposed system, RESTful API endpoint will be created to be used on any device with an internet connection such as a mobile phone, IoT devices, clock, etc., this endpoint used to send an image to the model running on remote server which in response will generate and sent an caption describing the objects and their relationship with each other in image in a natural language.

Keywords Neural networks · Assistive vision · Caption generator · Deep learning · Restful API · Optimization techniques

1 Introduction

Automatically defining image content and their relationships or actions is an important issue for artificial intelligence that connects computer vision and natural language processing. But this can have a profound effect on helping blind people to better understand their surroundings. These pictures can be used to produce captions that can be read aloud to the visually impaired so that they can better understand what is happening around them. This proposed system provides an API endpoint which

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uses generative model based on a deep recurrent architecture that incorporates the latest advances in computer vision and machine translation and that can be used to create natural sentences describing a previously captured or camera-captured image. The model is trained to increase the chances of interpreting the sentence using the Maximum Likelihood Estimation (MLE) given the training image. The interesting fact about this is that it's a sole end model that predicts captions given a picture, rather than requiring complex data preparation or a pipeline of specially created models.

The model must be capable of solving computer vision problems such as detecting items in photographs, but it must also be able to capture and explain object relationships in everyday language. As a result, writing image captions has long been seen as a significant challenge. Its goal is to simulate a person's ability to perceive and assimilate enormous volumes of visual information in descriptive language, making it a fun AI task.

2 System Architecture

In this proposed system, we are creating a RESTful API with a single endpoint that will be used to provide an image to the Image Captioning model running on the server. For creating an API, we will use AWS API Gateway Service and AWS Lambda. AWS Lambda will have a function to send the image received from the API request to the Image Captioning model on the AWS Sagemaker (Fig. 1).

The starting point of this system will be an application that can run on any platform like a mobile phone, smartwatch, or any IoT devices. This application will send an image through the API request to the AWS Lambda function. The picture that is sent by the application will be a pre-captured image or an image captured by the camera device. The AWS Lambda function will be responsible for transferring this image for further processing to the Image Captioning model where the image is processed, and an appropriate caption describing that image will be generated. This caption will be in a text format. The API response will send this caption back to the application, and this caption will be spoken out loud by the device. Also, the caption will be displayed on the device screen, if that device has a screen.

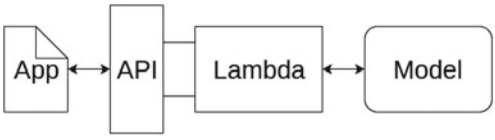

Fig. 1 System architecture

3 Datasets

There are various open source datasets accessible to solve this challenge, including MS COCO (180K photos), Flickr 30K (30K images), Flickr 8K (containing 8K images), and others [1]. However, we have used Microsoft's COCO dataset for the sake of this proposed system. There are around 180,000 photos in this dataset, each with five captions. MS COCO (180k photographs), Flickr 30K (30k images), Flickr 8k (containing 8k images), and additional open source datasets are available to address this challenge [1]. However, for the purposes of this suggested system, we have employed Microsoft's COCO dataset. This dataset contains approximately 180,000 pictures, each with five captions.

4 Data Cleaning and Data Pre-processing

When working with transcript, we frequently perform basic cleaning such as changing all of the words to lower case, deleting special tokens, and removing words that contain digits. Create a glossary of all the distinct words found in the dataset's 19,000 * 5 (as 950,000) image captions (CORPUS). As we are building a prediction model, System gives fewer words vocabulary that may occur frequently or may be common not all words related to that image. This helps our proposed model to be more authoritative for outliers and makes fewer blunders [2].

Data Pre-processing—Images

The system will convert each image into a fixed-sized vector that can subsequently be provided as input to the neural network (NN) because we have images of various sizes. We will employ the InceptionV3 model, which is a Convolutional Neural Network (CNN) designed by Google Research system. This model trained on the Imagenet dataset to accomplish picture categorization in 1200 different classes. However, we want to extract a fixed-length informative vector for each image, not only classify them. This will be accomplished through an automated feature engineering process [3]. To do so, we'll ignore the model's last softmax layer and remove a 1024-length vector for each image as bottle neck features.

Data Pre-processing—Captions

Prediction of the complete caption requires specific steps in sequence. The caption will be predicted word by word. That's reason system do encode every word into a fixed-size vector. For representing every exclusive word in the vocabulary, we will use an index in the integer form. The whole caption cannot be predicted all at once. Word by word, the caption will be anticipated. We'll use an integer index to represent every single unique term in the lexicon.

5 Model Overview

The model is described in three parts:

Encoder—This is a VGG16 model that is pre-trained on the ImageNet dataset. By pre-processing the photos with the VGG model and removing the output layer, we will use the extracted features predicted by this model as input. We have used VGG16 as an encoder because VGG won the image classification challenge in ILSVRC and so we can harness the state-of-the-art feature extraction capabilities of this model.

Sequence Processor—This is a word embedding layer followed by an intermittent neural network layer (NNL) with Long Short Term Memory (LSTM) for managing text input for specific timestamp.

Decoder—A fixed-length vector is produced by both the element extractor and the sequence processor. A Dense layer consolidates and processes these in order to create a final forecast.

5.1 Sample Working

In the main round, system scans or upload image vector and the first word ('begin') as inputs to the Sequence Processor and predict the second word like Input: Image_1_feature_vector + 'begin'; Output: 'This'.

Then again, we provide the image vector and the contacted first two words as inputs and predict the third word like Input: Image_1_feature_vector + 'begin This'; Output: 'white' and so on.

Reliant on the length of the output (description/caption), one image and one caption is not a single piece of data, but numerous data points. Not only does the image serve as an input in the system for all data points, but the descriptions that accompany it also aid in predicting the next word in the sequence.

5.2 Using Data Generators

In our training data, we have about 150,000 images, each with 4 captions. This makes a total of around 750,000 pictures and captions. Although we estimate that each caption is 5 words length on average, it will result in data points which is equal to 750,000 * 4 words will combine to form a sentence.

Even if we assume that each block occupies two bytes, we'll need more than 92 GB of memory to retain this data matrix. This is a massive demand, and even if we can fit this much data into RAM, the system will be significantly slowed. As a result, we employ data generators. We don't have to keep all of the data in one memory at once. Even if we only have a current set of points in memory, this is sufficient for our needs. Data Generators are a standard Python feature. In Python,

the generator function is used to accomplish this. It's similar to an iterator resuming where it left off the last time it was called.

5.3 Hyper Parameter Tuning

With a beginning learning rate of 0.002 step size and 2 photos per batch, the model was trained for 35 epochs (set size). The learning level was dropped to 0.0002 after 25 repetitions, and the model was trained in 7 photos each set. This makes sense because, as the model approaches convergence, we must lower the learning intensity in order to take incremental steps towards the minima during the most recent stages of training. Gradually increasing the batch size improves the power of your gradient and makes it dynamic.

6 Model of Proposed System

We used sequence to sequence to build encoder-decoder architecture in this system. A Deep Recurrent Neural Network with lengthy short term memory cells serves as the encoder. While the decoder is a pre-trained InceptionV4 Convolutional Neural Network. Raw images are converted using the encoder InceptionV4, convert the convolved features for the pictures into a stable length embedding F. This embedding is obtained by performing a forward pass to the layer preceding the last, i.e. the InceptionV4 model pool's average pool layer. In our approach, the decoder has two phases: training and inference. Given the convolved features associated with the source captions, the decoder is in charge of learning word order. In timestamp $t = 0$, these image embedding features F are used to initialise the hidden state of the decoder ht. The following equations demonstrate the core principle of the encoder-decoder model. [4].

$$\text{Input: } F = \text{Encoder}(I); \text{ Time stamp: } X_{t=0} = F;$$
$$\text{Output: } O_t = \text{Decoder}(X_{t:0} \rightarrow t)$$

The RNN training technique employing LSTM Cell-based decoder runs on a probabilistic model where the decoder improves the likelihood of a word p in captions given a convolved image feature F and previous words Xt:0 t. The decoder uses its repetitive nature to loop over itself N times with the prior knowledge (features and words sampled in timestamp t) put in storage in its cell memory as a state to learn the entire sentence of length N corresponding to the F features. The decoder can update Ct memory as it unrolls by accumulation of a new state, refreshing or forgetting the previous state with LSTM Algorithm f_t, entering it, and outputting it to memory gates.

$$f_t = \sigma(W_f.[h_{t-1}, X_t] + b_f) \tag{1}$$

$$i_t = \sigma(W_i.[h_{t-1}, X_t] + b_i) \tag{2}$$

$$c_t = \sigma(W_c.[h_{t-1}, X_t] + b_c) \tag{3}$$

$$C_t = f_t * C_{t-1} + i_t * c_t \tag{4}$$

$$o_t = \sigma(W_o.[h_{t-1}, X_t] + b_o) \tag{5}$$

$$h_t = o_t * \tanh(C_t) \tag{6}$$

$$O_t = \arg\max(\text{softmax}(h_t)) \tag{7}$$

σ	sigmoid;
O_t	Output word;
tanh	hyperbolic tangent;
W_o, W_f, W_i	Learnable Weight Vector;
b_o, b_f, b_i	Learnable bias Vector.

7 Training

In comparison to existing Caption Bots, our approach will employ Batched data, provide CNN fine-tuning, leverage TensorFlow, and operate on a GPU for offline evaluation [5]. All of these factors together will boost the Language Model's training speed by 100 times. Even though the 5000-image split is not a standardised split, several studies have used it to present their finding.

8 Result

8.1 Experimentation

The MS-COCO [6], Flickr 8K [7], and Flickr 30K [8] datasets are used to evaluate the performance of our approaches. They are the most often used and effective datasets for determining the accuracy of generated data. On the three datasets above, the comprehensive comparisons of reference captions are done. MS-COCO is a large-scale dataset for object detection, segmentation, and captioning. Over 83,000

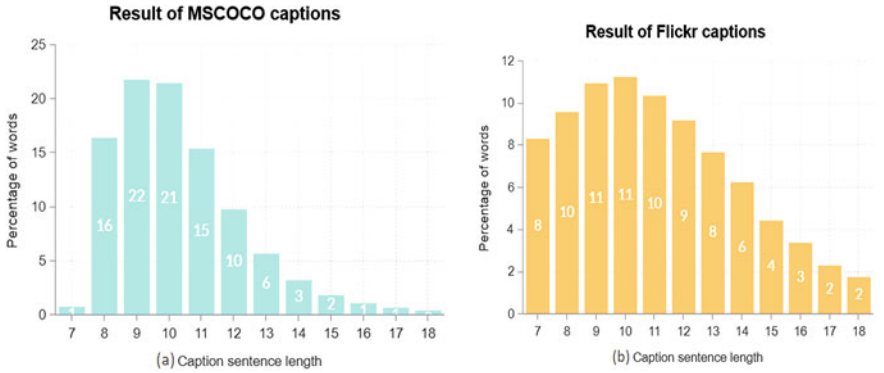

Fig. 2 Percentage of words per caption sentence length

training images, over 40,000 validation images, and over 40,000 experiment images are included in the official MS-COCO dataset. Method of splitting the official MS-COCO dataset into 123,000 training images, 5500 authentication images, and 5300 experiment images using the "Karpathy" split because it is the most generally used fragmented technique for reporting results. The Flickr 8K dataset is divided into three categories: 6500 photos for training, 1300 images for validation, and 1100 images for testing. The Flickr 30K dataset comprises 31,349 images, which we will divide into 25,298 training images, 2300 authentication images, and 3000 analysis images without any official division (Fig. 2).

The visualization of statistics of orientation captions on the MS-COCO dataset are shown in (a); the visualization of statistical effects of captions on the Flickr 8K and Flickr 30K datasets are shown in (b). The measurement of each caption sentence is embodied on the x-axis as length.

8.2 Evaluation Metrics

CIDEr, CIDEr [9], SPICE [10], METEOR [11], ROUGE-L [12], and BLEU [13] are some of the well-known metrics used by the author to analyse the efficacy of our method using image captions. Both CIDEr and SPICE are human consensus metrics. CIDEr is a tool for comparing the similarity of a generated caption to a set of human-written definitions. SPICE is also a conditional metric that assesses how well a structured language captures objects, characteristics, and their relationships. METEOR calculates sentence level similarities using the harmonic concept of unigram recall and precision. Gisting can be assessed using ROUGE-L. The number of dispersed units, such as n-grams, order of words, changed words between generated captions and human writing sentences determines its ratings as accurate as real time words. The BLEU machine translation metaphor is widely used. It is largely determined by the n-grams' cohesion.

9 Conclusion

The results above show that the algorithm we had used fits accurately to our proposed system and gives better results than the previous methods used for image caption generation, it consumes less computation power and generates caption quickly which is required for such real time Application and enhances the user experience. This application is optimized for assisting visually impaired peoples in understanding the environment with ease by leveraging the technological enhancements. This model can be used with other applications with the help of the API and it provides flawless integration.

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A Survey: Handwriting Analysis Software Using Image Preprocessing and Machine Learning

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Abstract This study is about an application that will perform Handwriting Analysis using Machine Learning. This application aims to input an image of a handwritten text and perform Handwriting Analysis on it to produce a brief report about the writer's personality traits. There are many areas where Handwriting Analysis is required, but it is not possible to consult a professional. This application will be used as a substitute for such situations.

Keywords Behavior prediction · Image processing · Feature extraction · CNN

1 Introduction

Humans have various handwriting patterns and a person's handwriting differs from that of another person's. A person's writing is useful in understanding the behaviour of a person. Handwriting is a combination of 4 attributes i.e. dots, lines, curves, loops. Handwriting is a subconscious activity and is considered a mirror of your own thoughts.

Graphology is based on the principle that after every individual is taught how to write, his/her handwriting develops to incorporate certain patterns which indicate traits of personality and thus every individual's handwriting contains a character of its own which is due to the uniqueness of one's personality.

Handwriting Analysis is the study of variations in the patterns of handwritten text, and the attached psychological interpretations to them. Writing can indicate personality features like a person's anxiety, honesty, self-confidence etc. Handwriting analysis has many uses, such as analyzing candidates for the recruitment process, analyzing criminals for criminology, and various other fields.

The currently available Handwriting analysis tools are charts for comparison of handwriting characteristics and a few online tools that analyze signatures. Analysis of signatures provides a minimal handwriting sample for analysis. The proposed system analyzes paragraphs for handwriting patterns and thus has a wider range of attributes to study which in turn results in a more accurate personality prediction.

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2 Literature Review

Lemos [1] analyzed the personality based on the slope of the baseline in handwritten text. CNN model was then used to compare the input image with the training dataset images.

Sen and Shah [2] analyzed the flow of handwriting shortness. This was created using Matlab. Some features of the input image were compared with the older images.

Varshney and Puri [3] discussed the various terms associated with handwriting. They also surveyed based on handwriting using ANN. They also showed various fields where this technique can be useful.

Fallah [4] used the MMPI technique, the HMM (Hidden Markov Model), and neural networks to perform analysis. The proposed system would identify the characteristics which were related and not related to the writer. The preprocessing was also performed.

The author used the autography movement to portray the written element of each person's handwriting pattern and design. The author creates a chart of the writer's characteristic attributes and his sentimental condition by analyzing the basics of his handwriting using graphology. In the graphological analysis, the image is divided into two parts: the graphic attributes and partitions of each digit and character. In this research, the author employs graphical accession which is calculated by analyzing the digit and signature of the consumption scheme's character using many-frame algorithms and ANN (Artificial Neural Network). The image is then divided into two spaces: the signature occupied on nine appearances and the letter digit space consumption scheme. Each space performs preprocessing to improve the accuracy of recognition. The ANN-based classifier is applied on five features, which results in a 56–78% accuracy, while that of the many frame algorithms results in 87–100% exactness [5].

In his paper, Dhang [6] categorizes the picture into two aspects: the signature based on three characteristics and the application form on the letters-digit area. A person's behaviour is analyzed based on his/her signature by using an artificial neural network. According to the research, performance assessment is done using Back Propagation Neural Network (BPNN) to calculate the mean square error.

In this paper, the author states that an individual's ethics can be precisely depicted as a set of influences sequenced by a Markov chain. To ensure the virtue of this system, the author conducted an experiment in which he was able to predict automobile drivers' subsequent actions from their starting preparatory movements with a 95% accuracy [7].

3 Comparison of CNN Based Emotion Analysis with Other Techniques

See Table 1.

Table 1 Comparative table between CNN and other techniques

S. No.	Modality—dataset	Technique/algorithm	Accuracy of personality prediction (%)
1	Handwriting samples	K-nearest neighbour	Happy-80 Stressed-70
2	Handwriting samples	Support vector machine	Happy-80 Stressed-70
3	Handwriting, drawing	Random forest approach	72
4	Handwriting samples	Convolution neural network	91

4 Motivation

Handwriting is an activity that is done by our subconscious mind and is hence considered as a reliable factor through which we can identify the traits of the writer's personality. The main motivation is to detect the behaviour of the user using the handwriting sample provided by the user.

5 Proposed Methodology

The features which are associated with handwriting are as follows:

1. Slant: The slant has three types, a. Handwriting tilted towards left or left slant. b. Handwriting is not tilted or straight. c. Handwriting tilted towards the right or right slant.
2. Letter size: A letter can be divided into three zones: the upper, the lower, and the middle zones. As some letters of the English alphabet are located in the middle and lower zones, the size of the middle zone plays a vital role in handwriting analysis.
3. Margin: The location of the alphabets on-page within a particular frame is known as margin. This feature is used to test a person's potential.
4. Pressure: - The pressure can tell how much the writer has emotional intensity. The low pen pressure indicates light thinking, and the high pen pressure indicates strong thinking.
5. Zones: The letter written can be divided into three zones: the upper, the lower, and the middle zones. The upper zone indicates the person's state of mind, 'the middle zone indicates the person's emotions,' and the lower zone indicates the 'impact of physical elements in their environment'.
6. Connections: There are four types of connections that can be seen in handwriting; they are garlands, arcades, angles, and thread.
7. Clarity: Clarity in handwriting indicates positive emotions. The clarity of the overall text is considered. A larger spacing between words indicates that the writer is interested in socializing. There are other factors also which are also considered along with clarity.

8. Spacing: Spacing is considered within words and overall with the margin also. A 'rule-of-thumb' technique is used in spacing. If the whole text in the handwriting sample is towards the left, then the person has certain fears about his/her future. If the whole text is towards the right, then the person is motivated and enthusiastic.
9. Baseline: The three common baselines found in a handwritten text are: ascending baseline, descending baseline, and level baseline.

The proposed system task (Fig. 2) is divided into six steps:

1. The user inputs an image of a handwritten text as input to the system. The input image is then passed to the system, as illustrated in Fig. 2 [1].
2. The input is converted into a grayscale image using OpenCV and python [2]. For this, the image is converted into a binary image by the following method- if the pixel's threshold value is higher than the fixed value, the pixel value is set to 1 and if the pixel's threshold value is less than the fixed value then it is set to 0. This binary image is given as input to the neural network.
3. Image preprocessing is carried out for the noise removal and sharpening of the image [3]. Preprocessing is done by ground clearance and locating the exact handwriting to be processed without any noise.
4. The segmentation of words into alphabet letters is done using the drop fall algorithm [4]. This algorithm divides the words into alphabet letters and is a standard segmentation technique for finding input traits.
5. The dataset is created through the collected data and is given as training data to the model [5]. Even if the data size is not large, a Convolutional Neural Network can work well and can perform smoothly. CNN gives better accuracy, with high noise resistance.
6. Finally, a report about the writer's personality is given as output to the user [6]. This report includes characteristics regarding the handwritten text such as average slant, pen pressure, baseline, letter size and spacing and the corresponding personality traits (Figs. 1 and 2).

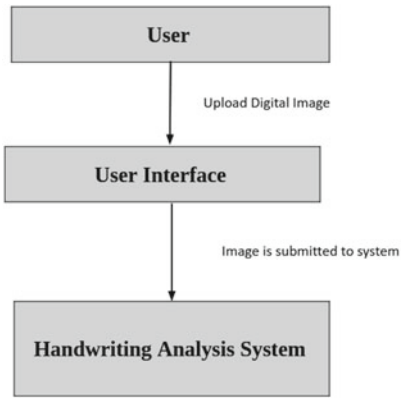

Fig. 1 Overview of system

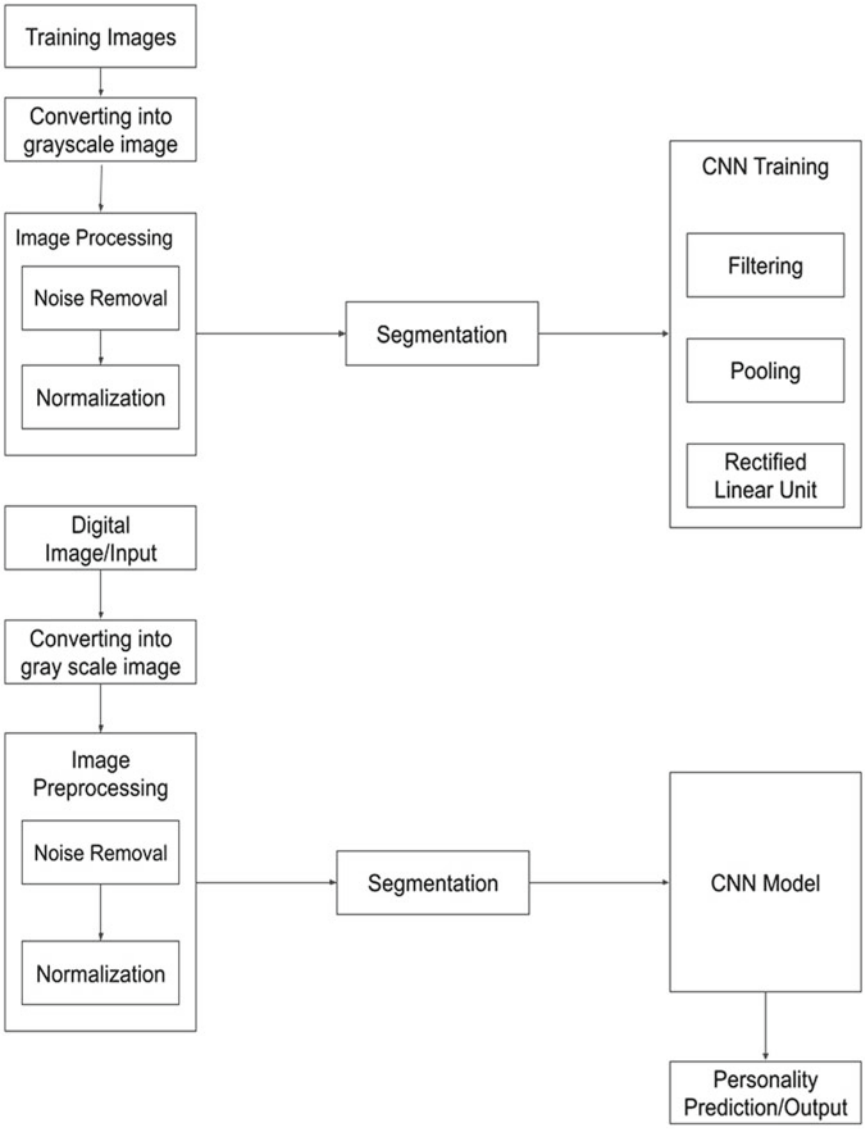

Fig. 2 Prediction of human personality

6 Conclusion

A method is proposed to predict an individual's personality traits based on his handwriting analysis. The system extracts features from breaks, size, space between words, baseline, and few other features like pressure, margin and slant. It will analyse

the input image with CNN model in the proposed methodology. The main feature of this proposed system is to extract from handwriting all possible features of human behaviour. Graphologists can use the proposed system as a tool to improve their accuracy and to anticipate behaviours more quickly.

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Design and Technology Co-optimization for Investigating Power, Performance, Area and Cost Trade-Offs in FinFET Technologies

Vijayalaxmi Kumbar and Vaishali Raut

Abstract The speed of the semiconductor technology roadmap was conventionally defined by the scaling of the patterning pitches, with the main objective of halving the cost per transistor for each subsequent technology node. In this scaling process, a certain degree of uncertainty influencing the time-to-market of a technology node is intrinsic. While improving the technology there is need of device technology co-optimization. This paper presents the survey of device technology co-optimization for A fin field-effect transistor (FinFET) devices that deals with optimization of the power, performance, area and cost. It focuses on the co-optimization of the various designs implemented using FinFET devices. Further, it provides the challenges and constrained associated with the co-optimization of the FinFET device designs and applications.

Keywords Fin field-effect transistor · Device technology co-optimization · Technology scaling · Power optimization

1 Introduction

Number of transistors on the given chip area doubles every two years. Technology scaling helps to reduce the features of the device by maintaining or improving the speed and power dissipation. Because of smaller feature size, the source and drain regions of the MOS devices encroaches into channel area that motivates the leakage current to flow between them. Due to this leakage current it becomes difficult to turn of the MOS device completely [1].

A fin field-effect transistor (FinFET) is a multi-gate MOSFET (metal–oxide–semiconductor field-effect transistor) device [2]. This device is constructed on the substrate where the gate is placed on two, three, or four sides of the channel or wrapped around the channel thus forming a double gate structure. The fin provides the larger region between source and drain thus reduces the leakage current and hence resulted in smaller size and faster device [3]. These devices are called as "FinFETs"

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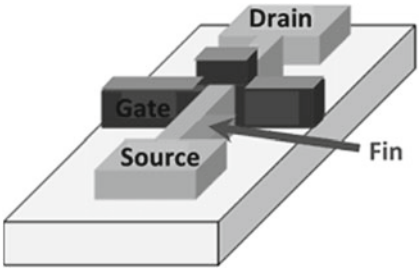

Fig. 1 Structure of FinFET [6]

because the source/drain region looks like fins on the silicon surface. Thus, FinFET is also called as 3D transistor or non-planar transistor.

FinFETs have attracted huge attraction of fabs and commercialized in first half of 2010 [4]. Later, it became the major gate design at 14, 10, and 7 nm. The FinFET devices have considerably higher current density and faster switching times than planar Complementary Metal–Oxide–Semiconductor (CMOS) technology. A single FinFET transistor can consists of several fins, arranged on outer side and all fins are covered by the common gate, that act electrically as one, to increase drive strength and performance as shown in Fig. 1. The FinFETs has advantages such as lower feature size, lower power consumption, lower operating voltage, higher speed, and reduced operating speed [5, 6].

In this paper, we present review of various co-optimization techniques adopted for the designs and applications implemented using FinFET technology. It focuses on the power, performance, area, speed, and cost optimization of the device. Further, it provides the challenges, constraints and open area for the future development in co-optimization of FinFETs.

The remaining paper is structured as follow: Sect. 2 provides extensive survey of various co-optimization techniques adopted for various FinFET based designs. Section 3 depicts the findings and challenges in FinFET designs from the survey. Finally, Sect. 4 offers the conclusion and the future scope of the proposed work.

2 Survey of FinFET Design Co-optimization

Device and technology co-optimization has become an important part of defining and leveraging advanced technology. The co-optimization deals with the complex trade-off between platform technology and product support. The co-optimization can be performed at the device level, logic block level, core/chip level and application level [7].

Design-technology co-optimization (DTCO) helps to semiconductor manufacturing industries to achieve the target of optimized power, performance, area and cost (PPAC). Typical chips consist of multiple blocks such as logic blocks that perform the logical operations and Static Random Access Memory (SRAM). The chief aim of

the design technology co-optimization is to maximize PPAC gain, to get maximized output and to increase the speed [8].

Gupta et al. [9] investigated the effect of fin ratio, height, thickness and orientation of fins for the co-optimization of performance and area of SRAM using FinFET. They have suggested symmetrical spacer thickness and independent gate to co-optimize the SRAM performance. Energy, delay and yield co-optimization is dependent of the transistor variability [10]. Xu et al. [11] presented perpendicular magnetic junction tunnel (PMJT) as storage element and FinFET transistor as the access transistor. It is observed that the optimal write pulse width depends upon the design and architecture specifications. Gerrer et al. [12] studied that predictive Technology Computer Aided Design (TCAD) tools variability also affect the design process and DTCO process. Shafaei et al. [13] presented High V_t(HVT) FinFETs for the co-optimization of SRAM that improved noise margins and reduces the leakage current.

Increase in the device parasitic and interconnect resistance cause the voltage drop and limits the gain of device improvement. Badaroglu et al. [14] presented co-optimization of 5 nm technology node using low k-device spacers, non-Cu based interconnects for improved interconnect resistance and wrap-around contact for improved device parasitic. Jo et al. [15] proposed design rule checker framework with the help of automatic layout generator for the design technology co-optimization. They have evaluated the changes the design rules, its impact on the number and types of design rule violations along with chip area. They have achieved the faster and efficient performance and better co-optimization with the help of well formulated complex design rules and double patterning lithography. They have suggested that machine learning techniques can be used for the future to optimize the design quality.

Girish et al. [16] explored the Search Optimization (SO) technique based on predictive approach to optimize the design structure of the FinFET and SRAM that ensures the fault tolerance in dynamic computational devices and applications. They have used mathematical formulation for getting significant outputs and lower computational time. SO has given better performance traditional particle swarm algorithm (PSO). Bufler et al. [17] proposed that on current (ION) caused due to the effective gate in FinFET devices can be reduced using multiple sheets because of higher resistance of lower lying sheet. This study presented the performance of the nano-sheets and FinFETS. They found that single sheet device simulation is inaccurate compared with multi-sheet device simulation.

Huo et al. [18] implemented 6T SRAM cell using 7 nm FinFET device. They have evaluated the performance of the proposed design on the basis of leakage reduction, improvement in read noise margin, improvement in write margin, improvement in hold noise margin and improvement in hold noise margin. It achieved better performance in terms of implementation simplicity, speed, cost and accuracy. It achieved better balance between static power dissipation, stability and delay under process fluctuations.

The comparative analysis of the various optimization techniques of the FinFET designs are given in Table 1.

Table 1 Performance comparison of DTCO techniques

S. No.	Author	Application	Simulation platform	Advantages	Disadvantages
1	Girish et al. [16]	SRAM design	MATLAB	Less computational complexity, less energy consumption, high accuracy	Optimized solution is not guaranteed
2	Bufler et al. [17]	P-type and N-type device	Monte Carlo simulation	Higher on-current, access resistance ION is smaller	Increasing number of sheets contributes very low in IONs of nano-sheets
3	Huo et al. [18]	6T SRAM	Commercial global TCAD solutions (GTS)	Leakage reduction, improvement in read noise margin, improvement in write margin, improvement in hold noise margin	Process fluctuation leads to power dissipation. The quantum effect slightly degrades the write margin
4	Badaroglu et al. [14]	Star wireload	MIT virtual source model 9	Improvement parasitic and interconnect resistance	Thermal challenges, difficulty in getting sustainable gain
5	Jiang et al. [10]	14 nM FinFET	NAND, NOR, inverter	HSPICE	Improved performance, reliability-aware circuit design, gives better results for high and low performance devices
6	Xu et al. [11]	22 nm FinFET	Spin-transfer torque RAM	Monte-Carlo simulations	Optimal write pulse can give minimum write energy and latency
7	Shafaei et al. [13]	7 nm FinFET	6T SRAM	SPICE simulations	Low energy delay product, reduced leakage current, enhanced hold signal noise margin (HSNM) and read signal noise margin (RSNM)

3 Challenges in FinFET Based Designs

A FinFET is multi-gate 3D transistor that results in improved power consumption, and performance. It has huge reduction in static (leakage) power and dynamic power.

FinFETs have capability to reach to extend Moore's law all the way to 5 nm. The major challenges faced by FinFET designs based on analog, digital, parasitic and signoff viewpoint are:

- Fabrication of FinFET needs additional masking for correct printing at below 20 nm technology.
- For layout designing it needs additional node requirements.
- Increased electro-migration because of the low process node operation
- Large number of complex fabrication based design rules
- Quantum effect and process fluctuations may degrades the performance of design
- Difficulty in getting sustainable gain
- Restricted device sizing
- Larger static and dynamic power dissipations
- Trade-off between power, performance, area and cost
- Process fluctuation leads to power dissipation.
- The quantum effect slightly degrades the write margin
- Leakage reduction and noise margin improvement is complex
- Effect of parasitic is rarely addressed.

4 Conclusions and Future Scope

Thus, this paper presents the extensive survey of the design technology co-optimization in FinFET designs. It describes the need and challenges in the optimization of the various parameters such as power, performance, area, speed, accuracy, and cost of the device. This survey paper, gives the information about FinFET design, co-optimization techniques, simulation platforms, etc. FinFETs give better solution to short channel electro-static effect, sub-threshold leakage, ability to operate at low voltage, lower variability due to doping variability and higher device parameter variability. In future, work can be extended to minimize power dissipation, variability issue, improve the speed, area, power and cost.

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Improving Security with Optimized QoS in Cognitive Radio Networks Using AI Backed Blockchains

Shital S. Chopade and Surendra S. Dalu

Abstract Cognitive radio networks (CRs) are used whenever intelligent channel selection is needed. Using CR, the trans receiver is able to send scan signals on the network to evaluate if the network is free or not. Once the scan is complete, then data communication is performed on the network. In order to optimize the network performance, various state-of-the-art approaches are proposed which optimize the quality of service (QoS) parameters like end-to-end communication delay, throughput, energy consumption, packet delivery ratio, etc. While optimizing these QoS parameters, there are certain security loop holes created in the CRNs. Due to these loop holes, the sensing capabilities of the CR nodes get affected as attackers induce invalid signatures on the nodes, thereby making them misbehave. In order to reduce these attacks, this paper introduces a blockchain based approach to secure the cognitive radio network. But due to the inclusion of a security framework, the network QoS reduces. In order to reduce the effect of blockchain on QoS, an adaptive Artificial Intelligence (AI) is incorporated into the network. This AI layer is responsible for enhancing the QoS performance, while keeping the CRN secure. The AI layer uses sidechains in order to perform this task. This work is observed to have a 20% higher trust level than non-blockchain based security algorithms, while maintaining a 10% improvement in the overall network QoS.

Keywords Cognitive · Attacks · QoS · Blockchain · Artificial intelligence · Sidechain

1 Introduction

Cognitive radio network security requires the network designer to take into consideration a large number of network scenarios in order to full proof the network. During

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this full proofing a large number of lacunas arise in the network, which affects the quality of service parameters. For instance, while adding encryption capabilities to the network node, the computational complexity of the node increases. This increases the power consumed by the node while transacting data packets, thereby reduces the network lifetime. Moreover, due to additional computations there is a delay introduced into the network. This delay slows down the network, and thereby reduces the throughput of the network. The energy calculation per unit communication for one node can be observed from Eq. 1,

$$E_{left} = E_{start} - E_{Tx} * N_{Tx} - E_{Rx} * N_{Rx} - \sum E_{Compute} * N_{Compute} \quad (1)$$

where, E_{left} is the energy left in the node, E_{start} is the initial energy of the node, E_{Tx} is the transmission energy needed for sending one packet, E_{Rx} is the energy needed for receiving one packet, $E_{Compute}$ is the energy needed to perform computations before sending or after receiving the packets. The N_{Tx}, N_{Rx} and $N_{Compute}$ are the number of packets transmitted, received and computed during communication. The summation sign on the compute energies indicates that there can be more than one operation for computation, which affects the energy consumption in the network. Thus, as the complexity of security algorithms increase, there is an increase in either the number of packets communicated, the number of packets computed or the computational complexity (which directly relates to the energy consumption) of the nodes. This results in reducing the energy left in the network, which directly affects the lifetime. In order to reduce the energy consumption, algorithms are tuned to reduce the number of node computations, and the complexity of each computation. It is also preferred that most of the computations to happen at the high-power router node, while the communication nodes should do minimum chrome computations, and utilize their maximum energy for performing communication operations. The ratio of the energy utilized for communication to the total energy utilized to perform that communication is termed as communication energy efficiency of the node, and can be represented using Eq. 2

$$E_{eff} = \frac{E_{com}}{E_{tot}} \quad (2)$$

where, E_{eff} is the energy efficiency E_{com} is the Communication energy and E_{tot} is the total energy needed for completion of the communication, which is evaluated from Eq. 1. Similar evaluations are done for delay, throughput, jitter, packet delivery ratio and other QoS parameters. Using these evaluations, it is observed that in order to improve the QoS parameters, there is a need to reduce the number of calculations and the computational complexity of algorithms. Moreover, as the calculations are reduced, and the computational complexity is reduced, the security quotient of the algorithm reduces. The security quotient or strength of any security algorithm can be represented with the help of Eq. 3, wherein the security calculations and complexity

values are represented in the form of metrics.

$$S_q = \sum N_{calc} * S_{calc} + \sum N_{comp} * S_{comp} \tag{3}$$

where, N_{calc} is the number of calculations done in order to provide the given level of security S_{calc} is the security quotient of the given calculations, similarly N_{comp} and S_{comp} represent the number of computations and the security quotient of the computations to obtain the given level of security? The security quotient values S_{calc} and S_{comp} are in the range of 0–1, where 0 indicates that this calculation has no effect on enhancing security of network, while 1 indicates that the calculation is totally dedicated towards increasing network security. As the value of S_q increases, so does the security of the network. But this increase in S_q also increases the number of computations, thereby reducing the overall QoS of the network. Thus, there is a need to balance between the security parameters and the network performance parameters in order to design a high QoS& secure CR network.

2 Literature Review

A large amount of research, done in the field of cognitive radio security focuses on data modification algorithms. For instance, the work in [1] proposes the use of blockchain enabled internet of vehicles framework which uses cognitive radios. The CRN used in this work utilizes the standard Technique for Order Preference by Similarity to the Ideal Solution (TOPSIS). Bilen [2] proposes decentralized database using blockchain to verify spectrum sharing between cognitive radio.CR overview is studied in paper [3]. In [4], wherein concepts of digital signature and mutual authentication are applied in order to secure the cognitive radio networks. The work in [5] proposes a simple tree-based mechanism for backbone formation in the network. An admission control mechanism for cognitive radios using blockchain is described in [6], wherein a secondary user using the channel is interrupted in case a primary user arrives, which pushes the secondary user to the waiting queue. Such that, in case any user (either primary or secondary) is not following the policies, the node addresses are not registered in the blockchain, thereby informing the system not to accept any packets from these nodes. The work in [7] analyzes the cross layer framework based particle bee optimized convolution neural network for examining the malicious activities present in the cognitive radio networks. In [8] it has been proposed that a Q learning-based dynamic optimal band and channel selection by considering the surrounding wireless environments and system demands in order to maximize the available transmission time and capacity at the given time and geographic area. Another Q-Learning based mechanism is described in [9], wherein spectrum access is estimated using reward-mechanism. Another machine learning mechanism which uses modified whale optimization algorithm(MWOA) for spectrum access is described in [10], wherein the system aims to reduce the transmission

power, bit error rate and signal interference, while increasing the signal throughput and the frequency spectrum efficiency. A system using artificial neural network with fuzzy inference system is described in [11], wherein in-place of whale optimization algorithm the ANFIS algorithm is used.In [12] a deep Q-Learning network is dedicated to improving the spectrum allocation and resource allocation for CRNs. The system is able to reduce the congestion rate between nodes, and thereby improves overall network quality of experience for the nodes. Another reinforcement learning based algorithm for improving network quality in cognitive radio networks is defined in [13]. Here, the system uses State-Action Reward- (next) State- (next) Action (SARSA) algorithm combined with Cooperative reinforcement learning to improve network capacity. In order to improve spectrum sensing capabilities of a cognitive radio network, reinforcement learning can be utilized as depicted in [14]. Due to the cloud-based learning it is observed that the capacity of the nodes is further improved, and the overall energy consumption per node is reduced when compared to a non-cloud assisted architecture. This concept is further extended by the work in [15] wherein various Reinforcement Learning (RL) based techniques called No-External Regret learning, Q-learning, and Learning Automata, are used to Minimize Channel Switching and User Interferences. The work in [16] proposes a comprehensive virtual predictive WB sensing approach with QoS-optimization phase. In order to improve the throughput of cognitive relay network and optimize system utility, a cognitive relay network throughput optimization algorithm based on deep reinforcement learning is proposed in [17]. The work in [18] introduces the concept of blockchain as applied to AI enabled increased throughput 5G networks. A QoS provisioning and energy saving scheme for single Base Station management is proposed, in [19]. In [20] an overview of blockchain and ML is briefly described. An integrated digital signature and mutual authentication (IDsMA) mechanism is proposed in [4]. The work in [21] provides a reinforcement learning algorithm to improve the QoS and QoE (Quality of Experience) for high speed networks. An adaptive GB-aware MAC protocol that supports multiple simultaneous assignment decisions for multiple CR users under dynamically varying channel quality conditions due to fading are mentioned in [22]. In order to evaluate the channel allocation efficiency, the study in [23] can be utilized, wherein different mechanisms for CRN evaluation and improvement are mentioned. Cognitive radios can also be extended to vehicular adhoc networks (VANETS). This can be observed from [24], wherein a decentralized communication scheme using hidden Markov model (HMM) is described. Wherein [25], a simple double threshold algorithm for spectrum sensing is described. Using this algorithm, the Spectrum-Scarce VANETs performance is improved. This technique can be further improved by hybrid spectrum access and prediction techniques used in the high-traffic cognitive radio communication system, in order to enhance the throughput and overcome the problem of waiting states [26, 27] Describes application of spatial modulation (SM) in overlay cognitive radio (CR) networks. In order to extend the security of these networks another blockchain implementation can be observed in [28], which provides optimal admission control to secondary users based on a discounted Continuous Time Markov Decision Process, and algorithms for smart city deployment of blockchain technologies. A permissioned blockchain

trust framework is proposed for the spectrum sharing in multi-OPs wireless communication network in [29]. In [30] an anomaly detection and reputation assignment scheme called Sense Chain has been proposed based on the reputation information disseminated via a blockchain. 6G technologies along with potentials of blockchain for resource management and sharing in 6G using multiple application scenarios namely, Internet of things, device-to-device communications, network slicing, and inter-domain blockchain ecosystems are described in work [31].

3 Improved QoS with Enhanced Security Spectrum Access Blockchain-Based Cognitive Radio Architecture (IQESBCR)

This section describes the proposed IQESCBR, that improves the spectrum access efficiency along with improved security in cognitive radio networks. The proposed deep learning based QoS optimization architecture for cognitive radio networks using blockchain has 3 major components,

- Data communication based on proof-of-work based smart contracts
- QoS optimization based on deep learning
- Auto side chaining based on genetic algorithm.

All these components are linked together via a Q-Learning approach, which works on a reward and penalty model to distribute data storage. The flow diagram of the proposed system can be observed from Fig. 1, wherein the security layer, QoS optimization and the auto-side chaining layers are connected with the help of the Q-Learning framework.

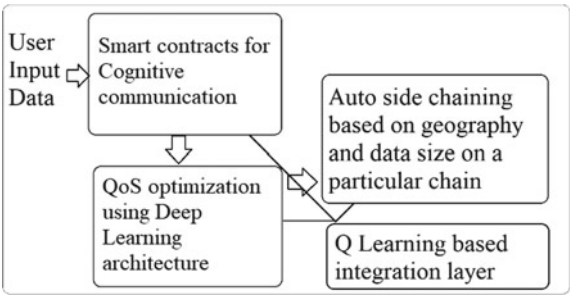

Fig. 1 Flow diagram of the proposed work

4 Results and Analysis

In order to evaluate the results of the proposed IQESBCR protocol, the following network parameters were taken into consideration.

From Table 1, the numbers of nodes were varied from 30 to 100, and the numbers of communications were varied from 2 to 10. Upon doing this the following scenarios were considered under varying levels of network communications,

- Basic cognitive network with AODV (B)
- Basic cognitive network with AODV under attacks (BATT)
- Cognitive network with only blockchain under attacks (BATTB)
- Cognitive network with blockchain, side chains and deep learning under attacks (IQESBCR).

From the result it can be observed that the initial values of delay and energy are the most optimum for the cognitive radio without any attacks. Once the attacks take place, then both the energy and delay requirements increase exponentially. This is due to the fact that, a network under attack is prone to have less QoS because one or more resources are not able to perform at their most optimum performance. But, due to inclusion of the blockchain layer, this performance is improved. The performance levels are better than the ones which are in the attack phase, but they are still lower than the optimum values. Here, due to the inclusion of deep learning for better QoS performance, the delay and energy parameters get further optimized. In certain cases, the delay and energy values are very close to optimum, while in other cases they are always better than the secured blockchain network. As the performance of the proposed IQESBCR protocol is found to better than the other configurations,

Table 1 Simulation parameters

Network parameter	Value of the parameter
Propagation model	Two ray ground
MAC	802.11
Interface queue type	Drop tail priority queue
Antenna model	Omni directional antenna
Number of nodes	30–100
Routing protocol	AODV
Network size	300 m × 300 m
Idle power	1 mW
Reception power	1 mW
Transmission power	2 mW
Sleep power	0.001 mW
Transition power	0.2 mW
Transition time	0.005 s
Initial node energy	100 mW

Table 2 Comparative performance of QoS parameters

Parameter	B	BATT	BATTB	IQESBCR
Delay (us)	2257	4185	2941	2279
Energy (mJ)	23.6	49.7	34.9	25.1
Throughput (kbps)	286	179	205	277
Jitter (us)	56	129	76	59
Packet delivery ratio (%)	100	85	91	99

similar comparisons were made for other QoS parameters. The average values of these QoS parameters taken over 10 communications for 100 nodes can be observed in Table 2,

5 Conclusion and Future Scope

From the entire QoS results it can be observed that the performance of the proposed secure and QoS optimized network is at par with a cognitive radio network that is not under any kind of attack. This makes the proposed algorithm applicable for real-time CR networks. From the delay performance of the proposed network it can be observed that the cognitive radio without attacks has an average delay similar to the delay of the proposed protocol. This can also be observed from Fig. 2, wherein the average performances of all the algorithms are plotted.

The delay is improved by almost 50% when compared to the cognitive radio network under attack. Similarly, the energy performance follows the same trends. The throughput performance follows an inverse trend, because when using the proposed protocol in cognitive radios the overall throughput increases by almost 40% when

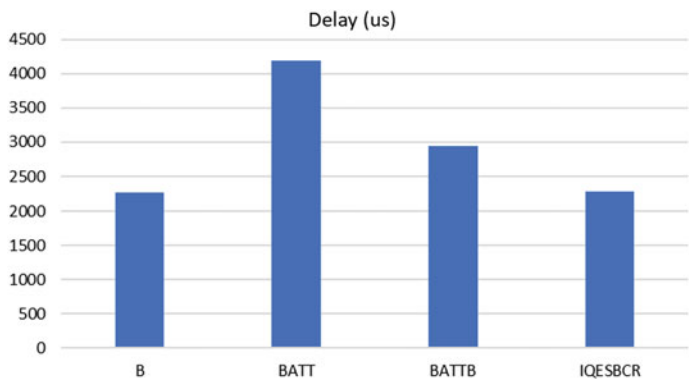

Fig. 2 Delay performance of algorithms

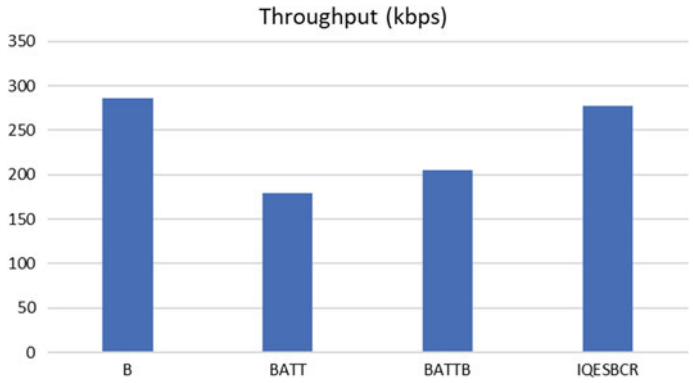

Fig. 3 Throughput values for different network conditions

compared with the cognitive radio under attack. This can be observed form Fig. 3, wherein the throughput values for different algorithms are plotted.

Similarly, the jitter reduces and the packet delivery performance of the network increases when the proposed protocol is applied. It is recommended that researchers compare the performance of the proposed protocol under their network conditions before implementing this protocol onto their network. In future, researchers can work on reducing the computational complexity of the network, and include light-weighted blockchain models so that the initial requirement of QoS optimization can be relaxed.

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Single Shot Detector for Multi-vehicle Detection and Tracking in Different Lighting and Weather Conditions

Shilpa Jahagirdar and Sanjay Koli

Abstract Intelligent communities use innovative ideas to make human life better. Smart transportation is one of such idea to be implemented in smart cities. As number of vehicles are increasing too fast, need of smart transportation is increasing day by day. Vehicle detection and tracking has become essential part of such smart transportation systems. Self-driving car, accident detection, traffic flow statistics, license plate recognition are some related research works which can be undertaken based on vehicle detection and tracking. This paper compares different approaches of vehicle detection techniques. Multiple vehicle detection and tracking in various atmospheric and lighting circumstances by making use of deep learning-based single shot detection algorithm is described in detail by authors.

Keywords Vehicle detection · Tracking · SSD · Surveillance videos

1 Introduction

Multiple vehicle detection plays important role in smart transportation system. By correctly detecting and tracking multiple vehicles from CCTV videos, numerous types of research work can be undertaken.

Obviously, various techniques for detecting and tracking vehicles is the base for all such research work. Vehicle detection and tracking becomes more challenging if it is to be achieved in different visual conditions [1].

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State of art methodologies involves traditional steps, such as removing background from video, thresholding, performing morphological operations, finding contours, drawing contours on video, drawing binding box and feature extraction. But there are few drawbacks associated with the state of art methodology like large processing time and single contours formation for close objects. Because of these drawbacks, such methodologies cannot be used for advanced real time applications like self-driving car or accident detection.

Advanced algorithms from deep learning like, Single Shot Multi-Box Detector (SSD), You Only Look Once (YOLO), Region-based Convolutional Neural Networks (RCNN), Faster Region-based Convolutional Neural Networks (Faster RCNN) gives improved results in comparison with state of art methodology and that too at very fast rate [2].

In this paper, Sect. 2 elaborates literature survey on multi-vehicle detection and tracking. In Sect. 3 authors discuss the popular SSD algorithm in detail. Section 4, discuss about experimentation carried out and the results obtained for multiple vehicle detection and tracking using different methodologies.

2 Literature Survey

Vehicle detection and tracking methodologies can be divided into state of art techniques as well as advanced deep learning-based algorithms. Traditional object detection process is primarily about how to extract the required features manually and later how to use different classifiers to find out if the area in image is part of a particular object. Such as, for performing detection of object, including automobiles, a multi-scale DPM (deformable parts model) was suggested by Felzenszwalb et al. [3, 4]. Further, Dalal and co-authors suggested to the utilize HOG (Histogram of Gradient) features [5], along with a linear SVM (support vector machine) for object detection. Such method has an advantage of high speed of execution, but its accuracy to detect object was poor in complex environments.

But with development of artificial intelligence, machine learning and deep learning methods over the past few years, remarkable results were achieved in the fields like computer vision and many other fields like text recognition, speech recognition [6–11]. Increased computational speed was the backbone behind these advanced methods.

The early object detection framework, based on convolutional neural networks, i.e., RCNN was suggested in 2012, by Girshick et al. [12]. Compared to traditional algorithm, 30% more Mean Average Precision (mAP) had obtained using RCNN. Further, He et al. suggested the SPP net [13] in 2014. A layer of spatial pyramid pooling is used in it to decrease the size limitation of CNN. This was followed by a number of advanced detectors, like Mask RCNN [14], Fast RCNN [15], Faster R-CNN [15] etc. These object detection algorithms have quite high accuracy, however nonetheless speed of detection was poor for all these methods.

You Only Look Once (YOLO) was suggested by Joseph and co-authors in 2016 [16]. In this paper, for the first time, the detection process was executed as the regression job. Subsequently, in 2016, Single Shot Multi-Box Detector (SSD) was suggested by Liu et al. [17]. In this paper, for the first time, to detect regression, single shot detector algorithm offered multi-layer.

MAPs. Joseph and co-authors launched YOLOv2 in 2017, which is the better version of YOLO. It notably improved object detection speed, but did not support detection of tiny objects [18]. Further DSSD-Deconvolutional Single Shot Detector algorithm was proposed by Fu et al. in 2017, [19], in which author added a deconvolution layer and presented a residual module. Detection of tiny objects was greatly improved with it as compared with previous Single Shot Detection (SSD) algorithm. Joseph et al. offered next version of YOLO as YOLOv3 relying on the concept of SSD [20] in 2018. It came up with improved detection ability even for tiny objects.

These advanced deep learning-based algorithm for object detection can also be used for numerous applications in open CV. For example, Shilpa et al. elaborates use of these algorithms for accident detection in surveillance videos [1]. Manisha et al. describes use of such algorithm for video-based person reidentification [21], Rameez Muneer et al. focuses on emergence and functionality of 3D videos with the help of deep leaning based algorithm [22] and Swapnil et al. elaborates identification of sugarcane foliar diseases with the help of deep learning based advanced algorithms [23]. In short, the main advantage of deep learning-based algorithms is its capability of good performance in object detection at high speeds and wide spread area of application.

3 Single Shot Detection (SSD)

As name indicates, Single Shot detector takes only one shot for detection of multiple objects present in an input image using multiple boxes. The SSD has of two components, a backbone model and SSD head. Generally, feature extraction is done with the help of an image classification network which is pre-trained such as ResNet, ImageNet or MobileNet and is used as backbone model. Final fully connected classification layer is removed from these networks leaving behind the deep neural network which extracts logical information from image without disturbing structure of the image in spatial domain. The SSD head is additional convolutional layer or layers added to the model. Finally, the outputs are portrayed in terms of the bounding boxes as well as classes of objects (Fig. 1).

3.1 Grid Cell

Instead of using typical approach of sliding window, SSD came up with new approach. SSD divides the whole input image in to small grids and each grid is

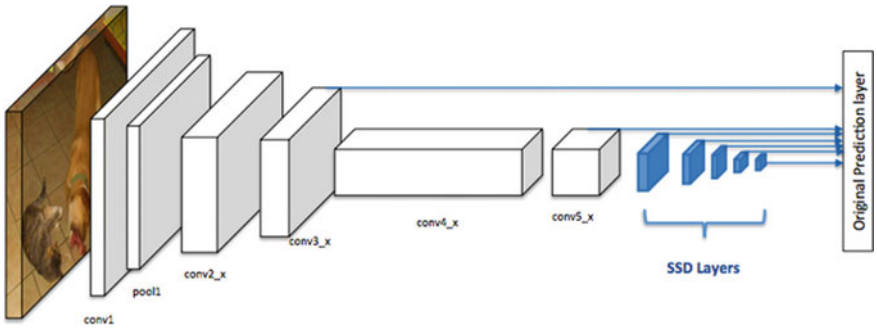

Fig. 1 CNN architecture with an SSD detector [17]

further responsible for detecting object in that area of input image. It predicts location and class of an object in grid region. If object is not present in grid area then location is ignored. If there are multiple objects inside a grid area then anchor boxes play important role.

3.2 Anchor Box

Multiple anchor boxes of different aspect ratio are assigned to each grid cell in an input image. These anchor boxes are responsible for shape and size of object within a grid cell. While training, SSD algorithm uses matching phase to match the particular anchor box with bounding box of ground truth in an input image. Out of multiple anchor boxes, the anchor box having the highest degree of overlap (higher than threshold of 0.5) with object is considered responsible for predicting location and class of that object.

3.3 Loss Function

SSD algorithm uses MultiBox loss as its loss function, which composed of the localization loss and confidence loss. Over all loss function of Single Shot Detector is addition of confidence loss (conf.) and localization loss (loc.)

$$L(x, c, l, g) = \frac{1}{N}\left(L_{conf}(x, c) + \alpha L_{loc}(x, l, g)\right)$$

where N is number of matched default boxes, L_{conf} is confidence loss, L_{loc} is localization loss and α is weight term.

3.3.1 Localization Loss

Localization loss, L_{loc} is the loss between ground truth box (g) and predicted anchor box (l) parameters. Coordinates of center of box (cx, cy), height and width (h and w) of bounding box are the parameters which are considered while calculating the localization loss.

$$L_{loc}(x, l, g) = \sum_{i \in Pos}^{N} \sum_{m \in \{cx, cy, w, h\}} x_{ij}^{k} smooth_{L1}\left(l_i^m - \hat{g}_i^m\right)$$

$$\hat{g}_j^{cx} = \left(g_j^{cx} - d_i^{cx}\right)/d_i^w \quad \hat{g}_j^{cy} = \left(g_j^{cy} - d_i^{cy}\right)/d_i^h$$

$$\hat{g}_j^w = \log\left(\frac{g_j^w}{d_i^w}\right) \quad \hat{g}_j^h = \log\left(\frac{g_j^h}{d_i^h}\right)$$

3.3.2 Confidence Loss

Confidence loss, L_{conf} is the error in predicting the class of object. It is the softmax loss over multiple classes confidence (c). $x_{i,j}^p = \{1, 0\}$, is the factor for matching ith default box to the jth ground truth box of category p. The equation of confidence loss is,

$$L_{conf}(x, c) = -\sum_{i \in Pos}^{N} x_{ij}^p \log\left(\hat{c}_i^p\right) - \sum_{i \in Neg} \log\left(\hat{c}_i^0\right) \; where \; \hat{c}_i^p = \frac{\exp\left(c_i^p\right)}{\sum_p \exp\left(c_i^p\right)}$$

4 Experimentation and Result

4.1 Experimentation

Experimentation for multiple vehicle detection in various visual conditions was carried out on an Intel (R) system with Core (TM) i5-8265 (U) CPU, at 1.60 GHz. Tools used are Anaconda 3.0, python 3.5.1 and many advanced libraries from python like Keras, ImageAI, and Tensor Flow. Google Colab, an online could service along with remote GPU is used for executing deep learning-based algorithms.

Fig. 2 Comparison of multi-vehicle detection and tracking using **a** state of art methodology **b** single shot detector (best viewed in color)

4.2 Result and Discussion

As discussed before, many lacunas are associated with traditional methodologies to detect and track vehicle. One of such lacunae is shown in following Fig. 2(a) where many vehicles quite close to each other are detected as a single object.

Further, SSD algorithm was used to carry out experimentation of multiple vehicle detection and tracking and results are compared with state of art methodology as shown in Fig. 2(b).

With above results, it is observed that SSD algorithm gives fast and accurate results for vehicle detection and tracking as compared to state of art methodologies. So, further experimentation was performed for detection and tracking multiple vehicles in distinct lighting circumstances like Early Morning, mid-Day, Night and various atmospheric circumstances like Sunny, Rainy, Foggy. Figure 3 shows results achieved for it.

5 Conclusion

This paper confronts state of art methodology for detecting and tracking multiple vehicles with deep learning based Single Shot Detector algorithm. It is noticed that Single Shot Detector algorithm for multi-vehicle detection gives superior performance as compared to state of art methodology as MAP for SSD is close or above 75 even at different FPS rates. The algorithm is also able to detect and track distinct kind of vehicles in various atmospheric and lighting conditions successfully, regardless of vehicles being proximate or overlapping in the frame. As SSD algorithm is very fast and accurate, research work such as, self-driving, accident detection and traffic flow statistics can be further undertaken using it.

Fig. 3 Multi-vehicle detection, tracking and classification in distinct visual conditions (**a** day **b** night **c** early morning **d** sunny **e** rainy **f** foggy) using SSD algorithm (best viewed in color)

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A Survey on Liver Cancer Detection: Based on Deep Learning Technology

Sunita P. Deshmukh, Dilip D. Shah, and Pravin N. Matte

Abstract Nowadays, in developing countries liver cancer has become one of the fatal and highly increasing cancers. It is very difficult to detect the tumor in the early stages of cancer mostly it is detected at an advanced stage which causes life-threatening issues. Hence, it is very necessary to develop such a system which can detect and locate tumor more accurately, precisely, and as early as possible. In this paper, a survey on different methods, techniques, and systems used for the detection of liver cancer is given. These systems are automatic, semiautomatic, manual detection systems. These systems are developed using machine learning technology with supervised, unsupervised, and deep learning techniques. Also, a table has been given in this paper, in which a comparison between different existing liver detection techniques based on accuracy is given. In recent days, in this field, deep learning is emerging out with very great results as compared to other techniques.

Keywords Liver cancer · Deep learning · CNN

1 Introduction

In 2018, as per the GLOBOCAN, about 18.1 million new cases were recorded in the world, and in that 9.6 million were death cases. Cancer is the 2nd main cause of death. Some of the major examples of cancer causes of cancer death are Lung cancer, colorectal cancer, Liver cancer, Stomach cancer, and Breast cancer, etc. The number of death cases provided by WHO [1] corresponding to different cancers in 2018 is given by the graph in Fig. 1.

Nowadays, in developing countries liver cancer has become one of the fatal and highly increasing cancers. According to AstraZeneca [2], this cancer is the 6th most common cancer and 3rd leading cause of cancer death. As per paper [3], the new cases of liver cancer recorded were 4.7% of all types of cancers in 2018. Mongolia and Egypt (Asia) have the highest liver cancer's incidence and mortality. According

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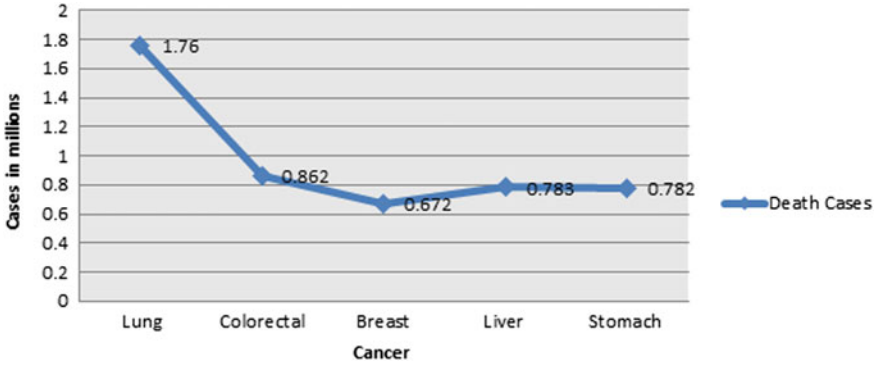


Fig. 1 Cancer death cases in 2018

to [4], Liver cancer was the 5th most common cancer in males and 9th in females also it was the 2nd cause of cancer death in males and the 6th cause in females.

The liver is an important internal organ of humans that performs many important functions such as drugs' detoxification, filtration of blood, protein generation, etc. It is the largest internal organ. In the liver, when the cell grows abnormally it causes cancer which is called hepatic cancer or liver cancer [5]. As per previous studies, it is very difficult to detect the tumor in the early stages of cancer most probably it is detected at an advanced stage which causes life-threatening issues. So it is very essential to detect it as early as possible. Due to this patients can receive the treatment immediately and it results in an improvement of survival rates. Manual detection of cancer tissue is a complicated, time-consuming, and difficult task. So, to detect the tumor accurately a computer-aided diagnosis (CAD) is used in the decision-making process.

2 Types of Liver Cancer

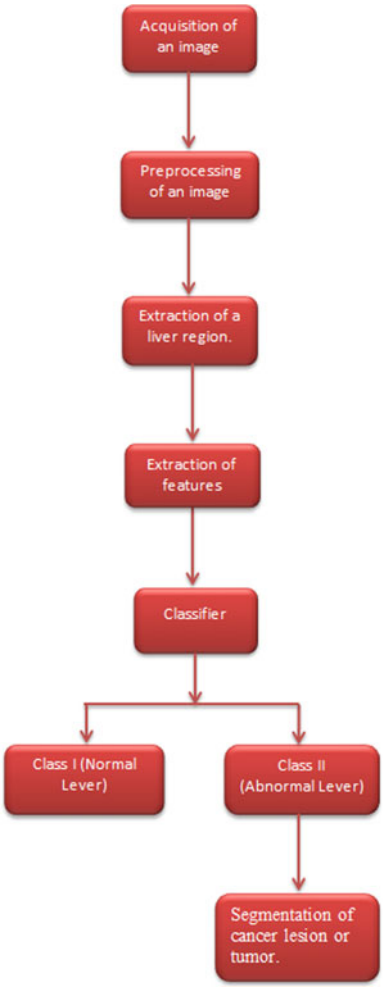
There are different types of cells present in the liver. These different cells form different types of tumors some of the tumors are cancerous call malignant and some are non-cancerous call benign. Two major types of cancer are:

1. Primary cancer
2. Secondary cancer

Primary are those which start in the liver and secondary are those which come to the liver from other parts. Hepatocellular carcinoma (HCC) is one of the common forms of liver cancer. According to [6], almost 80% of liver cancers in adults are of this type. There are some risk factors such as obesity, cirrhosis, gender, age, alcoholism, hepatitis B, and C [7]. According to WHO, the hepatitis B virus (HBV) can cause chronic infection, cirrhosis, and liver cancer.

According to previous studies, this Liver cancer is diagnosed by imaging tests, including ultrasound scans, MRI scans, and CT scans.

Nowadays, Computer-Aided-Detection (CADe) and Computer-Aided-Diagnosis (CADx) systems using machine learning techniques became indispensable in the medical field. There are various systems with different techniques that have been proposed in previous studies. Each one has some pros and cons. But the basic algorithm and steps are common in all. So, different techniques and algorithms that have been used in previous studies are discussed in this paper. The general approach used in previous studies is given in the flowchart.



Now, the different existing techniques and methods used for each process given in the above workflow are summarized as follows:

- preprocessing of image:

The image acquired by different imaging techniques is a raw image. Hence, in preprocessing quality of the image is enhanced by removing different noise and imperfections. It also involves different standardization and normalization methods of images. This process helps to improve not only the visual quality of the image but also the effectiveness of further processes. This is the basic process in Digital image processing (DIP).

Digital image processing is one of the important techniques by which an image is processed through computers with various algorithms. This image is acquired by different imaging techniques such as Magnetic Resonance Imaging (MRI), Computed tomography (CT), Positron Emission Tomography (PET), and Ultrasonography (US).

There are different methods to remove noise in the images. Major two categories of these methods are given below:

1. Spatial domain approach
2. Spectral domain approach

3 Methodologies

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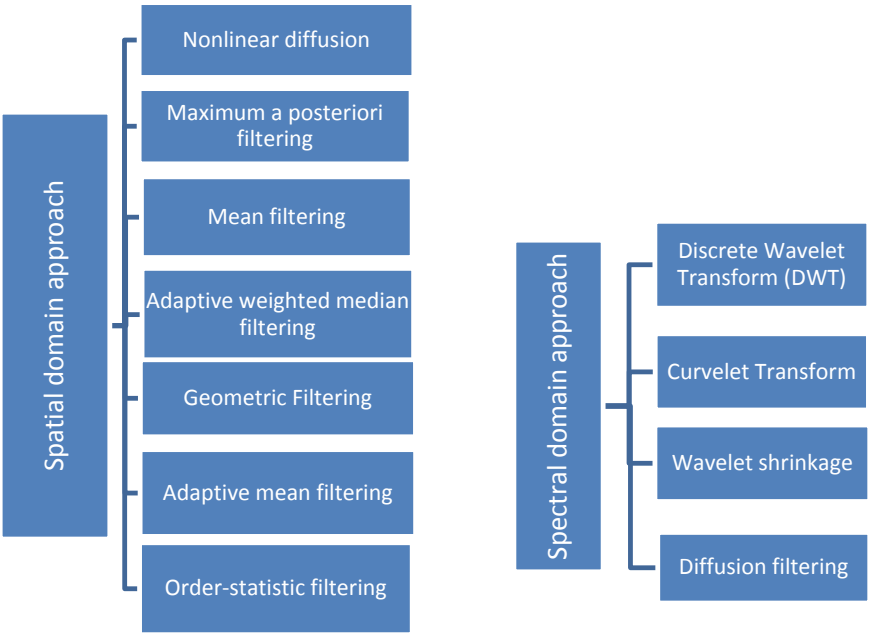

Fig. 2 Spatial and spectral domain approach

4 Classification

In the medical field, classification is used to predict diseases and medical diagnosis [8].

Two major performance factors of the classification are:

1. Accuracy: It must be as high as possible.
2. Execution time: It must be as low as possible.

In this process, the given object is classified into two, three, or multiple classes as per the requirement and for this procedure, features that were extracted or selected in the earlier steps are used. Training and testing is a fundamental process in classification. In two different ways the object can be classified as stated below:

1. Supervised: Predefined classes with labeled input data.
2. Unsupervised: Unknown classes with unlabeled data.

Some of the major examples of classifiers that are available are listed in Fig. 3.

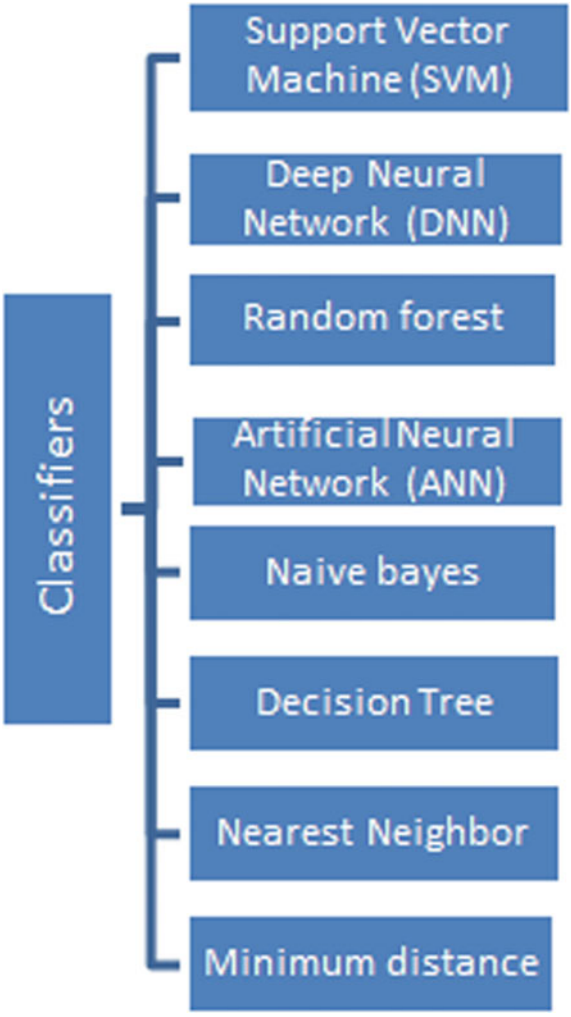

Fig. 3 Methods of classification

5 Results

Early detection is very essential to improve the survival rate. Enhanced MR image provides enough information for the diagnosis of the tumor, but according to paper [9], this diagnosis is affected by subjective experience. So, deep learning is one most suitable technique to overcome this problem.

Zhen et al. [9] used a deep learning technique for the diagnosis of liver tumors. To develop deep learning they used Convolutional Neural Network. In the dataset, enhanced and unenhanced MR images and clinical data are used. In the proposed system they have classified the given image into seven categories. This system has a high accuracy of detection and classification.

In paper [10], a Liver tumor segmentation system using deep learning was proposed. In this system, a 3D convolution neural network (CNN) was used. In this study, 3D CNN and plain (2D) CNN are compared. For 2D CNN U-Net is used. According to the paper [10], 2D CNN gives better results than 3D CNN. 3D CNN is computationally expensive.

5.1 Expected Result

From the previous studies and their result shown in Table 1, it is clear that not only the detection of a tumor but also detecting it as early as possible is very important. This can be achieved with the system having high speed and good accuracy. Therefore, it is expected that the proposed system should require less execution time and high accuracy (greater than 98%) or it should classify images precisely. This can be achieved with deep learning technology. Figure 4 shows the accuracy obtained using different classifier.

Table 1 Comparative study of existing liver tumor detection technique

Sr. No.	Applications	Authors and references	Year	Techniques methods/classifier/segmentation algorithms	Result/accuracy
1	Intelligent image processing techniques for liver cancer	Shah et al. [11]	2014	SVM, active control model	95.29%
2	Automatic liver and tumor segmentation	Yuan [12]	2017	Hierarchical convolutional/deconvolutional N.N.	96.7%
3	A computer-aided diagnostic system to characterize CT focal liver lesions	Gletsos et al. [13]	2003	Neural network classifier (NN)	97%
4	Liver tumor in CT Scans segmentation	Almotairi et al. [14]	2020	Modified SegNet	98%
5	An efficient method for segmentation of images	Ghamisi et al. [15]	2012	CNN model	80.06%
6	Liver and tumor segmentation from CT volumes	Sun et al. [16]	2019	H-DenseUNet	96.5%
7	Classification of Liver tumor candidate	Chlebus et al. [17]	2017	Random forest	90%
8	Computer aided diagnosis system for abdomen diseases in CT images	Sethi and Saini [18]	2016	Genetic algorithm, SVM, ANN	95.1%

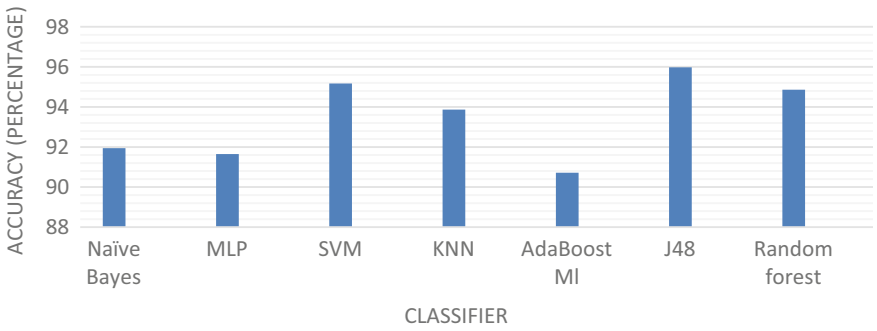

Fig. 4 Accuracy of different classifier

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Design and Implementation of Power Efficient 4 Bit Ripple Carry Adder Using 14 nm FinFET Technology

Kanchan Kadam and Swati S. Shetkar

Abstract In various relevancy like DSP (Digita Signal Processing), processors and microcontroller, Full Adder (FA) circuits is having very dominant role. The power-efficient FA plays significant role in electronics, which specially evaluate several ALU (Arithmetic Logic Unit) operations. In this Research paper RCA is implemented using 6T FA, which reduces the consumption of Power and maintains the lower difficulty of logic. The RCA is basic block of various design like Multiplier. The Layout and Simulation of 6T FA and 4 Bit RCA using 6T FA is carried out in Microwind 3.8 environment in FinFET 14 nm technology. 6T FA layout is designed with increased number of Fins in circuit design to reduce hot carrier induced device degradation. The transistor count is reduced in proposed design. The major superiority is its reduced power consumption. The Proposed RCA consumes 97.35% less power than Conventional RCA.

Keywords Ripple carry adder (RCA) · Full adder (FA) · FinFET · MOSFET · CMOS · Multi value logic (MVL)

1 Introduction

To work with digital circuits, it is important to do fast basic ALU operations like addition, subtraction, multiplication, division. Most of the basic ALU operations are done in binary only to do so; the basic building blocks should have Less Delays, Less Power requirement, Less requirement of Area. For achieving such conditions we are having various things to do with this, the one and major thing is to decrease the number transistor required and the another thing is to change methodology. The main building block of all basic operations is Full Adder. As time goes, several researchers have been proposing different design of FA by the use of different logics to reduce the transistor size and count and hence improved power consumption, speed and area. Every design is having its own advantages and disadvantages, it is

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not enough to reduce only the number of transistors, it is very important to decrease the supply voltage and do changes in the transistors Width/Length (W/L) ratio. This paper discuss on 4 bit RCA. N number of FA connected in parallel to form RCA. The logical diagram of RCA is shown in Fig. 1.

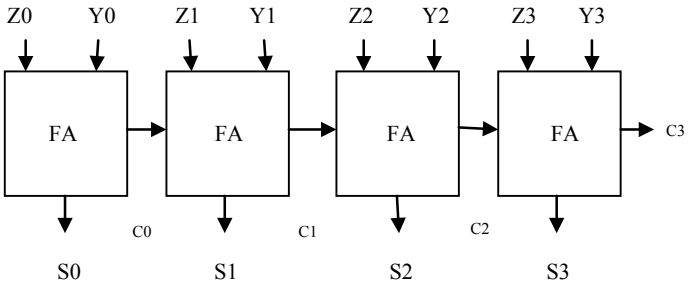
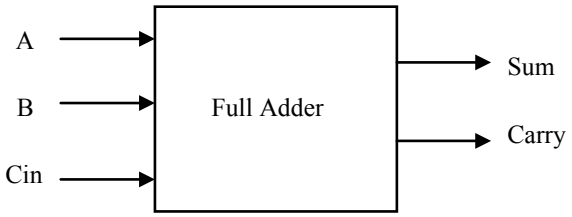


Fig. 1 4 Bit ripple carry adder

1.1 Basics of Full Adder

As discussed in [1–4], the Full-Adder (FA) is basic unit circuit of ALU. Full adder is used in various operations like Addition, Subtraction, Multiplication and Division. The circuit of FA implemented by the use of OR gate, AND gate and X-OR gates. The Block diagram of 1 bit FA is given in Fig. 2.

Fig. 2 1 Bit full adder



A. *Truth Table of FA and Conditions for RCA*:

Inputs			Outputs	
A (input 1)	B (input 2)	Cin (input 3)	Sum (output 1)	Carry (output 2)
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

Equation for Sum (output 1) and Carry (output 2) is given,

$$\text{Sum(output 1)} = (\text{A} \oplus \text{B}) \oplus \text{Cin} \quad \text{Carry(output 2)} = \text{A} * \text{B} + \text{B} * \text{Cin} + \text{A} * \text{Cin}$$

2 Related Work

A RCA is a basic module for many ALU (Arithmetic Logic Unit), Multiplier unit. The basic unit of RCA is FA. Until now different designs of FA are implemented in various styles. Comparative Analysis of FA is given in [2, 3] and [5]. In [2] various Full Adder circuits are provided with decrease in transistor count. Proposed design in [2] is 10T FA which gives very low leakage current. Same as [2] the paper [5] also given FA designs with decreased in transistor count. Proposed design in [5] is 6T FA. As shown in [1] to implement conventional CMOS RCA, it requires 184 transistors and it is having more Delay, consumed power is also more. As given in [1, 2] the 14 transistors FA circuit is used to implement the RCA. This 14T FA design requires 40 transistors to implement RCA and the power consumption is 542.15 μW. As given in [2], the 10 transistor GDI based full Adder is used to implement 4 bit RCA circuit. RCA is implemented with 56 numbers of transistors, which is shown in [1, 6] and [3]. The power consumption of this GDI based RCA is 142.56μw. As given in [1], the 9 transistor Based Full Adder and RCA is shown. 4 bit RCA is implemented by 36 number of transistor. The power consumption of this 9T based RCA is 9.731 μW.

FinFET is also plays important role in power Degradation. As discussed in [7] Fins with lower number can suffers from the hot carrier induced device degradation. To avoid such degradation the n-FinFET and p-FinFET could be taken with more number of Fins.

3 Overview of FinFET Technology

A FinFET (Fin-field effect transistor) is a Nano electronic device [8]. The main advantages of FinFET technology are to keep very small power consumption and also to reduce state leakage current. When we reduce the length and width of an Channel in MOSFET occurs various drawbacks like DIBL, saturation of velocity, punch through. To get rid off from SCE (short Channel Effect) we assign the other controlling gate without changing gives improved controlling capability to manage the flow of electrons from S (source) to D (drain). This innovation is named as FinFET.

$$\text{Cox} = \text{Eox}/\text{Tox} \tag{1}$$

where

Eox Permittivity of Oxide (F/cm)
Tox Thickness of Oxide (cm)
Cox oxide capacitance per unit area.

Same like MOSFET, FinFET is having channel upwards of silicon plane named as Fin. Channel of conduction is enclosed by Fin. This is the reason why SCE effect is controlled.

The FinFET is having major credits over MOSFET [8].

1. High output current per unit input voltage.
2. High speed of switching and Lower the consumption of power.
3. High technological maturity than planar DG.
4. Rid off to Short Channel Effect (SCE).

As given in [7] discussed about the performance of FinFET accordance with the Fins number. They have given the statement that device with fewer fins tolerate from very harsh hot carrier induced device degradation. It is mentioned that the effect of coupling which is between the fins lowers the similar electric field in the devices with more fins, thus gives better reliability than the fin with single device do after hot carrier stress (Figs. 3 and 4).

4 6T Adder Using FinFET Technology

A very first idea of implementing RCA using 6T Adder is came from [3] and [5] paper has implemented the 6T FA using MVL (Multi Valued Logic). 6T adder based on MVL is proposed. In the 6T FA sum is generated using 2 transistor XOR module and carry is taken using logic of pass transistor. The NMOS and PMOS are cascaded in such way that it generates XOR logic. In this design ($A \oplus B$) is given to multiplexer based pass transistor which is made of two transistor to pick one between two. To

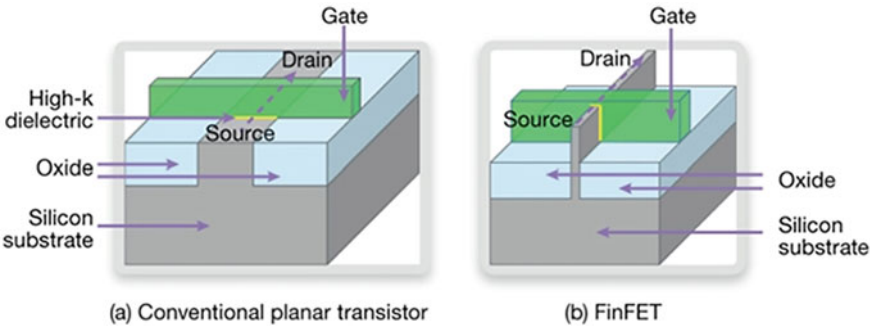


Fig. 3 Establishment of conventional planar transistor and FinFET [8]

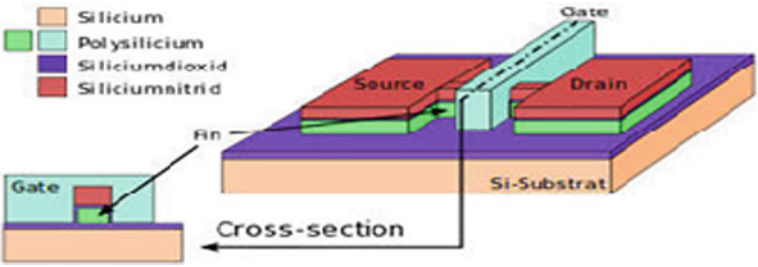
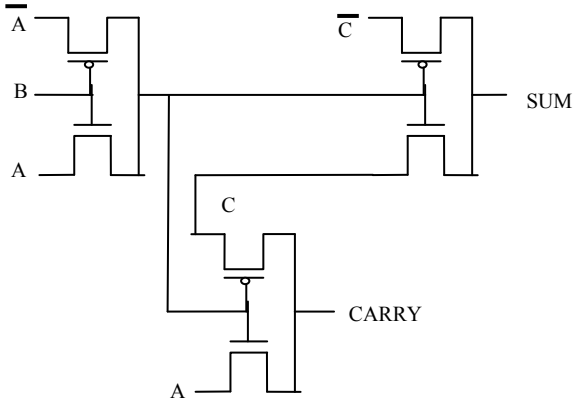


Fig. 4 Process of fin etching [8]

get carry (A ⊕ B) is forwarded to multiplexer to pick between A and C for generate sum (A ⊕ B) is to pick between C, $\hat{C}$ (Fig. 5).

Fig. 5 Proposed 6T full adder



5 Layout and Simulation Results

5.1 Layout and Simulation of 6T Full Adder

The layout of 6T FA is designed in Microwind 3.8 FinFET 14 nm technology as shown in (Fig. 6a) and simulation result for the same is shown in (Fig. 6b).

5.2 Layout and Simulation of RCA Using 6T Full Adder

The layout of 4 Bit RCA using 6T FA is designed in Microwind 3.8 FinFET 14 nm technology as shown in (Fig. 7a) and simulation result for the same is shown in (Fig. 7b). For implementing 4 Bit RCA, it requires 4 6T FA and 3 inverters. So the final count of transistors to implement 4 bit RCA is 30.

5.3 Comparison of 6T RCA and Conventional RCA

RCA	Transistor count	Consumed power (μW)
Conventional	184	258.34
6T RCA	30	6.846

6 Conclusion

A 4 Bit RCA is implemented using 6T FA. The RCA layout Design is implemented using Microwind 3.8 Environment FinFET 14 nm Technology. The design with more number of fins gives stability to the overall performance but area is increased. The Proposed RCA based on 6T FA consumes 97.35% less power than Conventional RCA and Transistor count for implementing is 30. Implemented Proposed design is having very Low power requirement than Conventional RCA. For the future work the area and delay can be improved.

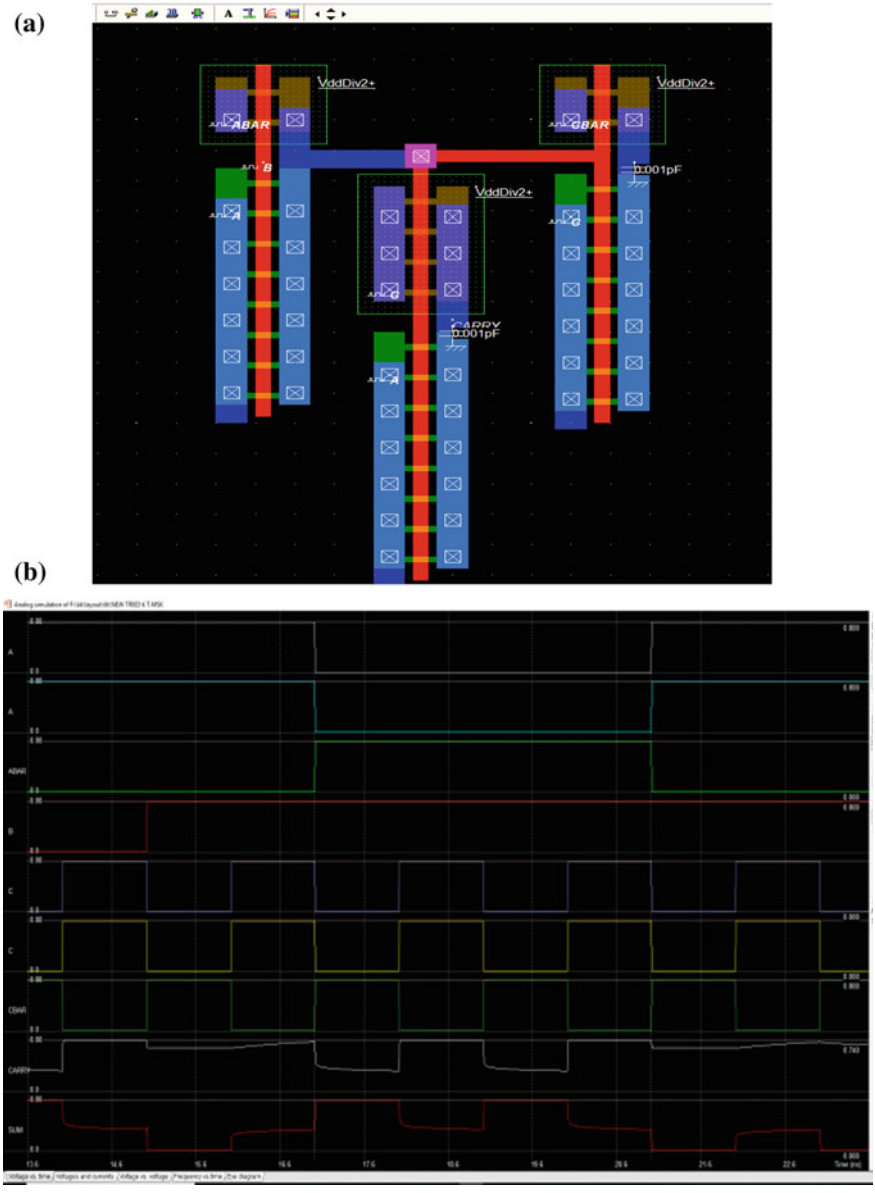
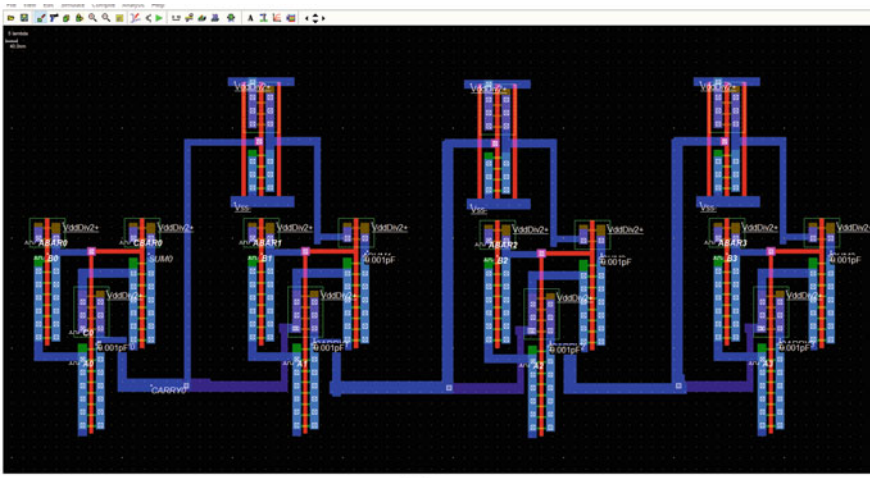
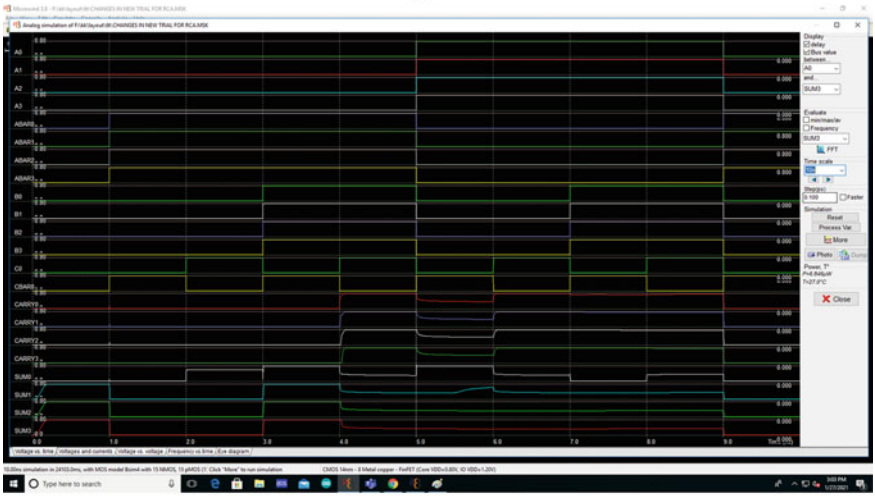


Fig. 6 Layout design of 6T FA and simulation result



(a)



(b)

Fig. 7 Layout design of RCA using 6T FA and simulation result

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Single Band Microstrip Patch Antenna with Slot and DGS for Millimeter-Wave Communication

Jyoti Hatte and Rupali B. Patil

Abstract In this paper a 61 GHz single band microstrip patch antenna of E shape with DGS (defected ground structure) is proposed for mm-wave communication. The maximum value of reflection coefficient (S_{11}) of the proposed design is upto − 39.51 dB, VSWR of 1.0214, with gain of 5.77 dB. The antenna is designed on a substrate layer made of RT Rogers 5880 with height of 0.787 mm having dimensions of width as 7 mm and length as 5 mm and with dielectric constant of 2.2 and loss tangent 0.0009. The radiating patch is having surface area of width × length of 3.2 × 2.5 mm^2. The proposed system is analyzed using HFSS 13.0 software. The proposed single antenna system was optimized to operate at 61 GHz frequency. This compact antenna system can be integrated in smart devices and hence finds application in 5G communication.

Keyword DGS · HFSS · Millimeter wave · Microstrip patch antenna

1 Introduction

Day by day need of high data rates for transmission and reception and need of large traffic is rising. Also the high bandwidth requirement can't be satisfied by sub 6 GHz band. Hence for fifth generation, 30–300 GHz millimeter wave finds application which provide large unused bandwidth [1, 2]. As 60 GHz millimeter wave operates in the spectrum that is unutilized, it is capable of providing high data rates for indoor application in terms of several gigabits per second. It provides large spectrum which is clear. Also as compared to the microwave systems compact, thin size antenna and RF components can be fabricated at 60 GHz frequency band. Thus mobile terminals and portable wireless devices can be shrink at 60 GHz mm wave [3]. WLAN, Satellite communication, radar communication, backhaul, WPAN are the

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areas where mm wave finds application [4]. Nowadays most of the communication devices come with applications that need larger bandwidth, one of the example of such device is the mobile phones which are getting slimmer along with being smart. Thus microstrip antennas due to its light weight and compactness can be used in these communication devices [5]. In recent years microstrip patch antennas theory has made considerable advancement. They have, more merits and better potential as compared with conventional antennas. Along with being lighter in weight, lower in volume, lower in cost, smaller in dimension microstrip patch antenna provide ease of fabrication and conformity. Also, the microstrip patch antennas can provide broad band-width, dual and circular polarizations, multi-frequency operation, sharpness in frequency, resilience in feedline [6]. FCC (Federal communication commission) have listed some band that can be licensed for 5G are as follows:

1. 24 GHz Bands: 24.25–24.45 GHz and 25.05–25.25 GHz.
2. LMDS Bands: 27.5–28.35 GHz, 29.1–29.25 GHz and 31–31.3 GHz.
3. 39 GHz Band: 38.64–40 GHz.
4. 37/42 GHz: 37–38.6 GHz, 42–2.5 GHz.
5. 60 GHz band: 57–64 GHz and 64–711 GHz.
6. 70/80 GHz: 71–76 GHz, 81–86 GHz and 92–95 GHz [7].

The single band antenna with E and I shaped slot on the patch of size 8×8 mm^2 is presented showing return loss of $-$ 40.99 dB at 60 GHz millimeter wave [8]. A tree shaped slotted antenna of size 7×12 mm^2 with 4 dB gain and return loss upto $-$ 36.3 dB has been proposed to cover the frequency band of 57–60 GHz[9].

In this paper DGS micro strip patch antenna is designed to operate at 61 GHz frequency which gave the good results in terms of S_{11}, VSWR, gain and radiation pattern. The designed antenna system finds application in the 60 GHz band (57–64 GHz and 64–71 GHz). Here an effort is made to get the desired resonating frequency of 61 GHz by optimizing the dimensions of patch. Introduction of the L shaped slots in the patch imparts E shape. Also the effect of defected ground structure in enhancing the characteristics of antenna system is observed.

2 Antenna Design

The choice of substrate was made taking into consideration the parameters such as height of substrate, its tangent loss and dielectric constant. Rogers RT-duroid 5880 with $\varepsilon_r = 2.2$, $\tan \delta = 0.0009$ and height 0.787 mm was chosen. Due its low dielectric loss and high gain obtained for microstrip patch antenna Rogers RT-duroid 5880 finds application for millimeter-wave frequencies [10].

2.1 Design Method

Microstrip patch antennas are manufactured by using a substrate with a dielectric constant and a ground plane on other side, it consists of the radiating patch printed on opposite side of ground plane [11]. Micro strip patch antenna can be designed by first selecting the resonant frequency and the appropriate substrate with a dielectric constant value, and by using the formulas of Eqs. 1 through 6 [12]. The different variables to be calculated are as follows.

Width of Patch (W): Rectangular patch width is obtained by using the following equations

$$W = \frac{C}{2f_r}\sqrt{\frac{2}{\varepsilon_r + 1}} \tag{1}$$

Here

W Patch width
c Velocity of light
ε_r Dielectric constant value
f_r Resonating frequency.

Effective dielectric constant (ε_{reff}) is determined using the below equation

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{W}\right]^{-1/2}, \quad W/h > 1 \tag{2}$$

Here h = substrate height.

Now, the length (L) of the patch is

$$L = \frac{c}{2f_r\sqrt{\varepsilon_{reff}}} - 2\Delta L \tag{3}$$

$$\text{Where } \Delta L = (0.412)\frac{(\varepsilon_{reff} + 0.3)\left(\frac{W}{h} + 0.264\right)}{(\varepsilon_{reff} - 0.258)\left(\frac{W}{h} + 0.8\right)} \tag{4}$$

Finally, the length of a ground plane (L_g) and the width of a ground plane (W_g) are determined from the below equations

$$L_g = L + 6h \tag{5}$$

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

The optimal length of the patch is calculated by using the above mathematical formula.

In the first step of the design, simple microstrip patch (of dimension width × length = 3.2 × 2.5 mm^2) was implemented on the substrate of size 7.2 × 5 mm^2. The desired resonating frequency was obtained by optimizing width of patch and two L shaped slot (of dimension width = 0.75 mm and length = 2.2 mm, with lateral thickness of 0.25 mm). It was observed that the antenna initially resonated at lower frequency but introduction of slots increased the resonant frequency. Thus the L shaped slot were introduced on the patch to shift the resonant frequency and improve the return loss along with the improvement in impedance matching [13]. The 50 Ω microstrip feed line is of width 0.8 mm and length of 1.26 mm.

Larger size, low gain, low impedance bandwidth, single operating frequency, and polarization problems are few drawbacks which conventional microstrip antennas face. Various techniques have been proposed for enhancing the parameters of conventional microstrip antennas such as Electronic Band Gap (EBG), Frequency Selective Surfaces (FSS), Defected Ground Structure (DGS), Photonic Band Gap (PBG), Metamaterials and many. Defected Ground Structure in the microwave components has obtained popularity among all the techniques. Defected ground structure describes the defects or slots that are integrated in the ground plane of antenna [14] DGS finds application as an emerging technique in microwave applications specially for antennas for improving the parameters such as cross polarization, narrow bandwidth and low gain [15]. A square ring defected structure etched in the ground plane reduces the surface waves and hence cross polar levels are decreased [16].

Thus, in the second step defected ground structure is used to improve the S_{11} and VSWR parameter. An attempt is made to use the ring type defected ground structure. Figure 1a shows the proposed model for the 61 GHz frequency, 2 dimensional view is presented in Fig. 1b. Table 1 shows the dimensions of the proposed single band antenna. Implementation of ring type defected ground structure showed a drastic improvement in the S_{11} parameter upto − 39.51 dB. The proposed antenna system resonates at 61 GHz with S_{11} parameter (Fig. 2a), VSWR of 1.0214(Fig. 2b), Gain of 5.77 dB (Fig. 2c). The impedance diagram and radiation pattern are shown in Fig. 2d and 2e respectively.

3 Simulation Results and Discussion

Simulation results are shown in Fig. 2, from results it is concluded that use of L shaped slots in the patch makes the prototype E shaped and gives the desired resonant frequency and the specific size of ring slot in the ground is obtained by several iterations to get the desired resonant frequency and enhanced return loss along with the improved VSWR. Shape of the slot in the ground plane is not exact ring type, one arm dimensions is increased to get the desired frequency. Thus it has been observed that the variation in the dimensions of the ring slot shows not only the improvement in S_{11} parameter but it also varies the resonant frequency. Also from the impedance diagram it is observed that the impedance of the proposed antenna system is nearly real at the resonant frequency.

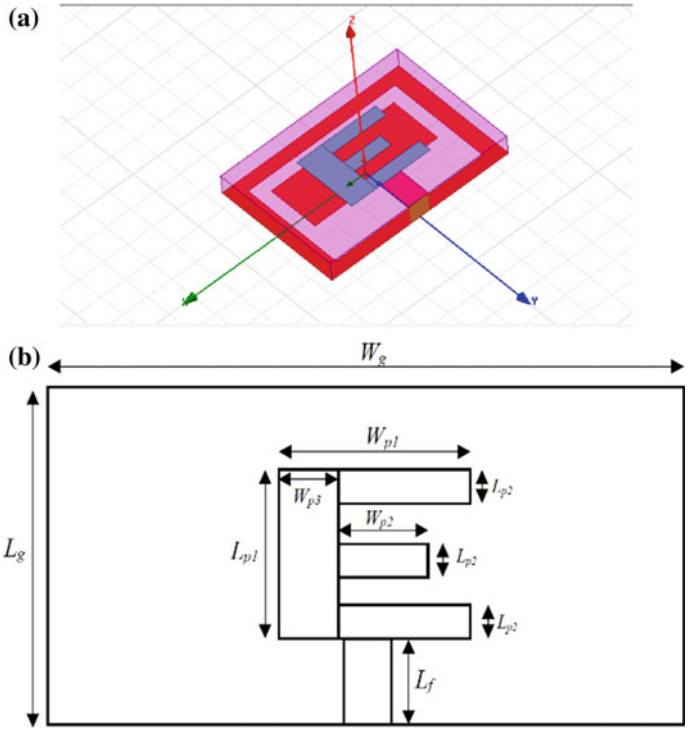

Fig. 1 **a** Proposed microstrip patch antenna with slot and DGS. **b** 2D view of proposed antenna

Table 1 Dimensions of antenna

Parameter	Dimensions (mm)
W_g	7.2
L_g	5
W_{p1}	3.2
L_{p1}	2.5
L_{p2}	0.5
W_{p2}	1.5
W_{p3}	1
L_f	1.26
W_f	0.8

4 Conclusion and Future Scope

This paper presents the design of 61 GHz antenna using Rogers RT-duroid 5880 with $\varepsilon_r = 2.2$, $\tan \delta = 0.0009$, which finds application in the 60 GHz band. The reduced size of the proposed antenna design finds application in the mm wave communication

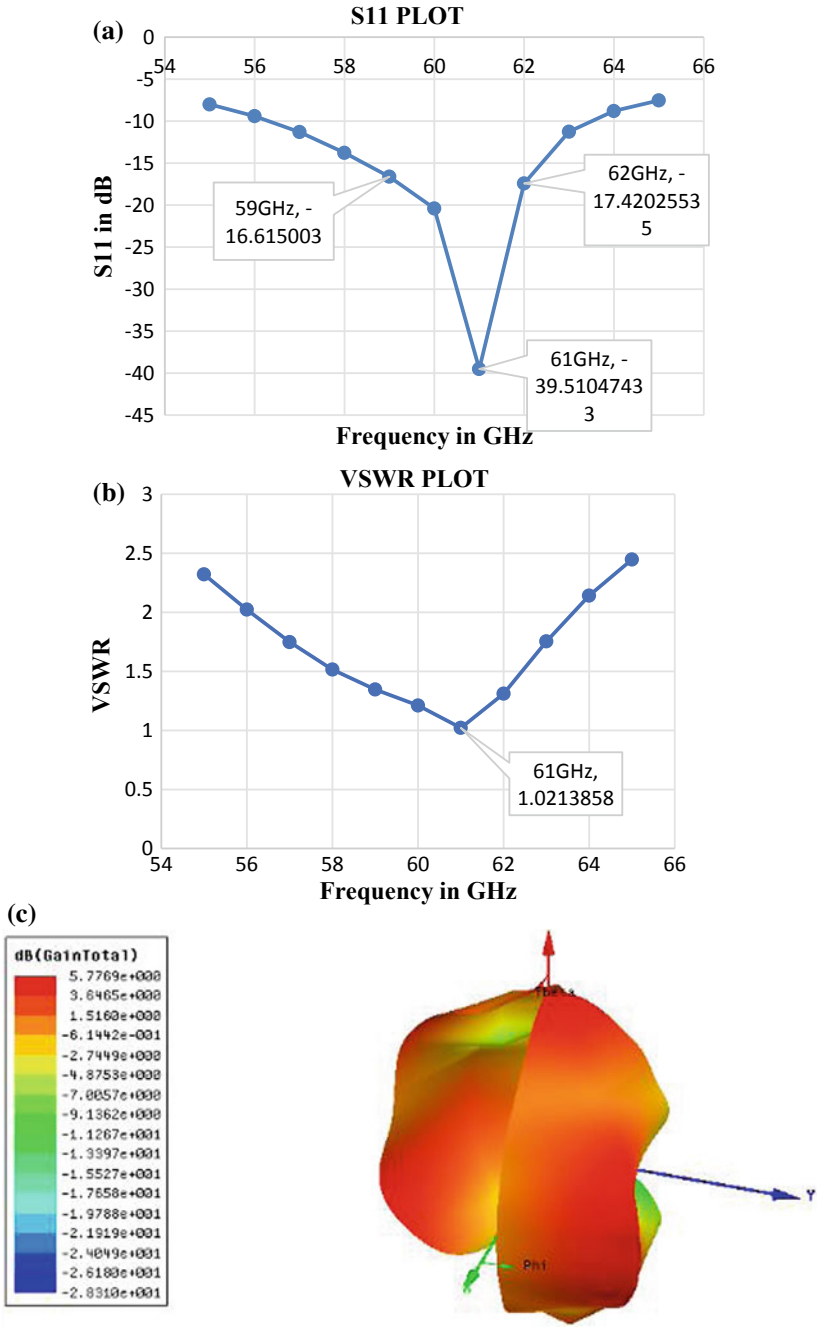

Fig. 2 **a** S11 parameter. **b** VSWR parameter. **c** Gain of the antenna in dB. **d** Impedance diagram. **e** Radiation pattern

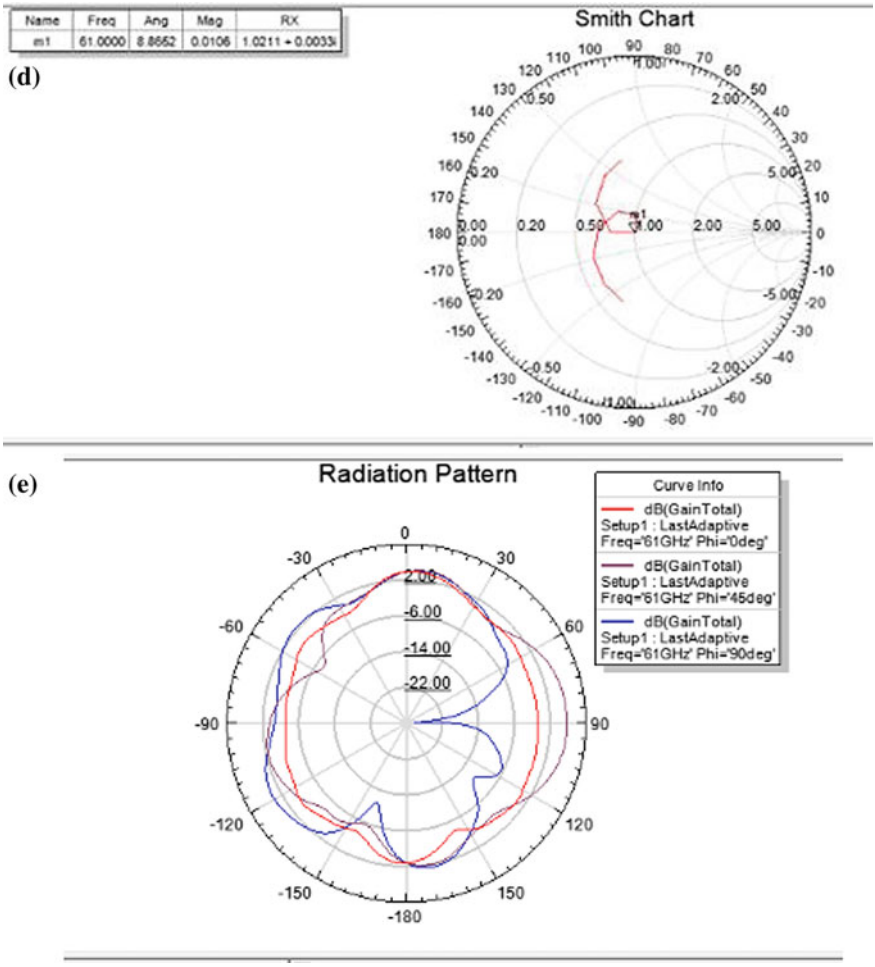

Fig. 2 (continued)

devices. Also the same prototype antennas can be implemented in array system to achieve the high gain of overall system.

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Efficient Use of Convolutional Neural Networks for Classification of Sugarcane Leaf Diseases

Swapnil Dadabhau Daphal and S. M. Koli

Abstract Early identification and diagnosis of plant diseases are more crucial for holistic development of the agriculture sector in India. Farmer's general estimates and observations are time costly, sometimes vague and misjudged. For this purpose, a appropriate deep neural network is proposed for the automatic identification of sugarcane disease. The classification involves 5 types of diseases and 1 healthy class. Experimentation is performed over the manually collected dataset of size 1470 images. Performance estimation of the network is dependent on the choice of optimization. In this paper comparative analysis for different optimizers stochastic gradient descent, Adadelta and Adam is given.

Keywords Sugarcane disease · Deep neural network · Classification · Test accuracy

1 Introduction

Sugarcane is widespread crop taken in India due to commercial importance. Significant portion of Indian farming population is involved in sugarcane farming. However, many foliar and stem disease reduced the quantity and quality of net agriculture pro-

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duction. In order to address these problems researchers have given variety of solutions to the other crops. However sugarcane remains unnoticed even with such high crop value. Hyper spectral images taken at higher altitudes have addressed the issues to estimate the total loss may be incurred. However it fails to give the remedy for disease mitigation and prohibition [1]. Remote sensing techniques are also efficiently used for estimating the coffee disease from leaf appearances [2]. Self driving aerial system for analysis and processing of the hyper-spectral images can recognize the farms specially affected with mosaic virus [3]. Low-cost unmanned aerial vehicle model DJI Phantom 3 successfully tested the diseases by using aerial images and it basically used the visual appearances and characteristics which could be used as input to the machine learning approaches [4]. Use of ARM processor for making a embedded system which uses the images to give the diagnostic analysis put forth a new perspective to address the problem [5]. Diseases associated with sugarcane stem were addressed by collecting the stem images using state of the art camera and finally applying the support vector machines for the classification of diseases [6]. Applications of these techniques gave a significant boost to the fruit industry. Use of deep neural networks for the classification of the guava disease opened new option to the fruit growers to mitigate the diseases in early stage of the plant life [7]. In recent time variety of networks were deployed for the classification of quality fruits as well plant pathology remedies [8–11].

2 Methodology

2.1 Convolutional Neural Networks

The neural network of the identification knows that CNN consists of an input layer, an intermediate layer, and an output layer. An input layer is a layer that accepts features as input, that is, images are made through this layer as input. The intermediate tier consists of the required number of nodes depending on the application. The output layer generates the output.

2.2 Network Specifications

Selection of accurate components decides the classification accuracy of the system. Different parameters related to the network are mentioned in Table 1. The filter size, the way of pooling and inclusion of dropout can impact the performance of network.

Table 1 Comparison of CNN performance for different optimization with parameter as filter size 3 × 3, pooling = Max, dropout 1 = 0.2, dropout 2 = 0.4, batch size = 5

Parameter	Optimization method		
	SGD	Adadelta	Adam
Accuracy	75.86%	76.22%	80.86%

2.3 Optimization

The network optimization does have influential effect on the overall performance. The rate of convergence of algorithm is decided by how good network tunes. There are three major arguments in the CNN they are namely SGD, Adadelta and Adam.

3 Results and Discussions

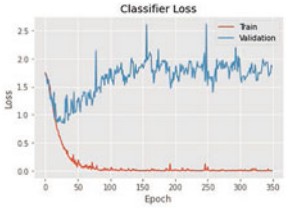
The experimentation is performed over the manually collected database of size 1470 images by Malik et al. [12]. 30 more images to each class were collected and later added during experimentation. Intentionally the capturing mode is kept random without any special standards keeping in mind the farmers way of handling the system.

Three main parameters were considered during the analysis i.e. classification loss, classification accuracy and AUC curves. The Area Under the Curve (AUC) is the measure of the capacity of a classifier to classify between classes and is used as a result of the ROC curve. The more the AUC, the good the performance of the model at separating between the positive and negative classes.

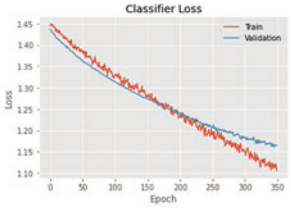
It is evident from Fig. 1a–c that classification loss is less in case of adam optimizer.

Comparison of classification accuracy proves again the efficacy of the adam over the SGD and Adadelta optimizer. Figure 1d–f implies that the adam works better in overall aspects.

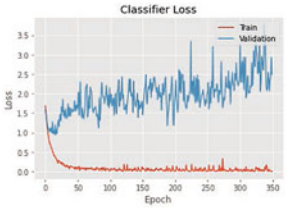
The AUC curves finally confirms the suitability of the algorithm to classify the diseases with greater degree of precision. Figure 1g–i gives the final curves after the 350 epochs. According to Table 1 the classification accuracy (CA) is found to be 80.86% which highest for the given database. CA for Adadelta and SGD is less than the performance of the adam. Hence it is estimated that keeping the same parameters for the network if the optimization method is changed it will have the significant shift in its performance.



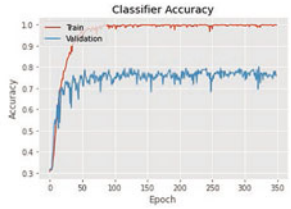
(a) Classification Loss with SGD optimization



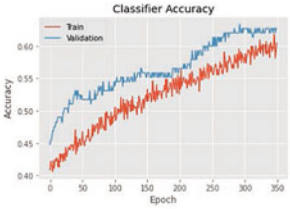
(b) Classification Loss with Adadelta optimization



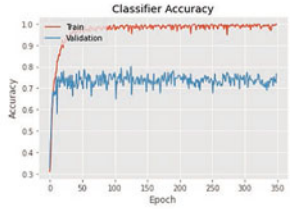
(c) Classification Loss with adam optimization



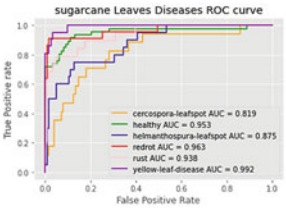
(d) Classification Accuracy with SGD optimization



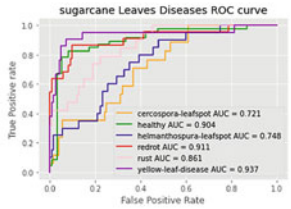
(e) Classification Accuracy with Adadelta optimization



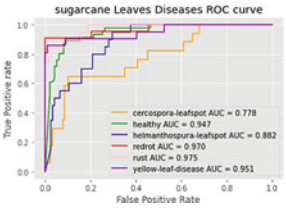
(f) Classification Accuracy with adam optimization



(g) AUC curves with SGD optimization



(h) AUC curves with Adadelta optimization



(i) AUC curves with Adam optimization

Fig. 1 Different parameters associated with CNN

4 Conclusion

In this paper convolutional neural network (CNN) is used for the classification of sugarcane diseases in 6 different classes. It mainly addressed the significance of optimizer use in performance of the CNN. Three variants of optimization techniques were tested with different set of train and validation inputs. It is found that the adam optimizer gives highest of 80.86% CA, SGD 75.86% and Adadelta gives 76.22% CA during the execution. Classification loss for the algorithms SGD, Adadelta and Adam is 24.14%, 23.78% and 19.14%, respectively. This paper demonstrates the key selection criterion for the CNN. Additionally it is estimated that CNN model could be deployed in real time application to predict the disease classes and inform farmers about the severity and dangers about the crop. However in this experimentation no data augmentation (DA) method was adopted. With use of DA techniques and adding more images to the database can increase the performance of the system in multifold. The data used was highly random in nature. In order to improve the recognition accuracy saliency detection and image enhancement method can help.

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Weather Forecasting Using Long Short Term Memory

Shraddha K. Nikam and Sunil B. Mane

Abstract Precise weather forecasting is one of Modern World's greatest challenges. Weather data is unstable in nature which makes weather forecasting less accurate with current measurements. Weather forecasts can be more accurately achieve with the help of machine learning models. In forestry, transportation, waste dispersal, connectivity, disaster management, weather forecasting and predicting assist. We propose an intelligent weather predicting system which predict the weather parameter like temperature, dew point and humidity by using JFK airport weather dataset from NOAA. Long short term memory (LSTM) algorithm of deep learning is used for predictions of different parameters and also use of train_test_split method for training and testing of dataset. LSTM gives better accuracy and lower error rate for temperature prediction compare to dew point and humidity.

Keywords LSTM · Machine learning · Deep learning · NOAA

1 Introduction

Worldwide, environmental conditions are evolving rapidly and continuously. In today's world, accurate forecasts are important. We rely heavily on weather forecasts in everything we do, from agriculture to manufacturing, from travel to regular commuting [1]. Since the whole planet is affected by climate change and its consequences, it is critical to accurately forecast the weather in order to ensure easy mobility and safe day-to-day operations.

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Deep learning is a kind of machine learning, influenced by the human brain's structure. Even when using a data set that is very diverse, unstructured and interconnected, deep learning helps machines to solve complex issues.In this work we proposed weather forecasting system, this system uses deep learning algorithm LSTM to predict weather parameters like temperature, humidity and dew point etc [2]. Weather data is gathered from surface observations generated by thousands of automated weather stations around the world, also using radars and satellites [3]. Weather forecasters use this expertise to create weather forecasting models and predict the weather. With large potential applications ranging from flight navigation to agriculture and tourism, an important research issue is weather forecasting [4].

2 Related Work

Hasan et al. [5]: In this study weather data for specific season months are taken for forecasting. The results are compared with ANN functions and training. The results show the network is effectively trained. Feed-forward propagation gives the desired value of prediction.

Kavya et al. [6]: Using Simple LR, Gradient Booster and Random Forest Tree Classifier, classification is carried out using empirical statistical methods. This method trains the data according to the collected data and correctly predicts and compares the different models. Gradient booster algorithm, followed by random forest and linear regression, has higher accuracy and low error rate.

Sulaiman and Wahab [7]: For monthly prediction of the precipitation ANN is used. precipitation data from local meteorological stations from 1965 to 2015 were collected. The ANN model efficiency is contrasted with the statistical methodology known as (ARIMA) Autoregressive Integrated Moving Average. The results state that the ANN model is better for heavy precipitation events above the risky level.

Holmstrom et al. [8]: Linear regression and functional regression are used. Stanford, CA, collected historical weather data and used it to train these algorithms. The results showed that linear regression is low bias, high variance model and functional regression is high bias and low variance for every next seven days, the performance was the max and min temperatures.

Grover et al. [9]: Hybrid approach used for prediction of weather combines trained predictive models with use of deep neural networks that model ranges from weather parameters in the joint statistics. In a gradient-based learner, temporal analysis by the use of features such as short-term and longer-term. Series of theoretical data experiments demonstrate the current approach produces better results than the NOAA benchmarks.

3 Proposed System

3.1 Data Preprocessing

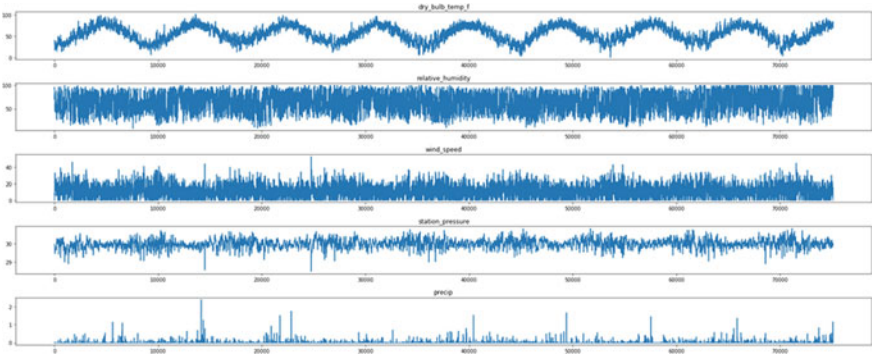
Raw data may contain noisy, incomplete data that can lead to implementation errors. To prevent these errors we preprocess the data. Data preprocessing is an important step to make raw data into formatted data.

Dataset: In this work, NOAA weather data from JFK Airport in New York City is used. The National Oceanic and Atmospheric Administration (NOAA) is a federal government agency in charge of environmental and weather monitoring in the US. The dataset includes 114,546 hourly measurements of 12 local climate variables collected from 2010-01-01 through 2018-07-27 at JFK airport, New York City, such as drybulbtemp, wetbulbtemp, visibility, wind speed, humidity, wind direction, precipitation, pressure, sea level pressure, dewpoint, etc.

Data Cleaning: The raw dataset is cleaned out by:

- Deleting redundant columns and keeping only primary numeric columns
- Data conversion and cleaning when necessary
- Developing a fixed interval of time between observations
- filling missing values and encoding certain weather parameters.

Data Visualization: In this section we visualize a few sections of the data, using matplotlib's pyplot module. The hourly temperatures follow a simple seasonal pattern, as we can see in the plot below. There seems to be much higher variance and randomness in wind speed, pressure, humidity and precipitation results. Instead of any of the other more noisy data columns, it might be more meaningful to make a model to predict temperature.



Data Normalization: The dataset is divided into two sets, categorical and numerical. we will convert string columns that refer to numerical values to numerical types. For columns such as HOURLYPrecip, we also drop the non-numerical parts of the value (the s character) (Fig. 1).

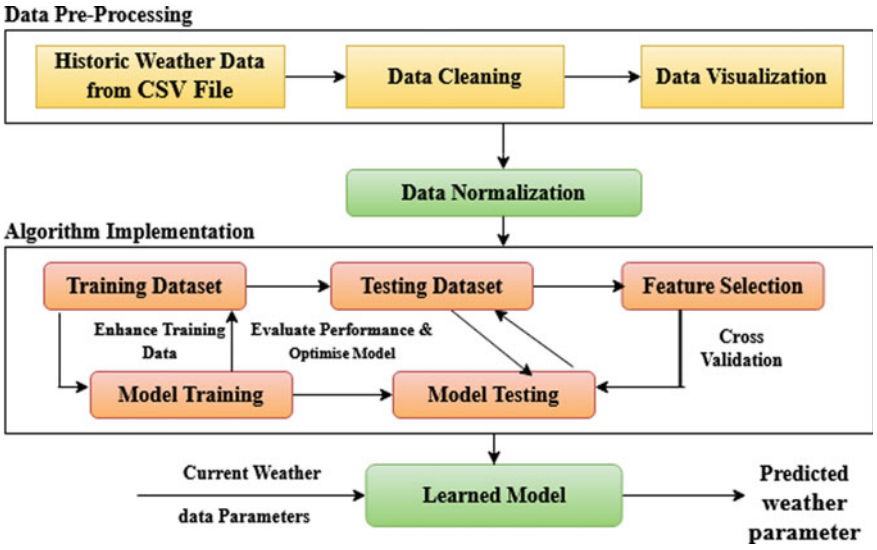


Fig. 1 Proposed system

3.2 Algorithm Implementation

RNN models have weaknesses of their own. In the sequence of input data, conventional RNN models cannot capture long term dependencies. A Long Short term Memory (LSTM) NN was implemented to solve this problem. LSTM can avoid the issue of gradient vanishing compared to conventional RNN models and catch long term dependencies in time series forecast problems. For prediction LSTM algorithm is used. This algorithm gives good accuracy and low error rate compared to other models.

Figure 2 depicts the general architecture of LSTM. The architecture utilises a deep learning architecture for prediction, consisting of the following inputs, as described in the paper:

1. x_t is the current time step input data.
2. h_{t-1} is the output data from the previous unit of LSTM and
3. c_{t-1} is the memory of the previous LSTM unit, which is the most input.

Training and Testing Dataset: The feature train_test_split is used for dividing data arrays into two subsets in Sklearn model collection, of training data and testing data. Dataset is splitted in two parts 70% for training data and 30% for testing data for this work.

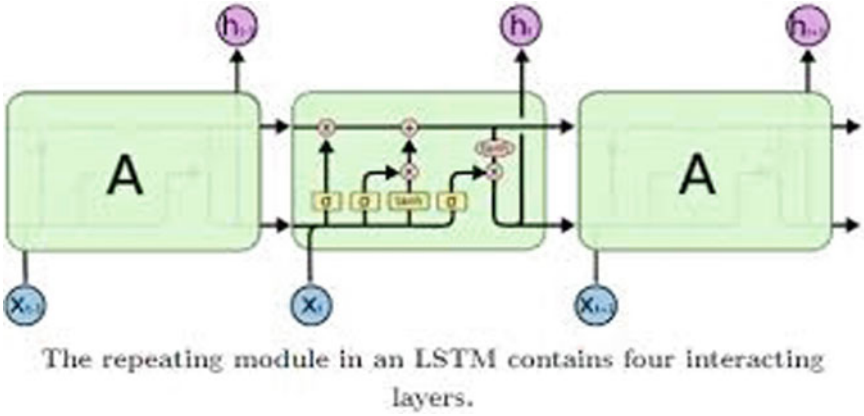


Fig. 2 LSTM diagram

Feature Selection Method: Features which are needed for implementation are selected, Some fields relate to hourly observations, while others relate to daily or monthly intervals.We select hourly observations for implementation.

Model Training: The training model is trained for weather prediction using machine learning algorithms. Using train_test_split function model is train.

4 Results and Discussion

Compare the MAE, MSE and RMSE values for different parameters [10], model with lower RMSE is better at predicting temperature, dewpoint and Humidity using LSTM algorithm and compare the accuracy and error rate of predicting those parameters. Below is a Table 1 that demonstrates the training loss, training accuracy, and testing accuracy of the temperature, dewpoint and humidity.

Training Loss: Loss function used is mse (Mean Squared Error) Average square variations between the $\hat{y}$ and y values predicted [11].

$$MSE = \frac{1}{n}\sum_{i=1}^{n}(y_i - \hat{y}_i)^2 \tag{1}$$

Accuracy: Accuracy is percentage of predictions that are accurate.

$$\text{Accuracy} = \frac{\text{Correct Predictions}}{\text{All Predictions}} \tag{2}$$

Table 1 Model accuracy measure

Feature	Train_Loss	Train_Accuracy(%)	Test_Accuracy(%)
Temperature	0.0618	95.36	98.41
Dew point	0.1268	91.92	98.27
Humidity	0.2748	73.10	80.41

Table 2 Model error measure

Feature	R2_score	MAE	MSE	RMSE
Temperature	0.9998	0.1597	0.0599	0.2448
Dew point	0.9997	0.1615	0.0909	0.3015
Humidity	0.9993	0.3167	0.2441	0.4941

The table states that Using LSTM algorithm temperature gives good testing accuracy as well as training accuracy. Also training loss is less.

Table 2 shows the different errors like MAE, MSE, and RMSE and R2_score of parameters like weather temperature, dew point and humidity.

Table states that temperature has less MAE, MSE and RMSE compared to dew-point and humidity by using LSTM algorithm of deep learning.

5 Conclusion and Future Work

In this work the LSTM algorithm was presented to predict temperature, humidity and dew point. The algorithm takes historical time series weather data of JFK Airport from 2010-01-01 to 2018-07-27 and predict the parameters. The results prove that using LSTM algorithm for forecasting temperatures is more reliable than dew point and humidity. This model can also be used as a weather forecasting application model which can be integrated into the mobile application and micro controller system. Most researchers may do an enhancement by increasing the LSTM layer and its epoch.

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Moisture Sensor Using Microstrip Patch Antenna

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Abstract Analyzing the moisture level of the material is one of the crucial parameters in industries such as the production of sugar, cereal grains, food packaging, etc. Investigation of moisture content in any material is important as it will affect its quality. Moisture measurement is carried out in this work, taking sugar as an example. For this, a rectangular patch antenna is designed at 2.4 GHz frequency. The main reason behind the popularity of Microstrip patch antennas in wireless applications is their low profile structure. Backscatter characteristics of the microstrip antenna are sensitive to medium and therefore they are used to measure moisture content. The percentage of moisture in Sugar and Calcium Chloride is measured for different concentrations. Simulation of the antenna is done using HFSS and return loss is measured using Vector Network Analyzer to analyze moisture contents. Very promising results are obtained for moisture measurement using a microstrip patch antenna.

Keywords Microstrip patch antenna · Moisture sensor · Reflection coefficient · Vector network analyzer

1 Introduction

In many fields like hydrology, geotechnical engineering, the food industry, soil science, and agriculture, estimation of water content is necessary. It is utilized to evaluate the material quality with operating and processing constraints. In real-time, for different materials, sensors operating at microwave frequencies provide effective, non-destructive, and uninterrupted moisture content measurements. The permittivity of a material is mainly affected by the presence of moisture. The main principle of a microwave moisture sensor is to measure the dielectric constant in a material such as

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edibles, soil, and building structures, chemical. As per the studies of measurements of dielectric properties, it has been shown that dielectric loss caused by the water changes the reflection coefficient (S_{11}) parameters [1]. The contact between material under test and the free space of patch antenna was the need in the traditional techniques. Monitoring the moisture in the sugar brix or solution or soil is tedious using these methods in far-field applications.

2 Literature Survey

Small antenna size, but at the same time reduction in the frequency is needed for today's communication. Small antenna size is also required in many applications based on IoT. Microstrip moisture sensor in the range of 1–3 GHz is developed with low insertion loss. The magnitude and phase of transmission coefficient will vary with the change in the moisture percentage. This has been investigated and analyzed in this work [1].

Parallel-plate electrodes, transmission line phase detection, and Time-Domain reflectometry (TDR) are some methods for dielectric measurement. In [2, 3], patch antennas have been designed where the material under test is in contact with probing electrodes in the near field region. Hence, these conventional methods may not be applied to far-field wireless applications. Microstrip antenna can work in the far-field, without the need for a battery. This microstrip antenna is excited by electromagnetic waves generated by the transmitter and the power is supplied to a sensor through the transmitter.

The product quality, processing conditions, and optimum handling are based on its water and moisture content [4]. The permittivity of some composite materials like building structures, soil, foodstuffs, etc. is mainly administered by the presence of water. The dielectric constant of these materials can be measured by a microwave-based moisture sensor. The results presented in [5] show that the paper material can serve the purpose of economical multilayer structures for telecommunication and sensing applications. So, here, we propose a rectangular patch antenna for wireless moisture measurements. This sensor is based on the backscatter characteristics of a rectangular patch antenna. It is designed for 2.4 GHz frequency.

A rectangular patch antenna having an operating frequency of 900 MHz is fabricated for moisture measurements in [6]. The backscatter characteristics are analyzed to measure moisture content and it is a contactless-type of the sensor. The content of moisture in the material under test is increased progressively and return loss is monitored. And it has been observed that the return loss reduces with a rise in moisture content for various materials. In [7] moisture content of lubricating oil is monitored using a microstrip patch antenna. Results of this work show, this sensor monitors the moisture contents of the lubricating oil. This method is based on the evaluation of the parameter S_{11}. Compared to existing techniques, it is easy as it does not contain transmitting and reflecting devices.

A compact frequency reconfigurable microstrip patch antenna with good return loss is discussed as a moisture sensor [8]. The length and width of ground and patch for a slotted rectangular patch antenna for soil moisture measurement in the frequency range of is 30 and 25 mm. This is used for the 2–5 GHz frequency range. Soil moisture, in rhizoboxes, is measured [9] and quantitative results are discussed. Results show that moisture measurement using microstrip patch antennas is non-invasive, reliable, and accurate. It has promising applications for moisture measurement.

In [10], a compact patch sensor is designed with a size of size 20 mm × 20 mm × 1.676 mm. This work focuses on the reduction of mean relative error (MRE) between the predicted moisture content (PMC) and actual moisture content (AMC).

3 Working Principle of Patch Antenna for Sensor Applications

The inherent presence of fringing fields between patch and substrate causes electromagnetic radiations. The performance of the patch antenna is determined by patch size, Patch shape, and permittivity of the substrate. The patch size also determines the resonance frequency of the antenna.

Salt and sugar solutions are made for different concentrations. Sensor i.e. patch antenna is used for measuring the reflection coefficient, which will vary as per the concentration. As the salt and the sugar contents increase in the solution, the dielectric constant decreases.

In [2], when salt is added to the water, the dielectric properties change. Because of this dielectric constant decreases and the polarization of water reduces. similarly, when sugar is added, bond formation occurs between molecules of sugar and water. This also causes a reduction in the polarization of water molecules and decreases the dielectric constant.

The dielectric constant and loss factor is directly proportional to the moisture content under certain conditions depending on temperature. Due to the high dielectric constant of water, change in moisture content results in shortening of wavelength. The presence and absence of moisture can be detected by the received power level from the microstrip patch antenna. The measurement of moisture was taken with the help of Vector Network Analyser to the patch antenna sensor through coaxial cable. As the dielectric constant reduces, the effective dielectric constant also reduces. Therefore, the load impedance decreases, and subsequently, decrement is observed in the reflection coefficient also.

4 Patch Antenna Design

A conducting patch mounted on the ground plane constitutes a microstrip antenna. The ground plane and conducting patch are separated by a dielectric substrate. To get maximum radiation, a lower dielectric constant is preferred. The standard rectangular patch antenna shown in Fig. 1 is considered, which is fed by a microstrip transmission line. The high conductivity metal i.e. copper is used to making the ground plane, microstrip transmission line, and patch antenna. The patch of length L_{rp} and width W_{rp} is designed. It is designed on the top of a substrate of thickness h_{rp}. The substrate is of dielectric constant ϵ_r. The thickness of the ground plane is not critically important but antenna efficiency is depending on thickness h. Typically, thickness or height h_{rp} should not be smaller than 0.025λ.

Based on length L_{rp}, the frequency of operation of the patch antenna of Fig. 1 is determined. The center frequency will be approximately given by:

$$f_c \approx \frac{c}{2L_{rp}\sqrt{\varepsilon_r}} = \frac{c}{2L_{rp}\sqrt{\varepsilon_r \varepsilon_0 \mu_0}} \tag{1}$$

The input impedance of the patch antenna is controlled by the width W_{rp}. Increased widths also result in larger bandwidths.

The behavior of the patch is approximately determined by a resonant cavity that is defined as a closed metal structure confining electromagnetic fields. At various resonant frequencies, certain modes exist in a cavity. Therefore, to get maximum radiation, the antenna should be excited at a resonant frequency. When an antenna

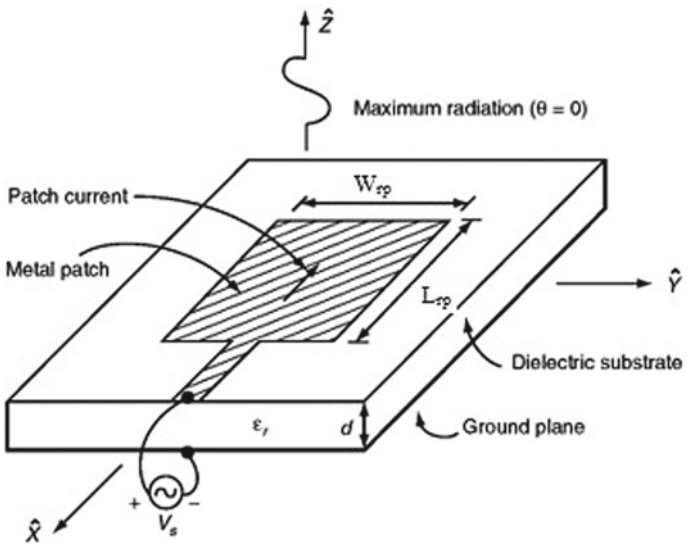

Fig. 1 The geometry of rectangular patch antenna [11]

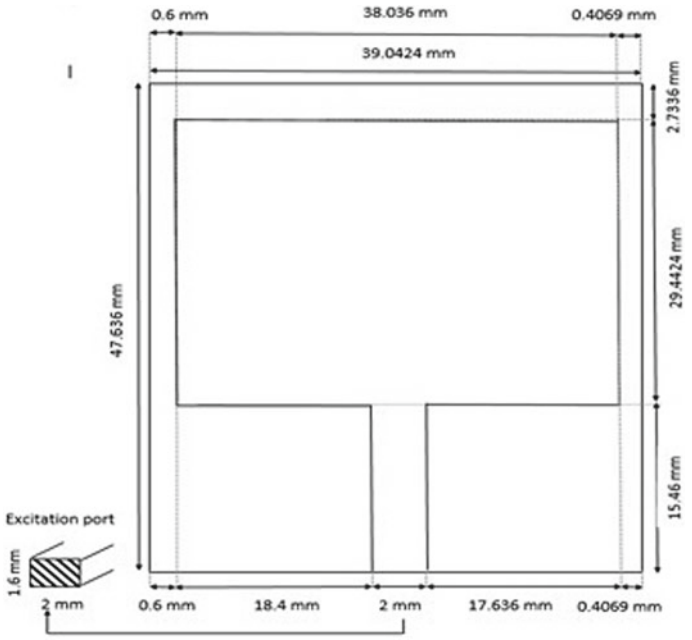

Fig. 2 Design of rectangular patch Antenna with dimensions

is excited at a resonant frequency, a strong EM field is created inside the cavity that results in a high current on the patch surface. So, maximum radiation is produced from an antenna.

Here, a microstrip antenna of the rectangular patch is designed. It is fabricated on silicon rubber as a flexible substrate. This patch antenna is designed to resonate at the desired 2.4 GHz frequency and its dimensions were calculated using standard design equations at the desired operating frequency of 2.4 GHz. These dimensions maximize the gain pattern, as the antenna resonates. Figure 2 illustrates the designed rectangular patch antenna geometry.

Antenna substrate's characteristics i.e. dielectric constant, height, and loss tangent are not constant. Therefore, substrate material should be chosen such that it can maximize radiation. This will increase bandwidth and efficiency. The FR4 Epoxy is used as a dielectric substrate in our Design. In FR4, FR stands for Flame Retardant, and type 4 shows Woven Glass-reinforced Epoxy resin. The glass resin determines the range of the dielectric constant of FR4 Epoxy. This material is less expensive and commonly used as compared to other PCB materials.

The width (W_{rp}) of the microstrip antenna is given by

$$W_{rp} = \frac{C}{2f_o}\sqrt{\frac{2}{\varepsilon_r + 1}} \tag{2}$$

where

c is the light velocity in free space
ε_r is dielectric constant
f_o is the resonant frequency.

The effective dielectric constant of substrate is calculated using Eq. (3)

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left(1 + 12\frac{h_{rp}}{W_{rp}}\right)^{-1/2} \tag{3}$$

where h_{rp} is the height of the antenna substrate.

The length of the patch antenna is a critical parameter as it determines the resonance frequency. The actual length and the calculated length are not the same because of fringing fields and the finite height of the substrate. And The actual length of the patch is determined using Eq. (4)

$$L_{rp} = L_{eff} - 2\Delta L \tag{4}$$

where L_{eff} is given by Eq. (5)

$$L_{eff} = \frac{c}{2f_o\sqrt{\varepsilon_{reff}}} \tag{5}$$

ΔL, that is an increment in length can be computed using Eq. (6)

$$\Delta L = 0.412h_{rp}(\varepsilon_{reff} + 0.3)(W_{rp}h_{rp} + 0.264)/(\varepsilon_{reff} - 0.258)(W_{rp}h_{rp} + 0.8) \tag{6}$$

The rectangular patch antenna design parameters are shown in Table 1.

Table 1 Rectangular patch antenna design parameters

Parameters	Value
Substrate's dielectric constant	4.4
Resonance frequency (f_o)	2.4 GHz
Dielectric substrate height (h_{rp})	1.6 mm
Length of patch (L_{rp})	38.036 mm
Width of patch (W_{rp})	29.442 mm
Length of ground plane (L_g)	39.042 mm
Width of ground plane (W_g)	47.636 mm
Length of feed line	15.460 mm

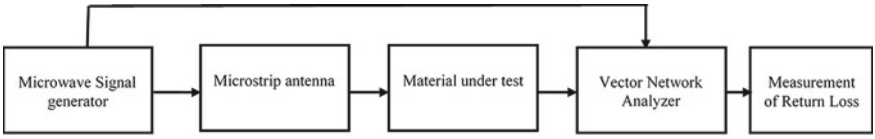

Fig. 3 Block diagram of system

5 Implementation of the System

5.1 Use of Simulation Software

To design a microstrip patch antenna operating at a frequency 2.4 GHz, we used HFSS (High-Frequency Structure Simulator) version 13.0, among various simulation software available like FEKO, IE3D, CST, etc. Being user-friendly, it is popular and also provides good accuracy for complex designs. The frequency range is between 1 and 4 GHz.

5.2 Experimental Set-Up

The block diagram of the system is shown in Fig. 3. The rectangular patch antenna and signal generator of Vector Network Analyzer (VNA), operating at microwave frequencies are connected. The patch antenna is placed at some distance from the Material Under Test (MUT).

At first, Antenna starts radiating at 2.4 GHz. These radiations pass through MUT. The vector network analyzer (VNA) measures the return loss of the reflected signal. Initially, a dry sample with no moisture is kept in the container. Gradually, the moisture content is increased by adding water, and return loss is observed.

Figure 4 shows the experimental setup for the same. The rectangular patch antenna is kept under the container with the material under test (MUT). The electromagnetic signal is passed through the material and return loss is measured on the VNA.

5.3 Steps Involved in the Process

1. Antenna starts radiating at frequency 2.4 GHz.
2. These radiations pass through the material under test.
3. Reflection coefficient S_{11} is obtained through Vector Network Analyzer.

Fig. 4 Experimental set up for moisture measurements

6 Complexities Involved

The proposed work is divided into four main stages i.e. Simulation, fabrication, measurement of conductivity, and antenna parameters. The electrical conductivity of the designed rectangular patch is measured by the four-probe technique. The first stage output depends on the measured value of electrical conductivity of a printed patch antenna. The measurement of antenna parameters such as gain, far-field radiation patterns, resonant frequency, and reflection coefficient S_{11} is the fourth stage.

The trial and error method is used to determine the location of the feeding point. For locating the optimum feed point, a distance of 30% is selected from the edge and is moved in a small step so that S_{11} is minimum.

A vector network analyzer (VNA) is used to measure S_{11}. The antenna and VNA are connected using a coaxial cable of 50 Ω. And To avoid near field interference, the experimental setup is kept on a foam box. The test is performed within the 2–3 GHz frequency range.

7 Results and Discussions

Figure 5 depicts return loss for the designed patch antenna that is observed through VNA. The dip in return loss can be observed at 2.4 GHz frequency. This shows that the antenna resonates at 2.4 GHz. Return loss is measured for different water concentrations in sugar and calcium chloride. In Table 2, observations of return loss for sugar concentrations are given. Figure 6 shows a plot of return loss for different water levels in sugar-based solutions. It can be observed that when the

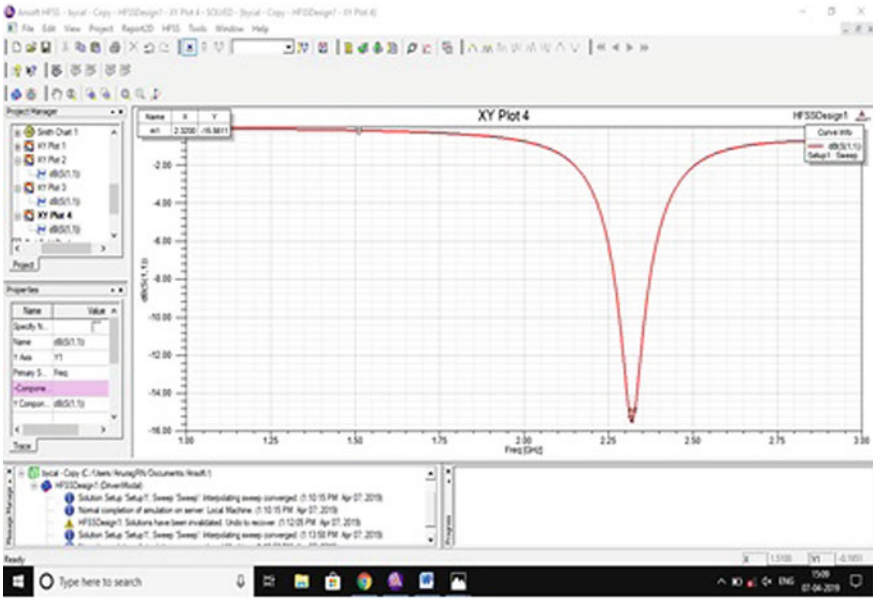

Fig. 5 The return loss of designed patch antenna

Table 2 Measured return loss for sugar solution

Water (in ml)	Moisture (in %)	Return loss (in dB)
0	0	−29.74
50	16.66	−19.92
75	25	−15.04
100	33.33	−12.95
125	41.66	−13.92
150	50	−13.78

water level increases, return loss also decreases [12]. Return loss is also measured for calcium chloride solution and obtained observations are listed in Table 3. A plot of return loss is shown in Fig.7. It can be seen as the water level increases, return loss is increasing at first and then decreasing. Figure 8 shows a plot of return loss for various samples. Here, observations for return loss of various samples i.e. Borax, Potassium Chloride, Lactose, and Sodium carbonate are considered [6]. It can be seen from Fig. 8, for sugar, return loss is increasing and for other samples, it is decreasing. The observations of return loss in percentage for sugar, Sodium carbonate, Borax, Potassium chloride and Lactose are listed in Table 4.

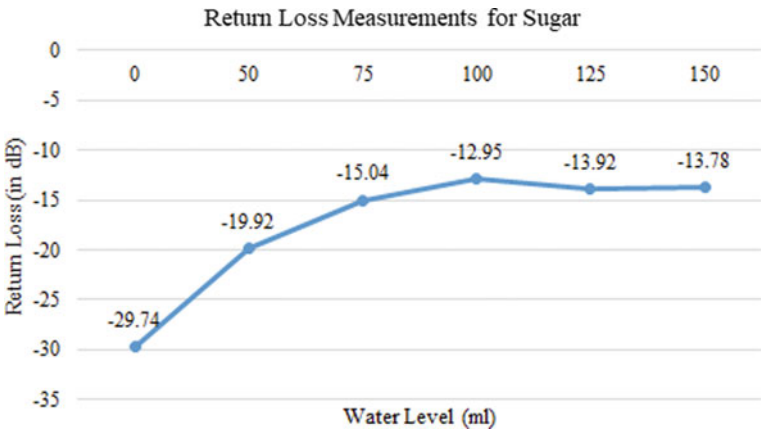

Fig. 6 Graph moisture versus return loss (sugar)

Table 3 Measured return loss for $CaCl_2$ solution

Water (in ml)	Moisture (in %)	Return loss (in dB)
25	10	−13.65
50	20	−11.65
75	30	−19.98
100	40	−20.66
125	50	−22.85
150	60	−18.55

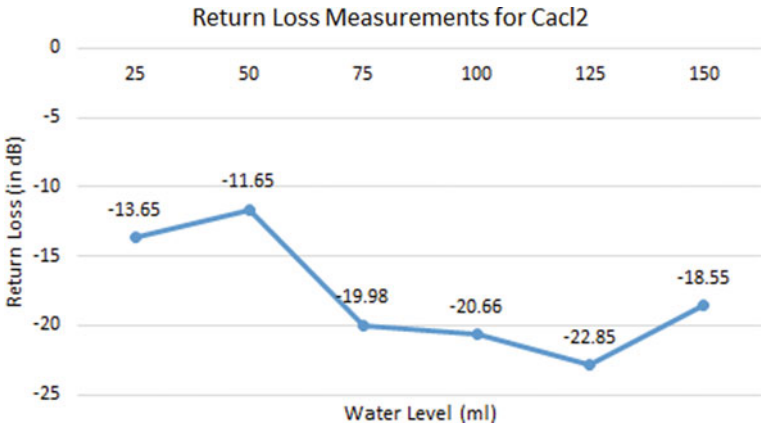

Fig. 7 Graph moisture versus return loss ($CaCl_2$)

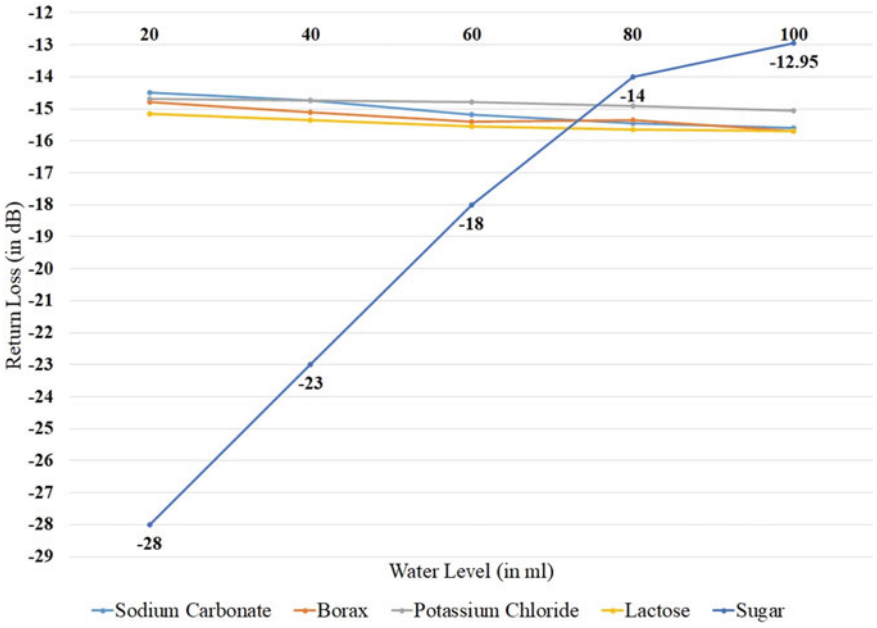

Fig. 8 Return loss comparison for different samples

Table 4 Measured return loss for various samples

Sugar	Water (ml)	20	40	60	80	100
	Return loss (in dB)	−28	−23	−18	−14	−12.95
Sodium carbonate [6]	Water (ml)	20	40	60	80	100
	Return loss (in dB)	−14.5	−14.75	−15.18	−15.46	−15.6
Borax [6]	Water (ml)	20	40	60	80	100
	Return loss (in dB)	−14.8	−15.1	−15.4	−15.35	−15.7
Potassium chloride [6]	Water (ml)	20	40	60	80	100
	Return loss (in dB)	−14.7	−14.75	−14.8	−14.9	−15.05
Lactose [6]	Water (ml)	20	40	60	80	100
	Return loss (in dB)	−15.15	−15.35	−15.55	−15.65	−15.70

8 Conclusion

A low-profile rectangular patch antenna is designed for the measurement of the moisture content of a material. Mounted on an inexpensive FR4 substrate, the antenna has a size of 39 mm by 47.6 mm. The antenna achieves a maximum gain with high efficiency. The proposed design of the microstrip patch antenna is suitable for sensor applications and wireless communication as it has robust radiation patterns. Sugar

solution and calcium chloride are considered for testing, and their reflection coefficients are measured. Reflection coefficient changes as per the change in the moisture contents. This microstrip sensor has a favorable sensitivity to detect moisture in a solution.

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Graphology Based Human Behavior and Personality Identification Using Artificial Neural Networks

Shivani Taru, Vini Mehta, Preeti Shinde, and Shalaka Deore

Abstract Handwriting is often called mind writing. For each individual, handwriting may be unique and the behavior, nature and certain psychological features of a person can be determined from it. Graphology or handwriting analysis is the investigation of the patterns and physical attributes of handwriting with an endeavor to distinguish the author, demonstrate the psychological state while writing, or assess personality characteristics. The manual method of handwriting analysis is extremely expensive and tedious. Therefore, the proposed approach centers around building up software for personality identification that can predict the behavioral features directly with the help of a computer without any human involvement. Our proposed system can predict personality by analyzing English as well as Devanagari samples using artificial neural networks. In a country like ours, it is most probable that people prefer Hindi over English. Hence, we have proposed an approach for developing a device that eliminates the language barrier to predict the writer's personality or behavior.

Keywords Graphology · Handwriting · Feature extraction · Behavior prediction · Personality traits · Artificial neural network

1 Introduction

When you compose something, your brain guides your hand. Everything you write down is the result of a connection between the reflex muscles of your hand and your brain. For each individual, handwriting may be unique and the behavior, nature and certain psychological features of a person can be determined from it. Every behavioral characteristic is depicted by a neurological brain pattern. Every composed stroke or movement uncovers a particular character attribute.

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Graphology is the study of distinguishing these patterns as they are seen in handwriting and depict the corresponding character attribute. It is a method of interpreting a person's behavior and character traits from properties in his/her handwriting. The manual method of graphology is extremely expensive and time intense. Hence the proposed technique centers around building up software for behavioral identification that can foresee the characteristics directly with the help of a laptop or computer without any human involvement. Many systems are predicting personality and behavior by analyzing English handwriting samples. But then a question arises, what about people who cannot write in English? As this system has such a wide use across various fields there will be all kinds of people from different backgrounds that the employer/owner could encounter and it is impossible to rule out this possibility in a diverse country like ours. So, considering this we have proposed a method to develop a system which is an expansion of the existing systems where we can predict the personality by analyzing English as well as Devanagari samples using artificial neural networks.

The prediction by a well-trained Artificial neural network (ANN) is generally a lot quicker contrasted with any typical technique. ANNs can be generalized. After learning from the initial inputs and their connections, it can surmise unseen connections on unseen information also, in this manner making the model generalize and predict unseen information. Thus, increasing the accuracy to a great extent.

2 Previous Works

Ghosh and Shivakumara [1] suggested a handwritten character analysis approach focused on graphology to classify human behavior. In order to evaluate the social both positive as well as negative and personal behavioral patterns that reflect the attitude of the individual, their method considers structural features such as zone, circle, angle, stem, oval, branch and bar.

Kumar et al. [2] introduced fuzzy logic-based approach to achieve accuracy in the writer recognition process. In addition to fuzzy based writer identification, they designed a Devanagari pangram to collect the benchmark dataset and test the performance of the system.

Sen and Shah [3] created a system in MATLAB Guide using graphology and Image Processing techniques. The system extracts different attributes of handwriting like baseline, margin, size, space, etc. and equates with the corresponding personality features. On 75 handwriting samples obtained from 20 to 40 age group subjects, image processing operations were conducted on numerical vectors.

A system to determine a person's behavior from letters 'i' and 'f', slant of the letter, baseline, pressure applied on the pen by the writer was suggested by Parmeet Kaur [4].

Champa and Ananda Kumar [5] proposed a process for predicting a person's personality from the letter 't', pressure applied on the pen and baseline as found in the handwriting of a person. These properties are passed as inputs to the artificial

neural network which in turn generates the individual's behavioral traits. The output was measured after analyzing several samples.

Lemos et al. [6] proposed a strategy to foresee an individual's character from the spacing between the words, slant of letters, baseline and as seen in his/her handwriting. Image sample was collected as an input and then it was passed to the ANN which yields the character attributes of the author. The presentation is estimated by analyzing different examples.

Djamal et al. [7] stated a strategy to anticipate the character of an individual which takes handwriting and signature samples as an input to ANN. With the assistance of various highlights, for example, streaks, margin, shell, etc. signature sample is processed whereas for processing handwriting sample, baseline, slant, curve, pen pressure, etc. features are used.

Chanchlani A [8] used Convolutional Neural Networks for behavior prediction. The images in the dataset were pre-processed. The dataset was divided into 5 labels: Criminal Intent, Excitable, Honest, Narcissistic and self-centered, Persistent. All the images were loaded into the memory using OpenCV. TensorFlow was used to implement the prediction system.

Hemlata et al. [9] scanned the handwriting samples 1st and stored them as an image. Then pre-processing was done to enhance the image quality. The handwritten page was divided into 3 segments—line, word, character. The following features were extracted to detect the personality of the person: zone, baseline, pressure, size, spacing, slant, margin. The output data was used to analyze the personality of the writer.

Dhumal et al. [10] extracted base line, slant of word, and the pen pressure from the writing samples. MATLAB was used to store the related data about the operations in the PC which can be used later in neural network. To identify the specific person SVM classifier and Gabor filters are used.

Varshney and Puri, [11] planned to show a total strategy to build up a framework utilizing the fundamental part of handwriting for example large and small middle zone, clarity, slant, connections, spacing, margin, letter size, upper zone extension, speed, pressure, zones, etc. and predicted the behavior based on feature values.

3 Proposed Work

An automatic Handwriting Analysis Framework is introduced in the proposed approach, which extracts distinctive handwriting features through image processing. The related personality traits are seen based on these attributes. In an integrated GUI environment, the framework is modified.

The proposed method will predict the results based on English as well as Devanagari scripts. The proposed technique extracts structural features like baseline, pen pressure, holes and loops, zones, margins, and other geometrical properties, to extract the hypothesis dependent on a word reference of Graphological rules.

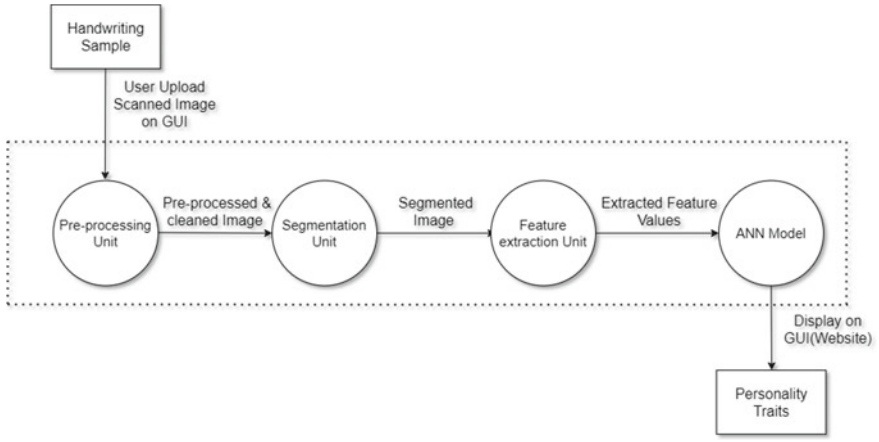

Fig. 1 Block diagram of automated behavior prediction system

We have used a trivial dataset for training and testing purpose which has been used for Handwriting Character Recognition using DCNN [12].

The proposed technique is split into various modules. Each module is clarified in Fig. 1.

3.1 User Interaction with GUI

The handwriting sample image is taken from the user from a website in this primary module. On the website, the user uploads the handwriting sample and then the image is transferred for pre-processing to the system.

3.2 Pre-processing

In the second module, pre-processing is conducted on the input image using various techniques to remove noise and to smooth the image for improved performance. Pre-processing is done to upgrade the input of the image data and also improve the quality of some image features for further processing. Pre-processing incorporates resizing, noise removal, binarization, and normalization.

a. **Resize**: While resizing an image, the size of the image is reduced and any unneeded pixel information will be discarded from it. This process also discards the margin space left at first by the author.
b. **Noise Removal**: Noise removal techniques are applied to remove the unwanted data and to upgrade the quality of the image.

c. **Normalization**: Normalization is used is to eliminate a portion of the varieties of handwriting styles and to streamline the states of images.
d. **Binarization**: Binarization converts the greyscale image into a binary image.

3.3 Segmentation

The third module is segmentation. Segmentation is the cycle for fragmenting the manually written page into three distinct kinds of sections, i.e., character, word and line. Line segmentation is used to separate the transcribed image into text lines, lines are additionally used for word segmentation used in the extraction period of components, and character segmentation is used to fragment the words into characters.

3.4 Feature Extraction

The fourth module is Feature Extraction. It is a method of minimizing dimensionality or extracting the necessary information from the input data which is highly dimensional. To analyze the writer's behavior, output data is used. The characteristics may be pen pressure, baseline, margin, zones, holes and loops, matching templates, etc.

a. **Baseline**: In the handwriting sample, Polygonization of the single line is used to find the baseline slant. The baseline can be ascending, descending, straight. The baseline is used to predict the emotional expense and the nature of the writer. Ascending baseline represents the person is Optimistic behaviour. The descending baseline shows that the person is pessimistic nature. A straight baseline shows that the person has stable outward behaviour and discipline.
b. **Pen Pressure**: At the time of writing, the amount of force applied is considered as the pen pressure. It can be medium, light or heavy. The pen pressure is calculated within the threshold image as a count of the number of forefront pixels. The number of dark pixels is an associate degree demonstrative of the pressure of the pen, stroke thickness, and writing size. From the pen pressure, we can analyse the mental energy of the writer.
c. **Analysis of Letter 't', 'i', 'f'**: There are many letters in a person's handwriting that give us some accurate details about the writer and some of them are the English lower-case letters 't', 'i' and 'f'. In many different ways, people write these letters. The methodology of identifying certain characteristics of the writer by testing the letters is known as template matching.
d. **Zone**: In order to see more effectively how the writer uses their brain, their thoughts and the real components in their current situations, the individual letters can be split into three zones, particularly the lower zone, middle zone and upper zone.

e. **Hole and Loops**: Loops emphasize feelings, while holes describe the feelings on a social and vocal level. While following the limit, if the proposed strategy visits a similar beginning stage once more, it very well may be considered as a hole or a loop. To discover holes and loops, we have used the Euler number concept.
f. **Margin**: Margin is the amount of space left on the right or left side of the page or at the top or bottom of the page by the writer. Before the writer starts writing, they consider some space for margin on the piece of paper.
g. **Word Spacing**: Word spacing is the space present between the ending of the first word and the starting of the next word. Word spacing is useful to understand the interaction of the writer with other people. Spacing tells the closeness of the writer with the other people and his intelligence.

3.5 Prediction Using ANN Model

In Neural network, there are primarily three types of layers namely the input layer, the hidden layer and the output layer. The proposed work mainly considers values calculated for the baseline, slant, pen pressure, zones, holes, loops, etc. as inputs to the ANN through which handwritings are differentiated. A particular attribute or personality trait found in the handwriting sample is expressed by each output of the ANN model. The ANN model will be trained with 70% dataset and the remaining 30% dataset will be used to test the trained model.

3.6 Display Personality Traits on GUI

The output of the ANN model represents different characteristics or personality traits found in the handwriting. These personality traits will be displayed on the GUI.

4 Conclusion

Manual analysis of handwriting is expensive, time consuming and prone to human error. There are very few graphology experts in India and the accuracy of the results largely depend on the skill of the examiner. Therefore, we have designed a tool which provides higher accuracy, cost effective and instant fuss free results without any human intervention. There are many systems predicting personality and behavior by analyzing English handwriting samples. These systems are very useful in many fields such as recruitment of staff, forensic studies, psychology, writer identification, medical diagnosis, career counselling, etc. We have proposed a method to develop a system in which we can predict the personality by analyzing English as well

as Devanagari samples using Artificial Neural Networks. Our approach eliminates the language barrier to predict the writer's personality or behavior. However, while graphology will help define the maturity of the writer, it is not possible to determine the individual's age or physical attributes, such as pupils, weight, hair, height, skin tone, etc. Certain handwriting attributes such as margin, slant help us understand the tendency of the writer to the past or future, but graphology cannot anticipate the future or justify the underlying cause, actions or specific circumstances.

Graphology is not a forecasting technique. To estimate personality from the given handwritten sample, most of the published work has addressed only a few attributes from the collection of several features available. As a consequence, the categorization is less precise. It should be remembered that a big limitation in graphology is the absence of scientific evidence for a correspondence between handwriting attributes and behavioral patterns. Therefore, in order to build more usable and functional systems, current techniques need to be enhanced in terms of feature extraction processes and precise evaluation of personality characteristics. A thorough analysis of graphology and related machine learning and deep learning methods for the development of a stable, effective, flexible and efficient automated system could be considered by researchers in the future.

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Android Forensic Tool

Linta Bawankar, Manasi Bongirwar, Prerna Sharma, Shrawan Bhojane, and Nikhil Mangrulkar

Abstract With the increase in use of mobiles, the smartphone has become a storehouse of data and can be a hub for criminal evidences. Nowadays data is very important and precious also it may be confidential and based upon it we can do many things. Data plays a crucial role in day-to-day life of every person. So, to deal with this, mobile forensic tools are used. In this paper we are presenting an application for extracting mobile contents like contacts, call logs and SMS using android app. So, if we lose data for any reason, we will be able to quickly access it. Our desktop application will show the data after backup in a user-friendly format (e.g., doc, pdf) so it is very convenient and easy for user. We have used .Net for desktop software and android studio for mobile application.

Keywords Mobile forensic · Smartphone backup · Android data · Backup application · Backup software · Forensic tools

1 Introduction

Nowadays smart phone is used by almost every person. It has become a very common and necessary device in daily life. There are 5.20 billion smart phone users in the world, according to the latest data from GSMA Intelligence. The total number of smartphone users around the world grew by 93 million in the last year [1]. Smartphone use is currently growing at a rate of 7%, with more than an average of 1 million new smartphones coming into use every day [2]. With the increase in use of smartphone the crime rate is also increasing. So, there is need of forensic application.

As smartphone contain important data, having its backup is important so incase data is lost, we can retrieve it. If data is backed up and organized properly, it is very easy and convenient to access, so this application shows data in user friendly (like doc, pdf etc.) way. Data Stored on smartphones can be extremely useful for investigation. The source of information residing on phone can be contact, SMS,

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Call logs, etc. Our application is helpful for forensic investigation also. As the data is organized properly, so the investigators can quickly get the information which they are looking for.

Data is very important because on the basis of the data we do almost everything and we cannot afford to lose our valuable data, that is why backing up of data is important. This application gives backup to contacts, call logs, SMS.

2 Literature Review

Akshay Jadhav et al. has done work on retrieving mobile contacts, SMS, unread calls from android phone remotely. They extracted information from phone if someone has forgotten, misplaced or lost our android phone [3]. Nihar Ranjan Roy et al. has made comparative study on various forensic tools and techniques. They have analyzed different tools and techniques used for mobile forensic and discussed results and findings in this paper. Their survey is based on different ways of acquisition techniques and different forensic tools used [4]. Rizwan Ahmed et al. have discussed that as computing power of mobile phone increase, they are more likely is as evidence for criminal cases. They also discussed the difference between phone forensics and computer forensics in their paper. As there are very less toolkits available for mobile forensics, their paper shows that there is need for more development in the field of mobile forensics [5].

N. A. Aziz et al. studied certain methods which can extract data from smartphones and analyzed them by using Sleuth Kit Autopsy. They extract email, contacts, messages, calendar and images from smartphones as a digital evidence. They suggested that these kinds of data can be used as a digital evidence for law enforcement [6]. Christos Xenakis et al. has performed forensic investigation on different set of android mobile application in order to extract sensitive information from mobile device. They chose application from google play which are popular eligible to handle sensitive information and free to install. They evaluate their security by using code and disk analysis. They analyzed that crucial and significant information can be revealed form such applications [7]. HtarHtar Lwin et al. has made a comparative analysis of various tools used for acquisition of data from android mobile devices. They made comparison between different open source and one commercial tool. They discussed some challenges and aimed to overcome those challenges to increase accuracy and integrity of Android forensic investigation. Based on their analysis, they suggest some tools for better results in android forensic investigation [8].

Indeshwari U. Akarawita et al. has done work in the field of android forensics. They have implemented open source mobile forensic framework for android platforms named 'ANDROPHSY' that supports all four phases of mobile forensic investigation. They worked on different approaches and also established the fact that 100% forensic soundness is not possible in Android forensic in their paper [9]. Patrick Dibb and Mohammad Hammoudeh has developed an open-source toolkit that can improve

workflow for forensic analysts. In this paper, they discussed about the various feature of their open source toolkit that can extract data automatically from the devices [10].

3 Implementation

As shown in Fig. 1, project is starting with desktop application. After opening desktop software, we will connect mobile to the desktop software by USB. After detection of mobile installation of android application (app) as a connector in mobile will be done by using this android application, we will extract Call logs, Contacts, Messages and other Mobile details.

After extracting all these details, we will save all these details as a temporary data in mobile in the .txt/.xml/.pdf format. After saving the data we will pull all these files to desktop application by using USB cable. After pulling all information, we will read all this data in the desktop application and analysis of data will be done. Finally, report will be generated.

The complete project is divided in two phases:

1. Android app.
2. Windows (Desktop) software.

As shown in Fig. 2, Project starts with Desktop application, the user can interact using the interface. User can view the data and generate report using this application.

This desktop application is created by using .Net frameworks in Visual Studio 2019. How it works, the steps is given as follows:

After opening desktop application,

- Connect the mobile to desktop by using USB cable.
- Application will auto detect the mobile connected.
- After detection of mobile, Android app will be installed in the mobile.

After this we are using the android application,

- Now we can extract contacts, call logs and messages from mobile. It completely depends upon user which data user wants to extract.
- After extracting all information, we can save all information as a temporary data in a mobile in various form like .txt/.pdf/.xml.
- Next, we can pull all the information to the desktop application by using pull and push method.

In Fig. 3, Android Connector App interface is shown, where user can extract data from smartphone and can generate .txt file of it. User needs to give certain necessary permissions to app after installation at early stage. As shown in Fig. 4, is the format in which the extracted data is present in .txt file for further process. The further process is clearly explained in the following steps:

After this, again we need to use desktop application,

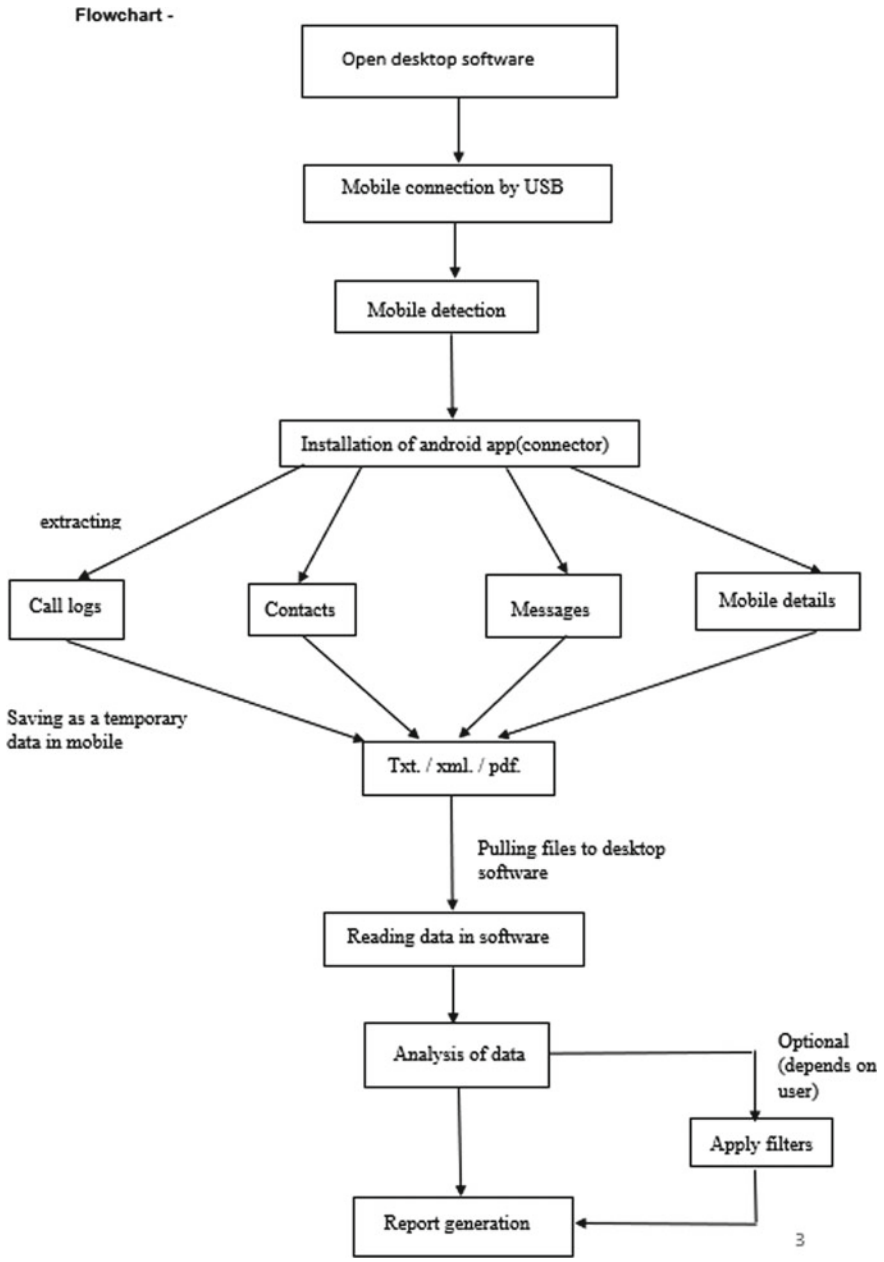

Fig. 1 Flowchart

Fig. 2 Desktop app interface

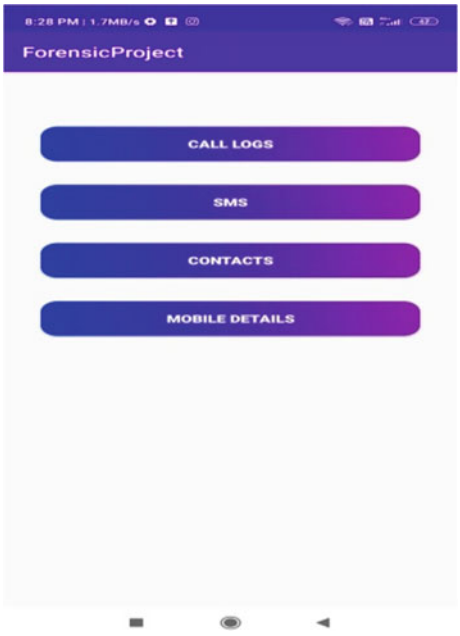

Fig. 3 Android connector app interface

- After pulling the information from mobile to desktop application, we will be reading all this information which will be analyzed by software.
- User can apply the filters in following way on the data which is completely optional.
  - User can choose information according to him.
  - User can search the information by date, name, etc.
- Finally, it will generate report of the extracted information from android mobile on the desktop application.

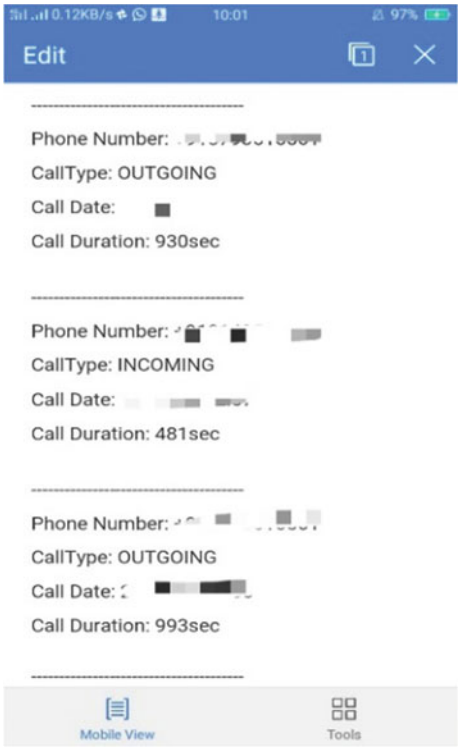

Fig. 4 Call log details

In Fig. 5, the sample format of how the generated report of desktop will look like is presented. This report will consist of all the data extracted from smartphone as per the need of user in a specified format. This report format will be convenient for user to view all the information extracted in single document.

4 Conclusion

In this paper, firstly we have reviewed different techniques in order to extract data from smartphones and analyzed the data to generate the report out of it. By studying and analyzing the literature, we deduced that we can extract data from contact, messages and call logs for report generation and can be available for further use. Then, we have elaborated our application and its procedure for extraction and analysis of data residing in android mobile such as call logs, messages and contacts. Filter option is also included in our application so that user can get only needed data which can be used in forensic investigation.

Fig. 5 Sample report

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Maize Leaf Healthy and Unhealthy Classification Using Image Processing Technique and Machine Learning Classifiers

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Abstract Automatic detection of the healthy and unhealthy maize plant leaf is a prevalent machine vision learning task and has significant applications in the Food Industry. In this paper, effective machine learning technique for maize leaf healthy and unhealthy classifications based on leaf images that have been presented. This study estimates color feature extraction using RGB mean and standard deviation and the classification, using PNN and KNN methods. A new Five-stage image processing method is presented (including image pre-processing, image segmentation, feature extraction, classification, and performance analysis). The Experimental results show that a small set of RGB color features reach an accuracy of 92.5% and 90% using PNN and KNN classifier respectively, while doing classification the KNN classifier requires more computational time as compared to PNN Classifier.

Keywords Classification · Feature extraction · Machine learning · PNN · KNN

1 Introduction

In the domain of agricultural data, the automatic detection and analysis of maize leaf diseases is extremely desired [1]. It is observed that diseases and nutrition deficiency are major causes of production and economic losses in agriculture. Unfortunately, diseases have caused a great deal of loss in yield, and disease is considered as one of the main culprits, reducing yield by between 60 and 100% [2]. Currently, the use of pesticides and deployment of blast-resistant cultivars are the main methods of combating the disease. So, it is essential and important to identify, classify and control the various disease and nutrient deficiency in successful farming system. In

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general, a farmer recognizes the disease and fertilizer deficiency in plants by using naked eye observations and this requires continuous monitoring.

However, this process may be less accurate [3]. Excessive use of Pesticides and nutrients to control the disease and nutrient deficiency not only increases the cost of production but also causes considerable environmental degradation. In addition to this it also causes various diseases to humans such as cancer, complications in the respiratory system and neurological disorders. To overcome this problem scientist had come with numerous solutions through the expansion of new technologies such as object identification, and image processing for the quality assessment. In this paper, image processing methodology is used for the identification and classification of healthy and unhealthy maize plant leaf.

This paper uses the numerous supervised classification methods such as PNN [4], and KNN [5, 6], for healthy-unhealthy detection and classification from maize plant leafs. Maize usually known as corn is one of the important crops which is very adaptable under numerous climatic circumstances. In this work, we have considered only the diseases that are associated to the leaves. Ishak et al. [7] proposed the (ANN) artificial neural network model for classification of Elegant Wall leaf diseases into two classes such as healthy or unhealthy. They have transformed the color structure of herb plant images by using image processing techniques. Padol and Yadav [8] presented the linear SVM for classification technique of the leaf diseases. The preprocessing methods are applied to the input images of the grapes and the disease regions. The ROI of diseased area is obtained the clustering algorithms from which the texture and color information are extracted. Dandawate and Kokare [9] classified the diseases of soybean leaf using SVM. The Scale Invariant feature transform technique (SIFT) used that automatically detected the plant diseases based on its shape. Singh and Misra [10] used a genetic algorithm for automatic leaf disease classification. The outline of the paper is ordered as follows. In the following section, we present our proposed approach for maize leaf healthy and unhealthy classification with references to related work. Section 2 presents our Materials and discussion. Section 3 gives Results and Discussion whereas Sect. 4 concludes the work.

2 Material and Methods

2.1 Proposed Approach

The proposed work comprises five stages: Database Finalization, Image Pre-processing, Image Segmentation, Feature extraction, classification, and Performance evaluation. The step-by-step process is given below.

- Healthy and unhealthy maize leaves collected from Plant Village Image Database.
- Database of healthy and unhealthy maize leaf is formed and considered into training and testing dataset.
- Extract the color feature RGB-mean and Standard deviation of maize leaf.

Table 1 Details of maize leaf image database

Maize leaf image database samples	Training	Testing
Healthy	20	10
Unhealthy	20	10
Total	40	20

- Maize leaf Healthy and unhealthy Classification is done by using PNN and KNN.
- Classifier.
- Performance Evaluation Matrix: The performance of the classifier is done using six Parameter viz; Accuracy, Sensitivity, Specificity, Precision, Recall, and F-measure.

Data Set: To evaluate the proposed method, we used Plant Village Maize Leaf Image Database. The maize leaf image databases contain Healthy and Unhealthy leaf image samples. There are 2 Classes of maize leaf images Leaf Type 1 is considered healthy and unhealthy as class 2. The leaf image database is taken from Plant Village Image Database [11]. Further, the maize leaf image database is sorted into Training Database and Testing Database. Both the database contains healthy and unhealthy leaf samples. Table 1 shows details of the Maize leaf Image Database used for training and Testing. Flow diagram of proposed maize leaf classification is as shown in Fig. 1.

Image Pre-processing: In this stage, the color (RBG) image is first resized and then converted into a HSV image. Then for boundary detection of converted HSV image is used to find the bounding box (BB) of the leaf. After the leaf image is cropped using the bounding box, it is also down-scaled of its original size.

Image Segmentation: The segmentation process involves the separation of leaf from its background segmentation algorithms can be employed to precisely extract the ROI for further extraction of desired features. In the Plant Village Maize Leaf Image dataset, the leaf background is a clear making it easy to segment the ROI. The segmented HSV image reconverted to RGB color space for color feature extraction.

Feature Extraction: As color is predominant characteristic for identification of healthy and unhealthy maize leaf. In the present work we consider color feature of RGB individual channel for maize leaf classification. A total of 6features are extracted to get better accuracy in classification result. Three features for Mean and Three features for Standard Deviation are extracted namely; R_{mean}, G_{mean} and B_{mean}, R_{std}, G_{std}, B_{std} respectively. For feature extraction the methods computed values mean and standard deviation of RGB color channels are used in color feature extraction [12].

1. *Mean*:

$$\text{Mean: } Mp' = \frac{1}{N} m_p \tag{1}$$

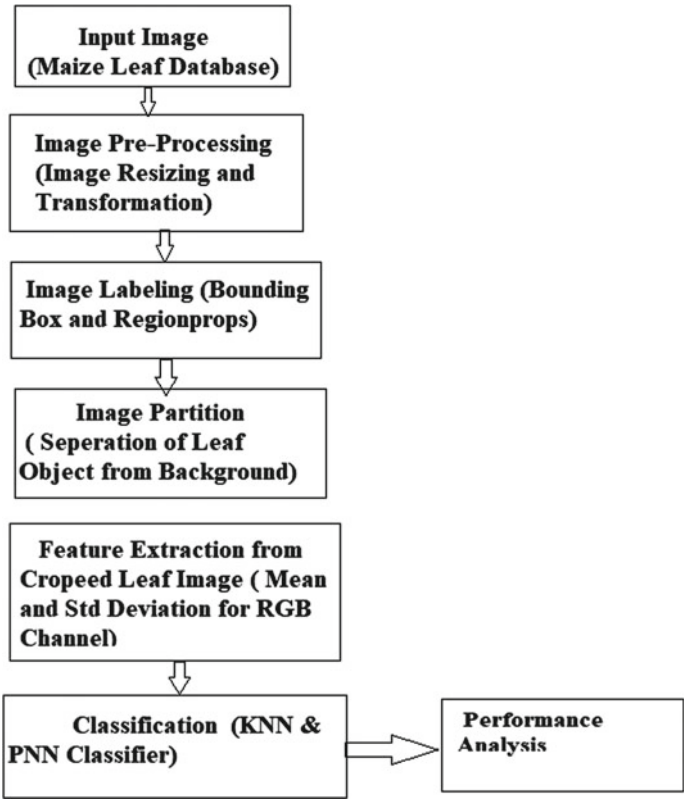

Fig. 1 Flow diagram of proposed maize leaf classification system

where M_p is the pixel intensity and N is the total number of pixels. Here mean is considered as one of the main features for RGB each channels (R-mean, G-mean, B-mean).

2. *Standard Deviation*:

Standard Deviation is the square root of the variance of the distribution. It is calculated for RGB each channels (R-std, G-std, B-std) using following formula:

$$\text{Standard Deviation}(\sigma) = \sqrt{\frac{1}{N}\sum_{p=1}^{N}\left(Mp - M'\right)^2} \tag{2}$$

Classification:

1. *PNN Classifier*: Probabilistic neural network is feed forward neural network, which is extensively used in and pattern recognition and classification. The

extracted 6 feature vector applied as input to the feed forward neural network for classification of query leaf image [4].

2. *KNN Classifier*: The K-Nearest Neighbors (KNN) it is a supervised machine learning, algorithm classically used in pattern recognition [5, 6]. It is based on the principle of nearest neighbor rule used in the classification process for the machine learning tasks. Similarly, the extracted 6 feature vector applied as input to the feed forward neural network for classification of query leaf image.

3 Result and Discussion

3.1 Maize Leaf (Healthy and Unhealthy) Feature Extraction

A total of 40 leaf samples were used for training the classifier (feature extraction). The 20 leaf samples were considered for testing the performance of classifiers. A total of 6 features are extracted to get better accuracy in classification results. Three color features for Mean and Standard Deviation are extracted individually Rmean, Gmean, and Bmean, Rstd, Gstd, Bstd. The features are computed with six feature vectors, for every healthy and unhealthy leaf samples the extracted features are shown in Table 2. Note: Leaf Type: 1—Healthy, 2—Unhealthy

3.2 Maize Healthy and Unhealthy Leaf Classification Using PNN Classifier

Actual and Predicted Leaf Sample Analysis: Table 3 shows an evaluation of Actual and Predicted maize leaf healthy and unhealthy samples using PNN Classifier. For the performance analysis, A Total of 20 leaf samples from the healthy and unhealthy class were considered. We assign Class 1 for Healthy leaf image sample and Class 2 for Unhealthy leaf samples recognized as Leaf Type. We assume Leaf Type: 1—Healthy and 2—Unhealthy while training and testing the classifier.

Classification Result Analysis of PNN Classifier: Table 4 shows the performance analysis of the PNN Classifier for Maize leaf Healthy and Unhealthy Classification. For evaluating the performance of a classifier, a total of 20 leaf samples from a healthy and unhealthy class were considered. The overall performance of the PNN Classifier gives 92.50% Accuracy for recognition of maize leaf healthy and unhealthy samples. The computation time required for a PNN classifier is 40.23 s.

Table 2 Extracted color features for training the PNN and KNN classifiers

Training leaf sample no	R_{eman}	G_{mean}	B_{mean}	R_{std}	G_{std}	B_{std}	Leaf type
1	0.31	0.526	0.21	0.0611	0.0936	0.0374	1
2	0.32	0.472	0.189	0.208	0.305	0.122	1
3	0.197	0.334	0.138	0.141	0.214	0.0825	1
4	0.22	0.548	0.3	0.061	0.151	0.104	1
5	0.215	0.338	0.135	0.21	0.328	0.131	1
6	0.275	0.472	0.193	0.129	0.212	0.081	1
7	0.162	0.405	0.262	0.111	0.278	0.185	1
8	0.208	0.519	0.447	0.0862	0.216	0.197	1
9	0.277	0.418	0.167	0.108	0.154	0.0613	1
10	0.118	0.186	0.0745	0.204	0.323	0.129	1
11	0.116	0.289	0.232	0.125	0.313	0.252	1
12	0.269	0.458	0.183	0.0931	0.146	0.0582	1
13	0.29	0.514	0.206	0.136	0.239	0.0961	1
14	0.211	0.389	0.156	0.16	0.292	0.117	1
15	0.255	0.631	0.383	0.0627	0.156	0.153	1
16	0.189	0.354	0.142	0.205	0.371	0.149	1
17	0.333	0.505	0.202	0.191	0.277	0.111	1
18	0.34	0.516	0.206	0.146	0.214	0.0857	1
19	0.266	0.397	0.159	0.126	0.161	0.0647	1
20	0.277	0.461	0.187	0.2	0.312	0.126	1
21	0.425	0.418	0.18	0.245	0.25	0.103	2
22	0.415	0.443	0.194	0.215	0.209	0.0888	2
23	0.16	0.226	0.091	0.237	0.323	0.13	2
24	0.375	0.445	0.185	0.19	0.172	0.0756	2
25	0.396	0.409	0.254	0.161	0.139	0.12	2
26	0.286	0.412	0.205	0.138	0.168	0.116	2
27	0.378	0.367	0.316	0.112	0.137	0.168	2
28	0.375	0.316	0.268	0.135	0.135	0.141	2
29	0.359	0.333	0.212	0.188	0.154	0.12	2
30	0.278	0.34	0.159	0.189	0.188	0.0888	2
31	0.297	0.378	0.231	0.136	0.138	0.128	2
32	0.324	0.356	0.158	0.19	0.177	0.0834	2
33	0.158	0.239	0.141	0.128	0.122	0.0717	2
34	0.23	0.197	0.122	0.198	0.206	0.109	2
35	0.279	0.283	0.138	0.233	0.225	0.102	2
36	0.288	0.388	0.162	0.169	0.186	0.08	2

(continued)

Table 2 (continued)

Training leaf sample no	R_{eman}	G_{mean}	B_{mean}	R_{std}	G_{std}	B_{std}	Leaf type
37	0.318	0.416	0.173	0.105	0.092	0.0518	2
38	0.291	0.327	0.155	0.193	0.17	0.0833	2
39	0.308	0.287	0.135	0.23	0.202	0.0941	2
40	0.341	0.279	0.241	0.123	0.125	0.114	2

Table 3 Evaluation of actual and predicted maize leaf healthy and unhealthy samples using PNN classifier

Maize leaf healthy classification			Maize leaf unhealthy classification		
Testing leaf sample	Actual	Predicted	Testing leaf sample	Actual	Predicted
1	Actual: 1	Predicted 1	1	Actual: 2	Predicted 2
2	Actual: 1	Predicted 1	2	Actual: 2	Predicted 2
3	Actual: 1	Predicted 1	3	Actual: 2	Predicted 2
4	Actual: 1	Predicted 1	4	Actual: 2	Predicted 2
5	Actual: 1	Predicted 1	5	Actual: 2	Predicted 1
6	Actual: 1	Predicted 1	6	Actual: 2	Predicted 2
7	Actual: 1	Predicted 1	7	Actual: 2	Predicted 2
8	Actual: 1	Predicted 1	8	Actual: 2	Predicted 2
9	Actual: 1	Predicted 1	9	Actual: 2	Predicted 2
10	Actual: 1	Predicted 1	10	Actual: 2	Predicted 2
11	Actual: 1	Predicted 1	11	Actual: 2	Predicted 2
12	Actual: 1	Predicted 1	12	Actual: 2	Predicted 2
13	Actual: 1	Predicted 1	13	Actual: 2	Predicted 1
14	Actual: 1	Predicted 1	14	Actual: 2	Predicted 2
15	Actual: 1	Predicted 1	15	Actual: 2	Predicted 2
16	Actual: 1	Predicted 1	16	Actual: 2	Predicted 2
17	Actual: 1	Predicted 1	17	Actual: 2	Predicted 1
18	Actual: 1	Predicted 1	18	Actual: 2	Predicted 2
19	Actual: 1	Predicted 1	19	Actual: 2	Predicted 2
20	Actual: 1	Predicted 1	20	Actual: 2	Predicted 2
Total	20	20	Total	20	17

3.3 Maize Leaf Healthy and Unhealthy Classification Analysis of KNN Classifier

Actual and Predicted Leaf Sample Analysis: Table 5 shows an evaluation of Actual and Predicted maize leaf healthy and unhealthy samples using the KNN Classifier.

Table 4 Performance analysis of the PNN classifier for maize leaf healthy and unhealthy classification

Maize leaf categories	Total number testing leaf samples from image database	Actually, classified leaf samples	% Accuracy and average accuracy	Leaf class type	Execution time in (s)
Healthy	20	20	100	1	40.23
Unhealthy	20	17	85	2	
Total leaf samples	40	37	92.50		

Table 5 Evaluation of actual and predicted maize leaf healthy and unhealthy samples using the KNN classifier

Maize leaf healthy classification			Maize leaf unhealthy classification		
Testing leaf sample	Actual	Predicted	Testing leaf sample	Actual	Predicted
1	Actual: 1	Predicted 1	1	Actual: 2	Predicted 2
2	Actual: 1	Predicted 1	2	Actual: 2	Predicted 2
3	Actual: 1	Predicted 1	3	Actual: 2	Predicted 1
4	Actual: 1	Predicted 1	4	Actual: 2	Predicted 2
5	Actual: 1	Predicted 1	5	Actual: 2	Predicted 1
6	Actual: 1	Predicted 1	6	Actual: 2	Predicted 2
7	Actual: 1	Predicted 1	7	Actual: 2	Predicted 2
8	Actual: 1	Predicted 1	8	Actual: 2	Predicted 2
9	Actual: 1	Predicted 1	9	Actual: 2	Predicted 2
10	Actual: 1	Predicted 1	10	Actual: 2	Predicted 2
11	Actual: 1	Predicted 1	11	Actual: 2	Predicted 2
12	Actual: 1	Predicted 1	12	Actual: 2	Predicted 2
13	Actual: 1	Predicted 1	13	Actual: 2	Predicted 1
14	Actual: 1	Predicted 1	14	Actual: 2	Predicted 2
15	Actual: 1	Predicted 1	15	Actual: 2	Predicted 2
16	Actual: 1	Predicted 1	16	Actual: 2	Predicted 2
17	Actual: 1	Predicted 1	17	Actual: 2	Predicted 1
18	Actual: 1	Predicted 1	18	Actual: 2	Predicted 2
19	Actual: 1	Predicted 1	19	Actual: 2	Predicted 2
20	Actual: 1	Predicted 1	20	Actual: 2	Predicted 2
Total	20	20	Total	20	16

Table 6 Performance analysis of the KNN classifier for maize leaf healthy and unhealthy classification

Maize leaf categories	Total number testing leaf samples from image database	Actually, classified leaf samples	% Accuracy and average accuracy	Leaf class type	Execution time in (s)
Healthy	20	20	100	1	47.28
Unhealthy	20	16	85	2	
Total leaf samples	40	36	90		

For evaluation similar to the PNN classifier, we have considered 20 healthy and unhealthy leaf samples for evaluating the performance of a KNN Classifier. Leaf Type: 1—Healthy 2—Unhealthy.

Classification Result Analysis of KNN Classifier: Table 6 shows the performance analysis of the KNN Classifier for Maize leaf Healthy and Unhealthy Classification. A total of 20 leaf samples from the healthy and unhealthy classes were considered for an evaluation of the performance of the PNN and KNN classifiers. The overall performance of a KNN Classifier gives 90% Accuracy for recognition of maize leaf healthy and unhealthy samples. The computation time required for the KNN classifier is 47.28 s.

3.4 Confusion Matrix

The performance of PNN and KNN Classifier techniques was analyzed in a testing phase for the 20 input leaf images. Figure 2 shows the confusion matrix of PNN classification results for 20 Testing maize leaf samples. For class 1 (Healthy), all leaf samples are correctly classified gives, the accuracy result is 100% for Class 2, (Unhealthy) 17 leaf samples are correctly classified and, 3 leaf samples are misclassified as class 1 gives accuracy result is 85%. The PNN classifier accuracy is 92.5%, shown in the diagonal end of the confusion matrix. Similarly, we have obtained Confusion matrix for KNN Classifier gives 90% Accuracy.

3.5 Performance Evaluation of Confusion Matrix

We have used 6 metrics parameters drawn from the confusion matrix. The performance evaluation of the PNN and KNN classifier namely; (1) Accuracy, (2) TPR—True Positive Rate (Sensitivity), (3) False Positive Rate (Specificity), (4) Precision

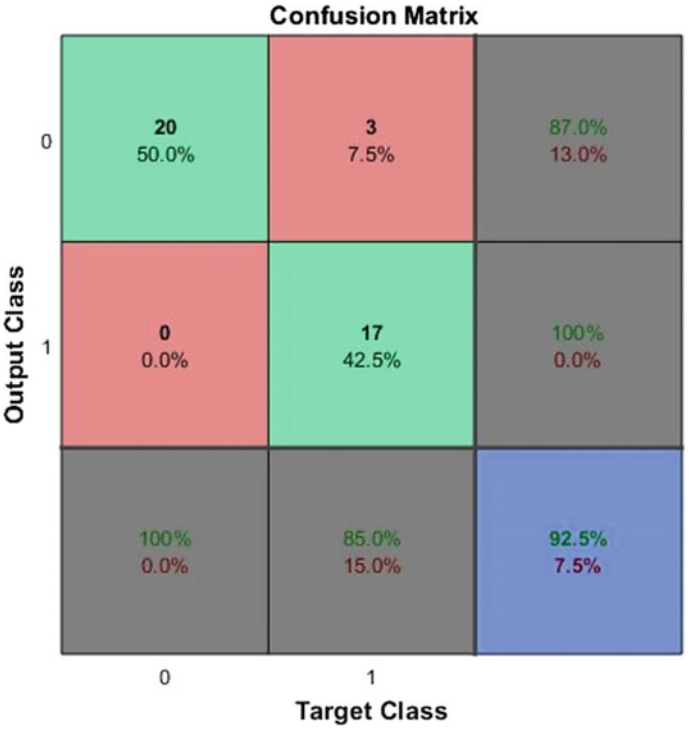

Fig. 2 Confusion matrix of PNN classifier

(5) Recall and (6) F-measure. From the binary confusion matrix following example shows how to compute Accuracy for evaluating the performance of a classifier.

Example: Computation of Accuracy.

TP: True Positive Sample: 17
TN: True Negative Sample: 20
FP: False Positive Sample: 0
FN: False Negative Sample: 3.

As per metrics parameter formula for computation of Accuracy is:

$$Accuracy = \frac{\text{TP} + \text{TN}}{\text{TP} + \text{TN} + \text{FP} + \text{FN}} = \frac{37}{40} = 92.5\%$$

Similarly, based on the evaluation metrics formula, we have computed the remaining parameters from the confusion metrics. Table 7 shows the evaluation measures for PNN Classifier.

Table 7 Performance evaluation measures from confusion matrix

Accuracy	Sensitivity	Specificity	Precision	Recall	F-measure
92.5	85	100	100	85	91.89

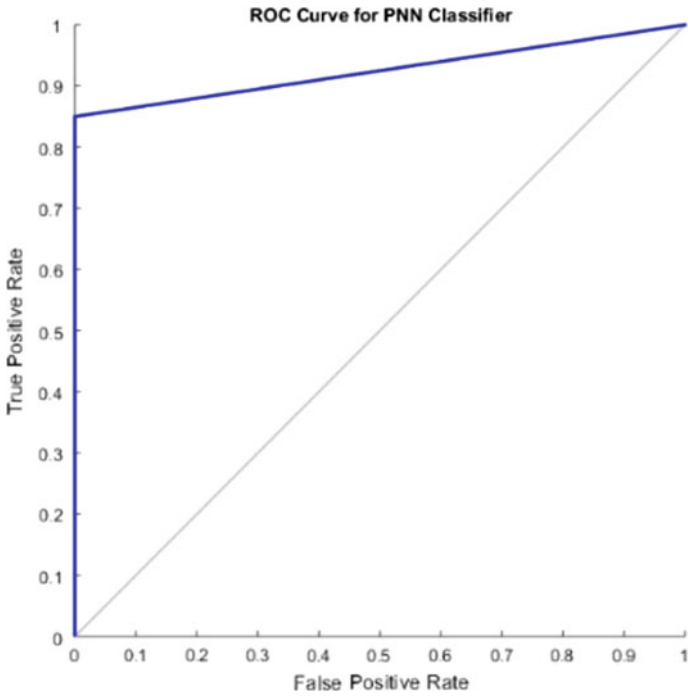

Fig. 3 ROC curve for PNN classifier

3.6 ROC: Receiver Operating Characteristic (ROC) Curve

The ROC curve is a plot of the TPR-True positive Rate versus the FPR-False Positive Rate as the area under the curve is varied shown in Fig. 3. A seamless assessment would show points in the upper-left corner, with a sensitivity of 85% and specificity of 100%. For this maize leaf recognition task, the PNN Classifier performs very well as compared to KNN Classifier.

4 Conclusion

In this paper, we proposed a dataset of Maize leaves for healthy and unhealthy classification. An image processing-based maize plant leaf classification system was

proposed, which exploits the use of RGB color features extracted from the leaf images. The proposed system is employing image pre-processing, Segmentation, Color Feature Extraction, and classification. The performance evaluation measures computed using 6 parameters from confusion metrics: Accuracy, Sensitivity, Specificity, Precision, Recall, And F-measure. The experimental results of the PNN as a classifier shown to give significant plant leaf healthy-unhealthy identification results compared with the KNN Classifier. The overall accuracy computed using PNN and KNN classifier is 92.5% execution time 40.23 s and 90% with execution time 47.28 s. Hence from the result analysis, it is found that the PNN Classifier is outperforming with high accuracy and less computation time than KNN Classifier.

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Skin Cancer Detection: State of Art Methods and Challenges

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Abstract Skin cancer is a major health concern worldwide affecting the life and wellbeing of people. Melanoma is the most harmful skin cancer with the highest mortality rate. Screening and early detection of melanoma is a complicated task for dermatologists because of the huge variations in morphological features of skin lesions. There is a real need for an efficient and reliable automated diagnosis system that aids dermatologists in diagnosis and correct decision making. In this study, we have examined the state of art methods of image preprocessing, lesion segmentation, lesion feature extraction, and classification of dermoscopic images. This paper reports performance statistics of important machine learning and deep learning-based segmentation and classification methods. We also highlighted the challenges associated with melanoma detection.

Keywords Skin cancer · Melanoma · Preprocessing · Segmentation · Classification

1 Introduction

Skin cancer is a major health concern worldwide affecting the life and wellbeing of people. Melanoma is considered as most deadly skin cancer responsible for the majority of deaths in several countries. According to cancer statistics report 2020, around 100,350 cases are diagnosed and 6850 deaths have been reported due to melanoma skin cancer [1]. Early diagnosis and treatment of melanoma are essential for its control and prevention.

Dermoscopy is one of the efficient imaging techniques addressing the early diagnosis of melanoma [2]. Dermatological photographs provide significant information than macroscopic images which are captured from smartphones or digital cameras.

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An experienced dermatologist is required to use dermoscopy as an effective tool for improving the accuracy of diagnosis.

The manual criteria used by clinicians and dermatologists for the identification of melanoma lesions mainly include ABCD rule and 7-point checklist [3]. Automatic methods for melanoma diagnosis are preferable as they help in early detection and cure by assisting dermatologists in taking correct decisions. These include pre-processing for reducing image imperfections, lesion segmentation for the location of lesions, lesion feature extraction and lesion classification.

2 Image Pre-processing Methods

The image pre-processing step is applied on both clinical as well as dermoscopic images for removing image imperfections like air bubbles, reflections, hair, ruler markings etc. before the segmentation process. Various methods have been adopted for the removal of hair which is common in images. The first method for removal of dark hair based on morphological operators was Dull Razor algorithm proposed in 1997 [4]. Soft color morphology algorithm based on fuzzy logic [5] for removal of hair in color images preserve the original colors without adding any new chromatic values. An improvement of the Dull Razor algorithm was proposed in [6] by which the orientation of hairs in the image is detected using Radon transform and noise and bubbles are filtered by the Prewitt filter method. Color enhancement can also be done in pre-processing using the color space transformation method [7] in which RGB images are first converted to CIE L*a*b* color space and then after transformation, intensity values of channels are adjusted for contrast improvement. The problem of shading caused by the variation in illumination is solved in [8] and local illumination is estimated using morphological closing operation.

3 Lesion Segmentation Methods

Segmentation is an essential step for determining the region of skin lesions from dermoscopic and clinical images. Segmentation is challenging because enough ground truth labels are not available and there are a lot of variations in size, shape, texture and color of lesions. An effective segmentation method holds capacity to solve above problems and boost the accuracy of the classification task [9]. Thresholding, Edge-based segmentation, Region-based segmentation, clustering, region merging, and splitting are basic algorithms developed by researchers in past decades. These are the simple methods applicable only to small datasets and hence cannot be applied to complicated tasks. Hu et al. [10] combined brightness and color saliency map for increasing the image contrast and then adaptive thresholding based on wavelet transform (WT) is applied for segmenting the skin lesion from healthy skin.

Table 1 Summary of performance of various segmentation methods for skin lesions

References	Technique	Dataset	Performance
[10]	Adaptive thresholding based on WT	ISBI 2017, PH2	DC: 92.19%
[11]	MRF model	ISIC 2018	JA: 76.40%
[13]	YOLO and Grab cut algorithm	ISBI 2017, PH2	ACC: 96% (ISBI 2017), 94.4% (PH2)
[14]	Improved FCN	ISBI 2017, PH2	ACC: 95.30% (ISBI 2017), 96.92% (PH2)
[15]	19-layer deep CNN	ISBI 2017, PH2	JA: 97.1%
[16]	Res-Unet50	ISIC 2017, PH2	JA: 77.2% (ISIC 2017), 85.4% (PH2),
[17]	Multistage FCN	ISBI 2016, PH2	DC: 91.18% (ISBI 2017), 90.66% (PH2)

Markov Random Field (MRF) theory is also showing great potential in solving image segmentation problems [11].

Recent efforts focus on convolutional neural networks (CNN) based methods as a superior tool in the field of image analysis. After the availability of high-performance and less expensive GPUs, CNN models have become quite popular [12] for segmentation and classification tasks. In [13], authors have combined YOLO and grab cut algorithm for detection of lesion location and then post-processing is applied for getting the fine segmented image. An improved fully convolutional neural network (FCN) [14] is proposed for the segmentation of full-resolution images of all skin types. The 19-layer deep fully convolutional network is designed in [15] and fusion of 50-layer U net and ResNet architecture called Res-Unet50 is proposed in [16] for segmentation. These methods reduce training time and reveal good results on the ISBI 2017 and PH2 dataset. Integration of multiple fully convolutional networks is proposed by authors for complicated and challenging skin lesions [17]. The performance of segmentation methods is determined by the evaluation metrics such as Accuracy (ACC), Dice coefficient (DC) and Jaccard Index (JA). Summary of performance of segmentation methods is given in Table 1.

4 Lesion Feature Extraction Methods

Features from the segmented area is of prime importance in the diagnosis of status of lesions. Extraction of the effective features and removal of redundant features is the main aim of all extraction methods. Shape, color, and textures are the three main skin lesion features [18]. The various shape features are asymmetry and border. Asymmetry can be examined by using several geometrical measures like perimeter, diameter, entropy measures, etc. [19]. Various techniques like wavelet transform [19]

and Fourier transform [20] are applied for the determination of border irregularity. Color information of the lesions can be obtained with the help of color spaces, for example, RGB, normalized RGB [21], HSV, and CIELAB [22] color space. Texture analysis can also be done by statistical means like the Gray level co-occurrence matrix (GLCM) and local binary operator (LBP) [23]. Filter based texture analysis methods are wavelet transform, Gaussian filtering and Gabor filtering [24].

5 Lesion Classification Methods

The performance of the classification mainly depends on the extracted features and classification algorithms. A large number of features, imbalance between normal and abnormal samples, variations in feature range are some of the concerns that need to be handled before the start of classification [18]. Classification methods based on machine learning requires hand-crafted features like shape, colors and texture whereas deep learning methods does automatic feature extraction. Shimizu et al. proposed layer and flat classification models which combines color, subregion and texture features for skin lesion classification [25]. Fully connected (FCN) U-net CNN architecture is implemented in [26] which works on sparse coded features for diagnosis of melanoma. The classification performance of four pretrained CNN architectures (DenseNet201, ResNet152, Inceptionv3, Inception ResNet v2) is 11% more accurate than highly skilled professional dermatologists [27]. Oliveira et al. [28] proposed an Optimum Path Forest Classifier (OPF) which gives 92.3% accuracy with hybrid feature extraction techniques. Ensemble of k-nearest neighbor (KNN), support vector machine (SVM) and Deep CNN classifiers is presented in [29] and hybrid (color-texture) feature extraction provides better results with SVM classifier [30]. Clinical profile of patients like age, gender, and lesion visual features are also incorporated in the CNN algorithm [31] for accurate and precise results. The performance of all classification methods is determined by Accuracy (ACC), Sensitivity (SE), Specificity (SP), Precision (Prec) and Area under the region of characteristic curve (AUC). Summary of classifiers is given in Table 2.

6 Data Sets for Melanoma Diagnosis

Several public and private datasets have been released keeping in view the rising cases of melanoma cancer worldwide. Among the private datasets, the largest one used by Esteva et al. [32] consists of 129,450 clinical images. Other popular databases are Dermofit Image library [33] and Interactive Dermatology Atlas [34]. The major public datasets available are ISIC archive [35], ISBI 2016 [36], ISBI 2017 [37] challenge dataset and PH2 [38] dataset. All these benchmark datasets are labeled by expert dermatologists and shows a fair number of imbalanced classes, difference in size and complexity.

Table 2 Classifiers for detection of skin lesions

References	Features	Classifier	Dermoscopic images (melanoma/lesions)	Performance
[25]	Hand-crafted	Linear	105/964	ACC: 90.48%
[26]	Hand-crafted	FCN U-Net	273/900	AUC: 84.3%, Prec: 64.9%
[27]	Pretrained CNNs	Softmax	1153/10,135	AUC: 94.4% (ResNet 152)
[28]	Hand-crafted	OPF	188/1104	ACC: 92.3%, SP: 97.1%, SE: 87.5%
[29]	Hand-crafted	Ensemble	214/484	ACC: 97.7%
[30]	Hand-crafted	SVM	146/397	ACC: 96%

7 Challenges in Melanoma Detection

Melanoma Diagnosis is initially done by dermatologists through the visual screening of skin lesions followed by a dermoscopic analysis [39]. Accurate detection of melanoma lesions of size less than 6 mm is quite difficult [40] and sometimes suspicious lesions required biopsy. Inadequate and imbalanced images in the available benchmark data set is another challenge in deep learning methods as they may lead to overfitting and underfitting problems. Some of the researchers work on non-public data sets therefore replication and validation of their results is a difficult task [41]. Another limitation is that all the available data set in the ISIC repository mainly consists of images of light skinned people and there is lack of benchmark dataset with images of dark-skinned people.

8 Conclusion

This paper presented different techniques of image pre-processing, lesion segmentation, lesion feature extraction and classification required for automatic diagnosis of skin cancer. Pre-processing methods like removal of hair, air bubbles, artifacts help in the extraction of appropriate features. It is observed that deep learning-based segmentation and classification bypass complex pre-processing operations. Pretrained deep learning model provides better results with small datasets. Incorporating ensemble classifiers compensate for the shortcoming of individual classifier. Patient metadata information like age, gender and lesion visual features must be integrated along with images for better training of model. The main purpose of all the automated diagnosis methods is to assist the dermatologists in early diagnosis of skin cancer and decrease the melanoma mortality rate.

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Empirical Analysis of Magnetic Resonance Imaging-Based Brain Disease Analysis Systems: A Statistical Perspective

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Abstract Brain magnetic resonance imaging (MRI) is required for patients having brain disease symptoms. These diseases include but are not limited to Parkinson's disease, dementia, Alzheimer's disease, autism spectrum disorder, etc. Each of these diseases can be detected using novel classification and prediction techniques which are suited for MRI data. These techniques use image segmentation, feature extraction, feature selection and classification algorithms in order to effectively detect the presence of diseases. A large number of research-works are present which use different algorithm combinations for effective classification of these diseases. While designing any such system, researchers need to carefully identify and use algorithms that can perform this classification task with high accuracy. In this text, an empirical analysis of feature extraction, feature selection and classification algorithms on different diseases are done, which can assist researchers and system designers to select the most optimally performing algorithms for their system design. Moreover, this text also describes the nuances of these techniques, and recommends best practices to improve their overall performance. Using the statistical analysis done in this text, researchers can also quantify and predict the performance of their system prior to real-time implementation.

Keywords MRI · Classification · Deep learning · Feature extraction · Selection · Classification

1 Introduction

Disease prediction from MRI data requires multi-domain classification steps. These steps include, but are not limited to,

- Effective MRI acquisition, which has to be done using either real-time MRI equipment, or using pre-captured MRI datasets. This acquisition is completely application specific and requires prior knowledge about the disease for which these images are being captured

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- Pre-processing of images is needed to remove noise components from the image. This step is also used for image enhancement purposes, for images which are taken under dim lighting conditions.
- The segmentation step is one of the most important blocks in MRI classification. It involves usage of application specific algorithms that identify color, texture and shape patterns from the MRI in order to obtain the final regions of interest. Performance of MRI classification is heavily dependent on the efficiency of this block.
- Feature extraction block is used to convert image data into numerical form. This numerical data is extracted such that images belonging to the same disease class have similar feature values, while images belonging to different disease classes have highly varying values. This is the 2nd most important block in MRI segmentation
- Upon extraction of features, the feature selection block is activated. This block identifies variance between features of images belonging to same & different classes. It tries to select features that have maximum variance between different classes, and minimum variance between same classes. Algorithms like Principal Component Analysis (PCA), Independent Component Analysis (ICA), etc. are used for this purpose.
- Finally, the classification block is used in order to categorize the given input features into infected or non-infected regions. Algorithms like neural networks (NN), support vector machines (SVMs), etc. are used for this purpose.

An example architecture of this system can be observed from Fig. 1, wherein feature extraction, feature selection, classification and segmentation blocks can be seen. A large number of algorithms are suggested for these blocks in order to improve the classification efficiency of application specific MRI systems. The next section accumulates these algorithms and identifies different nuances and advantages of the proposed techniques. This is followed by statistical analysis of these algorithms,

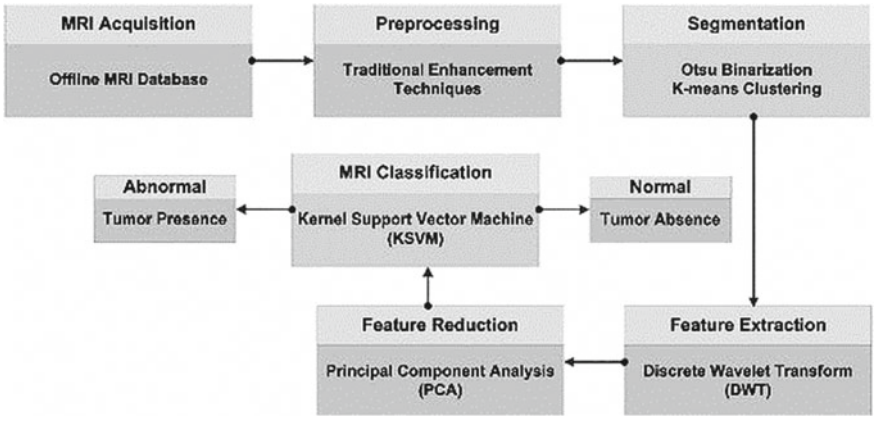

Fig. 1 Building blocks of MRI classification system

which will assist the reader in selecting the best possible algorithm combination for their research. Finally, this text concludes with some interesting observations about these algorithms and recommends ways to improve them.

2 Literature Review

MRI-based brain disease detection systems have gained a lot of popularity in the past decade. This is majorly due to simplicity of implementation, ability to detect a large number of diseases and high accuracy characteristics of these systems. For instance, the work in [1] uses convolutional neural network (CNN) based Broad Learning Systems (BLS) for detection of different stages of Alzheimer's disease (AD) including mild cognitive impairment (MCI) and control normal (CN). It uses threshold-based brain segmentation to extract brain regions from input imagery and then it uses slice extraction to extract various layers of the MRI. All these slices are combined in order to train a BLS-CNN in order to obtain an accuracy of nearly 98% for classification of MCI and CN Alzheimer stages. In this system slices are given to model-training for effective classification. The system is tested on Alzheimer's disease Neuroimaging Initiative (ADNI) dataset, and thus can only be evaluated on the same dataset. The system needs to be re-trained once the dataset changes, which requires large training delay along with limited accuracy of classification in case of cross-dataset evaluation. In order to remove this drawback, the work in [2] introduces transfer learning for detecting MCI, NC and AD across different datasets. Transfer learning also reduces the size of dataset to nearly 10% of the original data, and keeps the same level of accuracy for classification. They also utilize class activation maps (CAMs) in order to identify neuro-pathologically relevant regions that can further assist doctors to infer better information from the original imagery. They use VGG-Net CNN architecture with group partitioning for better inter-dataset learning performance.

Accuracies up-to 99% are achieved using the proposed method, with a 90% reduction in training delay. Thereby making the method faster and improving its applicability for real-time datasets. A similar research on multiple datasets is done in [3] wherein dementia and its sub-types are detected using whole brain sMRI images (structural MRI).

The system uses fused multi-level sMRI features and gives them to a CNN for evaluation of disease attention map. This attention map is then given to a multi-branch hybrid network to find dementia class. Architecture of the used CNN uses a series of convolutional layers are connected in tandem to obtain the final dementia class. They have used the ADNI-1, ADNI-2, and AIBL datasets in order to evaluate their proposed model. Due to evaluation on multiple datasets, the accuracy of classification is nearly 83%, which is very high considering that other state-of-the art methods produce a highest accuracy of 80% on similar datasets. This accuracy can be improved with the help of the cascaded CNN model as described in [2]. The system is mainly applicable to dementia patients, this applicability can be extended to other diseases

with the help of longitudinal MRI data as described in [4], wherein real-time data of more than 250 patients was analyzed using a support vector machine (SVM) classifier to obtain an accuracy of 87%. This accuracy can be further improved using effective feature extraction and replacing SVM with CNN-based classifier. An example of replacing linear feature extraction with bag of features (BoF) can be observed in [5], wherein same SVM classifier is used along with BoF to obtain a 93% accuracy for classification of ADNI dataset. They have used speeded up robust features (SuRF) for feature extraction, and k-Means for generating bag-of-word features.

Volumetric CNNs and transfer learning can also be used for classification of multi-dataset volumetric MRI images. The work in [6] uses this concept to detect NC, MCI, progressive MCI (pMCI) and stable MCI (sMCI) diseases. They have also considered functional MRI (fMRIs) for performing this detection. As a result of which the accuracy of classification reaches to nearly 86% across multiple dataset imagery.

Detection of AD can be extended further to incorporate AD progression. An architecture that detects long-term AD progression with more than 80% accuracy is described in [7], wherein a 2-stage classification process is used.

This process combines longitudinal models with random forest for progressive analysis of CN, MCI and AD. Another architecture which can be extended for progressive AD detection is described in [8]. This architecture uses genomic feature extraction along with predictive modelling for detection of multiple AD classes with an accuracy of 83%, which can be improved using the CNN models described in [9]. There is a brief comparison between deep learning and machine learning models done in [9], which indicates that the performance of SVM is similar to simple CNNs, but deep CNN models have high accuracy values in the range of 90% to 98% on a wide variety of datasets.

The work in [10] utilizes these biomarkers to detect pNC, sNC and MCI diseases with an accuracy of 95%. Single stage CNNs are used for grey scale MRIs while multi-scale CNNs with multiple-backbone layers are used for colored MRI data. This distinction can be clearly seen. This work is further modified in [11] to detect dementia and sNC with more than 80% accuracy with the help of 3D CNNs. It is recommended that the existing model of [10] be deployed for [11] in order to improve the classification performance. Moreover, both [10] and [11] can include the data from dorsolateral prefrontal cortex (DLPFC), left primary motor cortex (M1), MRI morphometric data in order to further improve classification accuracy as suggested in [12, 13]. In [12] the overall accuracy of AD classification is more than 95%, which is higher than both [10] and [11]. It can again be reconfirmed from [14] that the use of CNNs for dementia detection has higher accuracy than non-neural network-based methods, where the accuracy of prediction is more than 90% on the ADNI dataset. This analysis can be further extended to AIBL, OASIS and MIRIAD datasets as mentioned in [15].

The work in [15] also indicates that 3D topographic (3T) patterns for evaluation of these datasets are optimum as compared to 1D patterns. Accuracy of classification using these 3D patterns is in the range of 90–93% for NC, MCI and DEM diseases. Early diagnosis of AD can be done with the help of Resting-State Brain Networks as

described in [16]. In this work, researchers have used fMRI data and normalized it for obtaining key-point imagery. This imagery is filtered and converted into a time-series matrix for effective classification. The matrix is generated using a combination of feature extraction and auto-encoder units. Finally, this matrix is given to the CNN classifier for producing a classification accuracy of 91%. This method can be used for effective early detection of AD in patients of any age group with high accuracy. The output probability is used as a brain matrix for classifier tuning.

A fusion of MRI and PET scans can be used for highly effective and cross-dataset classification of MRI images. The work in [17] uses a fusion-based CNN-inspired architecture for detection of dementia and other AD related diseases. This network uses a combination of skull-stripping, bias field correction, affine registration, averaging and template-based registration with CNN to produce an accuracy of 97% for classification of AD and its related diseases.

The PET scan is further explored in [18] to determine AD detection for fluorine 18 (18F) fluoride-oxy-glucose (FDG) PET of the brain. Saliency maps are used for segmentation of images, and CNNs are used for performing final classification. An accuracy of 91% is achieved using this 18F-FDG-PET scans for detection of AD and its related diseases. This accuracy can be further improved to 95% using a 3D CNN as discussed in [19], wherein the same FDG-PET scans are combined with T1-MRI data to classify pMCI and NC symptoms in patients.

Temperature data from MRI images can also be used for visualization of brain anatomy during ultrasounds and spectroscopy [20, 21]. This visualization can assist in finding out brain pattern variations for effective AD localization. Work in [22, 23] and [24] further confirm the use case of CNN and General Adversarial Networks (GANs) for classification of AD and its sub-types with accuracies in the range of 90–97%. Observing this trend, it can be seen that CNNs and its dependent networks are mostly used for classification of AD-based diseases. A statistical comparative analysis of these methods can be observed from the next section.

3 Statistical Analysis

In order to perform the statistical analysis of the reviewed systems, the following parameters were evaluated,

Delay

Delay indicates the time needed by the algorithm between taking an input image and producing the output image. It is evaluated using the following formula,

$$Delay = T_{processed} - T_{unprocessed} \tag{1}$$

where $T_{processed}$ is the time when the image is just processed, and $T_{unprocessed}$ is the time just before the image is processed. A low value of delay is expected for any

real-time algorithm. As delay values for all algorithms are not available, thus values of Low, Medium and High are considered for this comparative analysis.

Classification Accuracy

Classification accuracy is evaluated using the following Eq. 2,

$$Acc.(\%) = \frac{N_C}{N_T} * 100 \tag{2}$$

wherein N_C is the number of correctly classified images, and N_T are the total number of classified images.

The referred texts do not have a similar comparison base which is needed for performing statistical evaluation. Thus, this evaluation is done by taking an average of all the readings observed in the reviewed texts. Average readings give an approximate estimate about the performance of reviewed algorithms when applied to different kinds of datasets, and thus it is used for evaluation. Table 1 indicates the performance evaluation of the reviewed algorithms.

Based on this analysis it can be observed that CNNs are most suited for classification of AD and its related diseases. The accuracy can be improved using PET scans and 3D CNNs.

4 Conclusion and Future Scope

From the research it can be observed that methods like SVM, RF, DT, etc. can produce moderate level of accuracy within 80–85% even with most optimized feature selection algorithms. This accuracy can be boosted within 90–99% using variants of CNN like 3D CNN, LSTM-based CNN, etc. Moreover, PET scans can be combined with MRI data for detection of larger number of diseases. Cross-dataset learning can be done with the help of transfer-learning methods, and re-enforcement learning techniques. But these methods are limited in terms of accuracy and applicability to real-time scenarios. In future, it is recommended that researchers should work on improving the efficiency of cross-dataset and real-time MRI datasets. Moreover, researchers can also work for improving the effectiveness of sMRI and fMRI-based processing. Feature selection techniques can also be improved in order to reduce the delay and improve the accuracy of prediction.

Table 1 Analysis of different methods for AD and its related disease detection

Algorithm	Feature	Disease	Delay	Accuracy (%)
BLS-CNN [1]	CNN on MRI	AD, MCI, CN	High	98
TL-CNN [2]	CNN on MRI	AD, MCI, CN	Low	95
CNN [3]	CNN on sMRI with attention maps	Dementia	High	Superior
SVM [4]	BoF longitudinal features	Dementia	Medium	87
CNN [5]	BoF on MRI with SuRF	AD, NC and MCI	Medium	93
Volumetric CNN [6]	CNN on fMRI	NC, MCI and pMCI	High	86
CNN [25]	Neuropsychology and EEG with MRI	NC, MCI and pMCI	High	90
3D CNN with Dense-net [26]	Dense-net CNN on MRI and PET	AD, NC and MCI	High	84
SVM [27]	Wavelet features on MRI	AD	Low	70
CBLSTM [28]	CNN on MRI	MCI, DEM and CN	Medium	86
AlexNet CNN [29]	CNN on MRI	AD and MCI	High	99
VGGNet [30]	CNN on MRI	AD, NC, MCI and DEM	High	90
VGGNet [7]	CNN on MRI	Long term AD progression	High	80
Random Forest [8]	Longitudinal MRI features	AD	Medium	83
CNN [9]	Longitudinal MRI features	AD	High	95
CNN [31]	CNN on MRI	Small vessel atherosclerosis and arteriolar sclerosis	High	85
ex-Vivo [10]	Bio-markers on MRI	pNC, sNC and MCI	Medium	95
3D CNNs [11]	CNNs on MRI	Dementia and sNC	Medium	80
CNNs [12]	CNNs on MRI	DLPFC, M1 and MRI morphometric data	High	95
CNN [14]	CNNs on MRI	Dementia	High	80
CNN [15]	3T Patterns	NC, MCI and DEM	High	81
CNN [32]	3T Patterns	Arteriolar sclerosis	High	91
RSBN [16]	CNN on fMRI	NC, AD	Medium	91

(continued)

Table 1 (continued)

Algorithm	Feature	Disease	Delay	Accuracy (%)
Fusion based CNN [17]	MRI and PET	AD, NC, MCI and DEM	High	92
3D CNN [18]	CNN on 18F-FDG-PET and MRI scans	AD, NC, MCI and DEM	High	91
3D CNN [19]	CNN on FDG-PET and MRI scans	AD, NC, MCI and DEM	High	90
Cascaded deep CNNs [33]	CNN on MRI	H3 K27M	High	95
GAN [24]	GAN on MRI	AD, NC, MCI and DEM	High	97

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Power-Delay-Area Efficient Design and Implementation of Vedic Multiplier Using 14 nm Finfet Technology

Swati Shetkar and Manisha Waje

Abstract Digital Multiplier is the important part of ALU and many other arithmetic operations. VLSI designers show keen interest in optimizing area, power and delay in multiplier. In this paper 2 * 2 bit multiplier with low power, high speed with novel architecture is designed using 14 nm FinFet technology using micro wind 3.8 which is based on Urdhva-Tiryagbhyam sutra from Vedic mathematics. The multiplier consumes less power and requires less design area than 45, 65 and 90 nm Technology based multipliers.

Keywords Vedic multiplier · Urdhva-Tiryagbhyam · Ripple carry adder · Finfet

1 Introduction

Multiplier is basic unit used in FFT, convolution, ALU and in many more DSP operations. So low power and fast multiplier is need for digital system. Optimization in logic levels as well as in transistor level to reduce area, power consumption and delay is the key interest of designer. Conventional multipliers use shift and add method but it requires large area and delay is more. Vedic mathematics is a solution on this problem.

2 Vedic Mathematics

Swami Bharati Krishna Tirtha (1884–1960), evolved techniques and strategies for amplifying the ideas contained with inside the aphorisms (sutras) and their corollaries (upasutras), and known as it Vedic Mathematics. Vedic mathematics is discovered

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from Vedas and it is based on sixteen sutras and thirteen upa-sutras. These sutras are nothing but quick algebraic computational algorithm. The Sutras follow to and cowl nearly each department of Mathematics. They follow even to complicated issues related to a huge variety of mathematical operations. Application of the Sutras saves quite a few effort and time in fixing the issues, in comparison to the formal techniques currently in vogue.

While designing Vedic multiplier the Urdhva-tiryagbhyam sutra which means vertically and crosswise is applied for multiplication

- In this method, partial products are generated parallely. Hence critical path delay is reduced drastically.
- Multiplication using Urdhva-tiryagbhyam sutra can be carried out in both ways. i.e. from left to right or from right to left.
- This sutra can be applied for more number of digits.
- This sutra is also effective for algebraic expression multiplication.
  e.g. (2a+2b) and (2a+b) multiplication

```
   2a    +    2b
   2a    +    b
-------------------------
4a2  +  6ab  +  2b2
```

The two bit multiplier design use the following steps as shown in Fig. 1.

3 Related Work

In Urdhva-tiryagbhyam Vedic mathematics algorithm [1] partial products are generated parallely which reduces the delay. Transistor level design of Vedic multiplier using 180 nm is shown in [2]. This Design shows better improvement in performance parameter compared to conventional multiplier with average power = 13.71 mW. In [3] Adiabatic multiplier is optimized using 3T AND gate, 8T full adder and 5T half adder due to which speed is also increased and area is reduced. Average power consumed without adiabatic is 211.55 mW and with adiabatic 24.11 mW. In [4] 180 nm technology based Vedic multiplier is implemented using Verilog coding which gives total power = 101.99 μW. MCC based Vedic multiplier design is proposed in [5] 45 nm cmos technology which has lower PDP and power = 39.81 μW. A 16 nm technology based 8 bit Vedic multiplier is proposed in [6] with high speed and power = 15.2 μW. Finfet based multipliers are comparatively studied in [7] which results that Finfet is low power, area efficient technology than cmos technology.

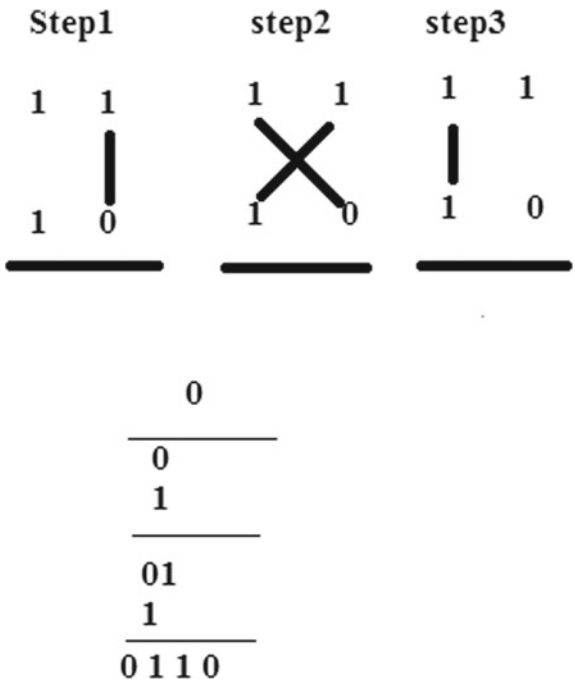

Fig. 1 Two bit multiplication method using Urdhva-tiryagbhyam sutra

4 Design and Implementation

4.1 Vedic Algorithm Technique for Multiplication

For 2 * 2 bit multiplication in Vedic multiplier, two LSB bits are multiplied first giving LSB bit of final product as shown in step one. In second step as shown in Fig. 1, cross multiplication of bits is done and added giving second bit of final product and generated carry is added to product of MSB bits in step three. As all the steps are performed parallely, so delay is reduced. For the implementation of this design hardware required is as shown in Fig. 2. Four AND gates are used to give partial products and two half adder blocks are used to give final product result as shown in Fig. 3. Similarly four bit multiplication method using UT sutra is shown in Fig. 3 with hardware implementation in Fig. 4.

5 Simulation and Result

4 * 4 Bit Vedic multiplier is designed and implemented in 45, 65 and 90 nm cmos technology using Micro wind 3.8. Simulation results of schematic and layouts are as shown in figures below. A proposed 14 nm Finfet technology based 2 * 2 Bit Vedic

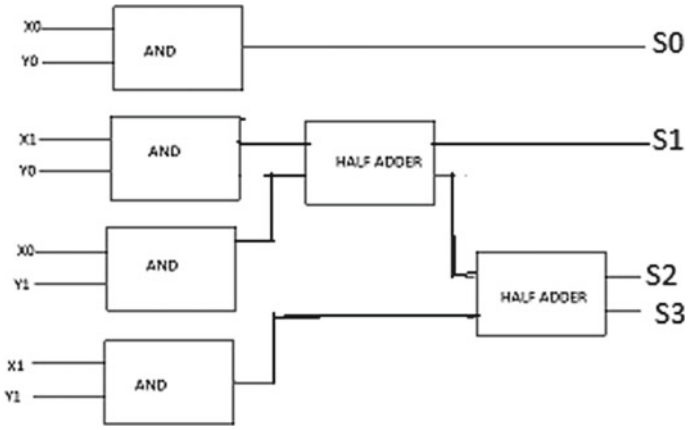

Fig. 2 Hardware requirement for Vedic multiplier

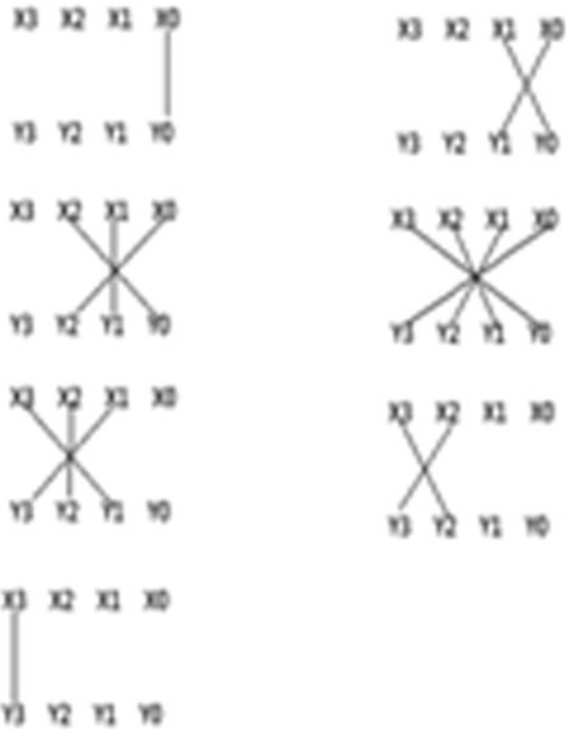

Fig. 3 4 bit multiplication method using Urdhva-Triyagbhyam

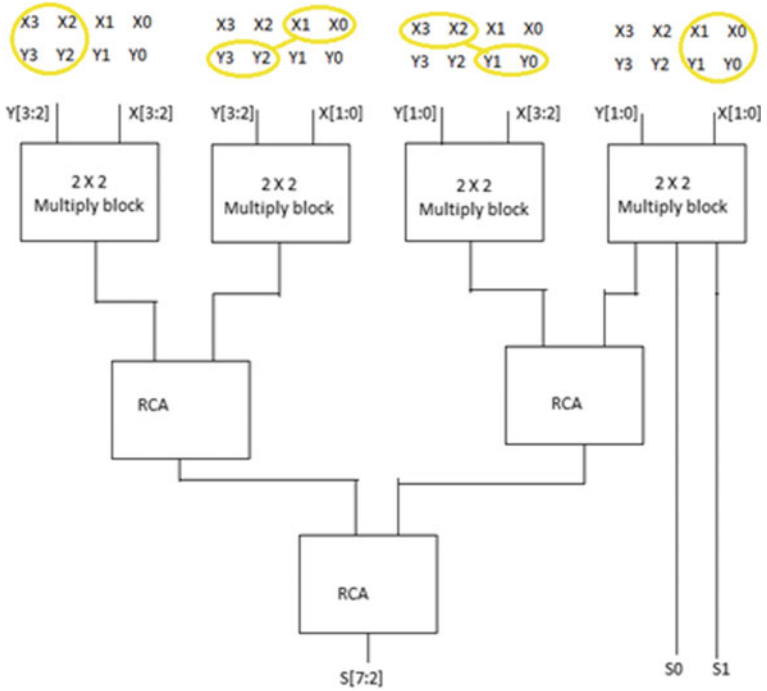

Fig. 4 Hardware requirement for 4 bit Vedic multiplier

multiplier is implemented. Its layout design and simulation result is as shown in Figs. 13 and 14 respectively. The proposed design is very low powered and compact (Figs. 5, 6, 7, 8, 9, 10 and 11).

*5.1 Simulation and Result of Proposed 2 * 2 Vedic Multiplier Using 14 nm Finfet Technology*

Summary of schematic simulation

Technology	I_{max} (mA)	I_{avg} (mA)	Power (μW)
45 nm cmos	0.48	0.001	1
65 nm cmos	0.50	0.001	1
90 nm cmos	0.60	0.004	4

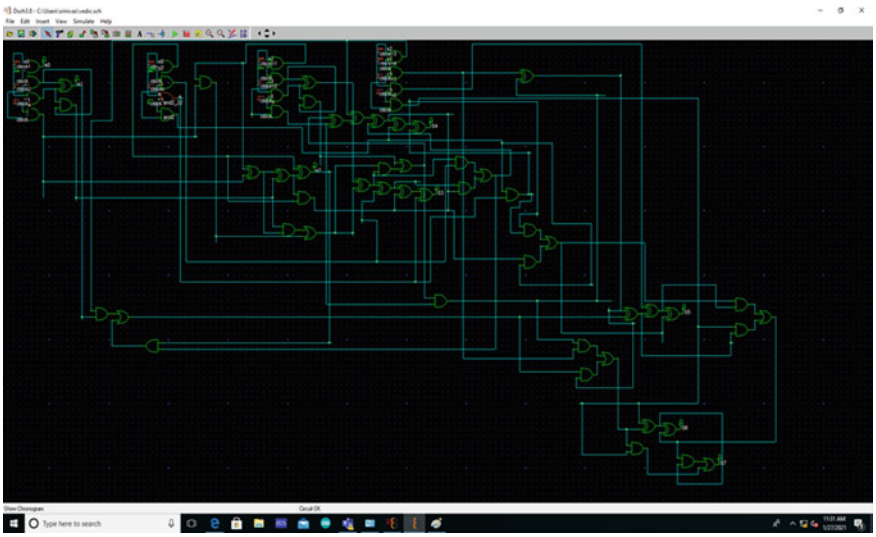

Fig. 5 Schematic design of 4 * 4 Vedic multiplier

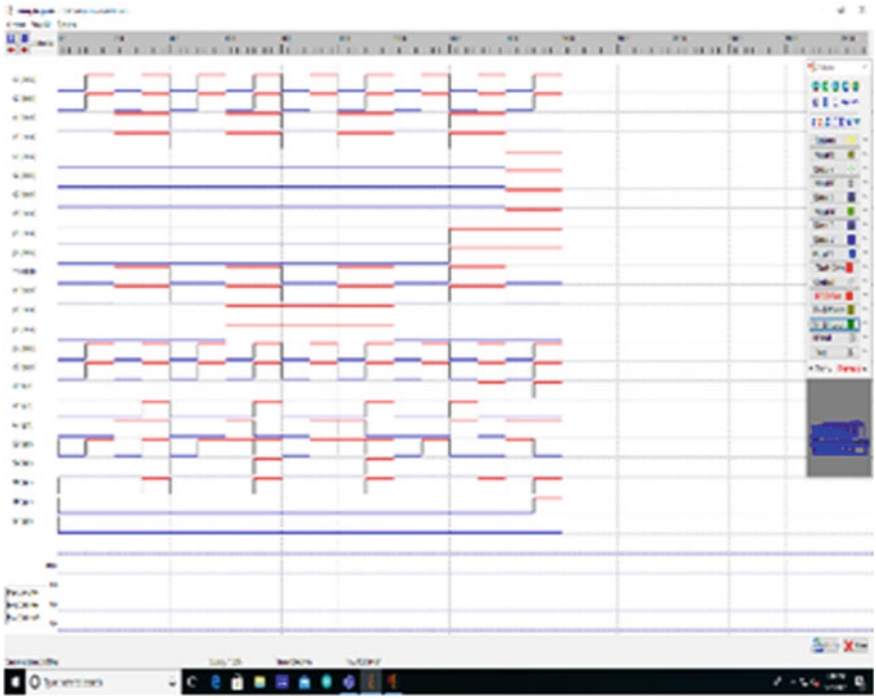

Fig. 6 Simulated waveform for 45 nm technology 4 * 4 Vedic multiplier

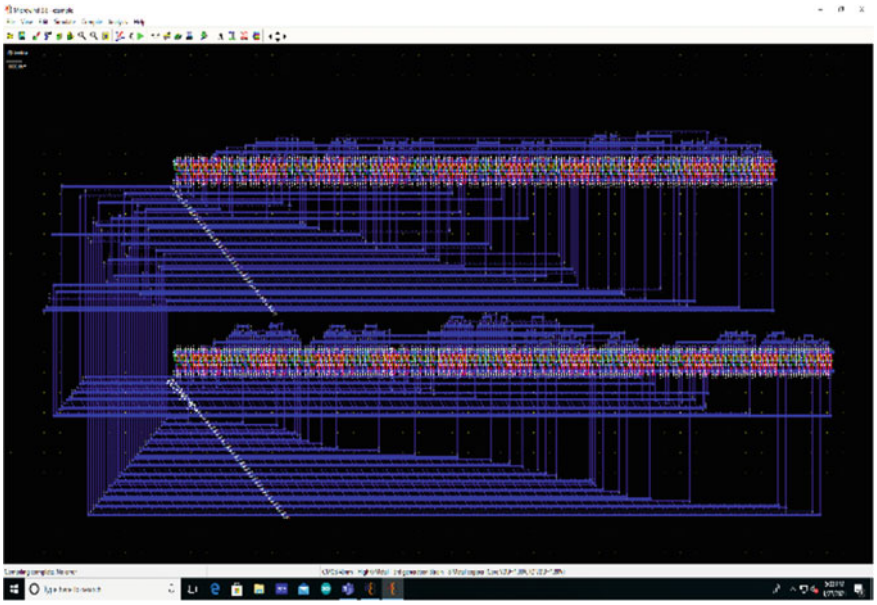

Fig. 7 Layout of 4 * 4 bit Vedic multiplier using 45 nm technology

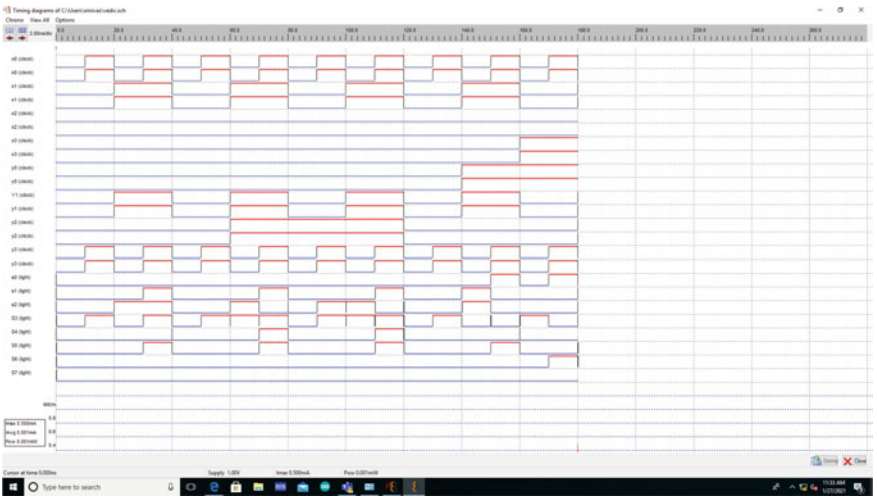

Fig. 8 Simulated waveform for 65 nm technology 4 * 4 Vedic multiplier

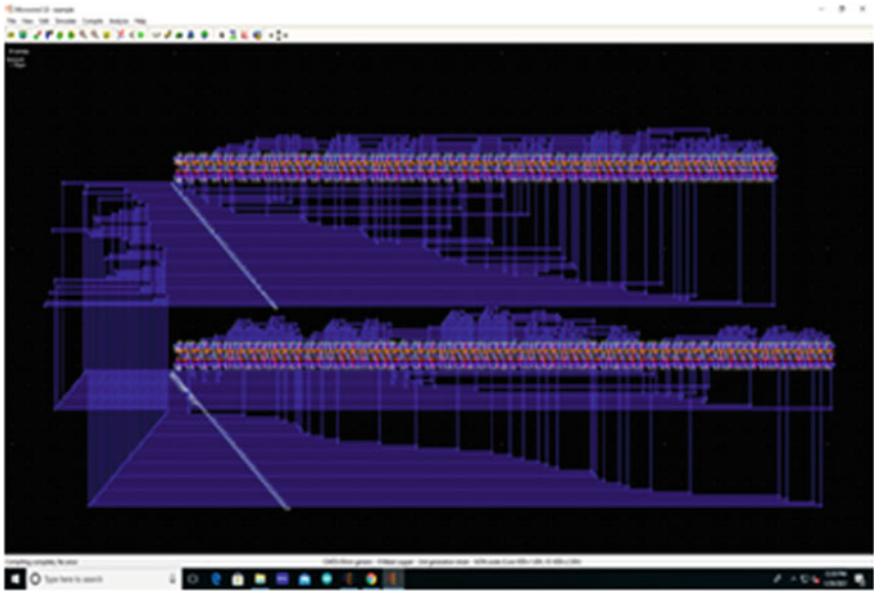

Fig. 9 Layout of 4 * 4 bit Vedic multiplier using 65 nm technology

Summary of layout simulation

Technology	Power (μW)
45 nm cmos 4 * 4 bit	27.044
65 nm cmos 4 * 4 bit	40.392
90 nm cmos 4 * 4 bit	87.059
14 nm FinFet 2 * 2 bit	1.039

6 Conclusion

Using micro-wind 3.8, 4 * 4 Vedic multiplier is realized in 45, 65, 90 nm cmos technology. 4 * 4 Vedic multiplier is designed using 2 * 2 Vedic multiplier as a basic building block. The proposed 2 * 2 Vedic multiplier using 14 nm FinFet technology gives 87% power reduction when compared with 32 nm Finfet Vedic multiplier with power consumption of 87 μW [8]. Proposed design is faster, compact in size and use low power compared to other multipliers.

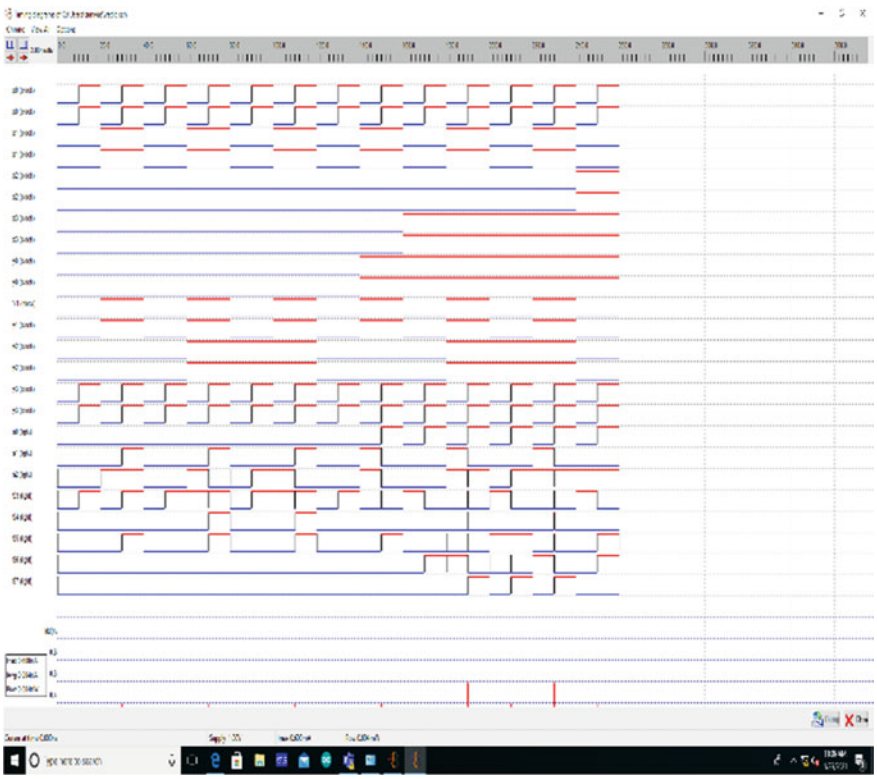

Fig. 10 Simulated waveform for 90 nm technology 4 * 4 Vedic multiplier

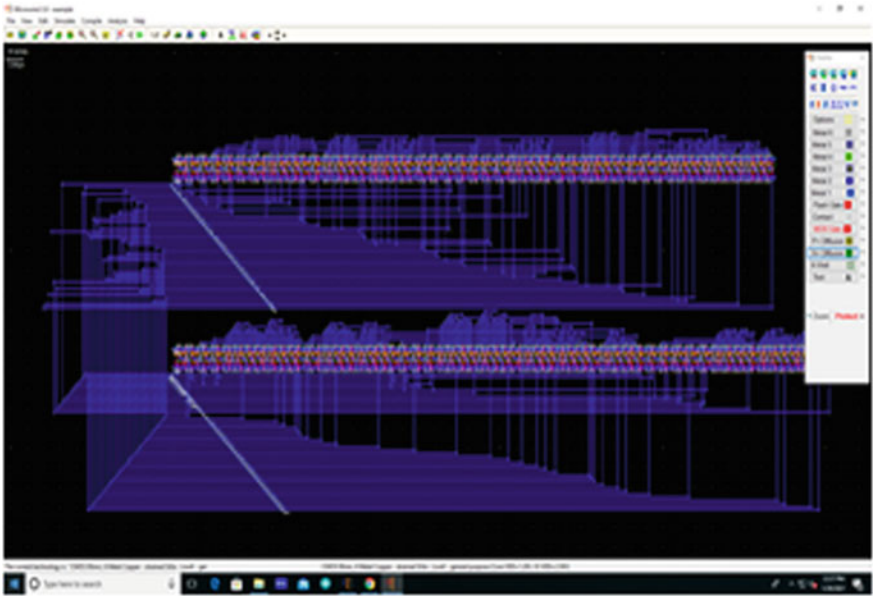

Fig. 11 Layout of 4 * 4 bit Vedic multiplier using 90 nm technology

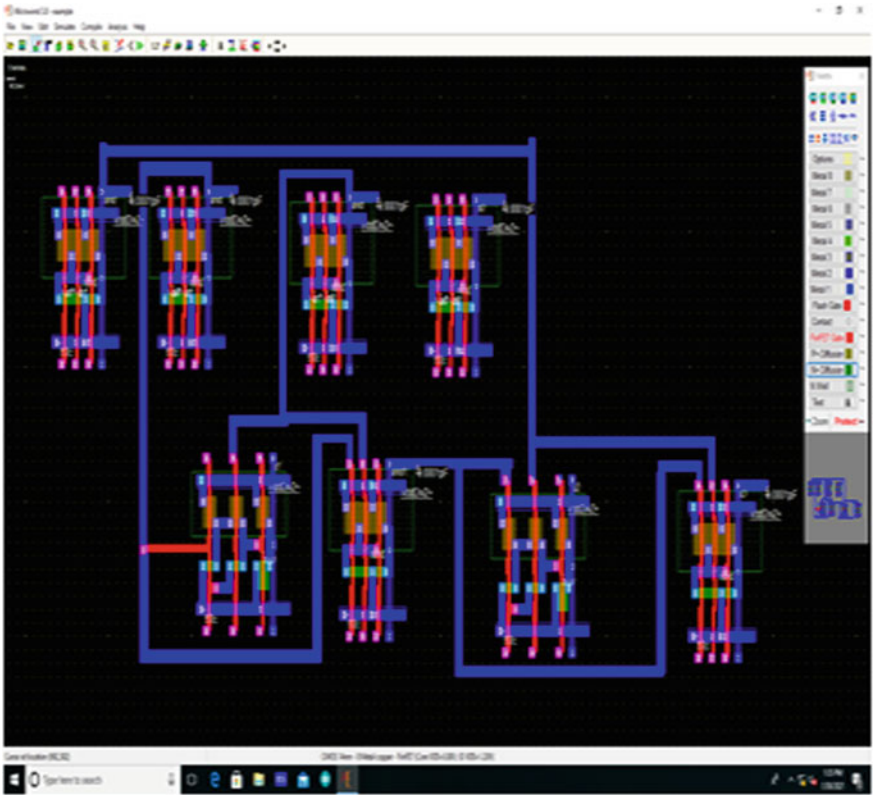

Fig. 13 Layout of 2 * 2 bit Vedic multiplier using 14 nm Finfet technology

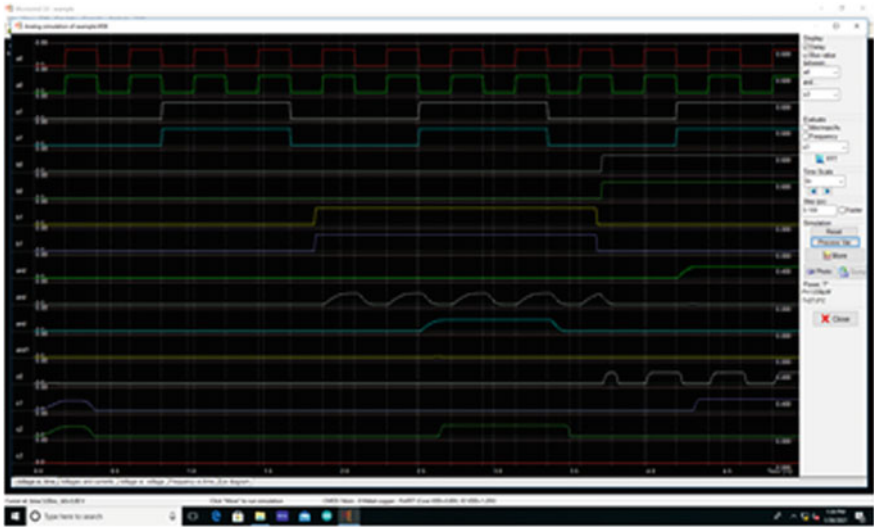

Fig. 14 Simulated waveform for 14 nm Finfet technology 2 * 2 Vedic multiplier

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Intelligent Beyond 5G Systems: Upcoming Wireless Communication Systems

Jai A. Desai and Shriram D. Markande

Abstract The beyond 5G systems are responsible for smart connectivity of the world. They will provide a wireless connectivity indoor as well as outdoor including the manmade structures like buildings, walls etc. They will be responsible for satisfying the increasing demands for reliable and very high capacity future wireless communication systems. Providing such a reliable system is one of the key challenges for beyond 5G systems. The use of a Large Intelligent Surface (LIS) may prove as one of the promising solution to increase the reliability as well as the coverage area. It will help in enabling an intelligent wireless propagation environment with active transmission and reception. All this will be possible by the use of millimeter wave for communication. A millimeter wave has a tenfold increase in bandwidth in comparison with the current wireless networks. The current communication system is based on conventional communication theories. These have limitations while extending to beyond 5G systems. The emerging machine learning algorithms provide a promising tool to handle the complex future communication systems. We will review the development of emerging machine learning solutions for beyond 5G wireless communications.

Keywords Large intelligent surfaces · Deep learning · Reinforced learning · Millimeter waves

1 Introduction

The use of mobile phone subscribers has doubled in the last 10 years. This in turn increases the mobile internet traffic beyond the capacity limits of wireless networks. Compared to the current performance of 4G systems, the spectral density, network density and the spectrum has to increase one thousand times. The most promising technologies to improve the above said parameters are massive MIMO, artificial

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radio space and use of millimeter waves for wireless communication [1]. In massive MIMO, the base stations include a large number of antennas, thereby scaling up the conventional MIMO systems by many orders of magnitude. This also improves the energy efficiency as more directed beams are used. But the main challenge in massive MIMO is design of compact antenna arrays and acquisition of high dimension CSI. Another solution is artificial radio space. The large intelligent surfaces are the most promising for a smart radio.

The complexity of the current network structures has increased due to exponential growth of use of data, high speed and low delay communication. This degrades the performance of conventional communication systems. The upcoming areas to improve the efficiency of 5G and beyond 5G communication systems are non-orthogonal multiple access (NOMA), massive multiple-input multiple-output (MIMO) and millimeter wave technologies to name a few. The existing conventional communication systems face a limitation in handling such a huge amount of data.

However, there are few key differences between massive MIMO and millimeter wave technologies. In massive MIMO the communication is through base stations using a large number of antennas. This results in a huge amount of transmission power required for transmission. The biggest disadvantage of massive MIMO is that they require channel state information (CSI) for hundreds of antennas being used. This CSI overhead degrades the performance of MIMO systems.

Unlike massive MIMO, the communication in Large Intelligent Surfaces (LIS)-where millimeter waves are used, is possible through various manmade structures. These LIS panels can be mounted indoor as well as outdoor. Here very few elements are connected to the base station which lowers the power requirement at the transmitter/receiver. Since its installation on any manmade structures the coverage area is more as compared to the massive MIMO which also results in increased data rates [2].

Recent studies indicate that the high frequency transmission such as millimeter wave communications is very helpful to realize LIS. The frequency range from 3 to 30 GHz is more attractive for the implementation of LIS for various beyond 5G systems that include Internet of Things (IoT), Device to Device Communication, Vehicle to Vehicle communication and so on [3].

According to [4] there are various key performance indicators that serve as the fundamental metric which are used to evaluate the system performance are:

- **System Capacity**: This metric deals with system throughput. The metric that are calculated in this KPI are peak data rate, experienced data rate, channel bandwidth, peak spectral efficiency and experienced spectral efficiency.
- **System Latency**: This KPI evaluates the end to end latency including the delay. This delay is mainly applicable for 6G systems.
- **System Management**: This is the most important KPI which deals with the management of networks such as energy efficiency, reliability and mobility.

Achieving these KPI require a technological revolution in the field of wireless communication.

1. **Spectrum Usage**: The 5G communication systems adopt the millimeter wave spectrum for communication. The signal processing is very crucial at millimeter waves. It is because of the hardware constraints due to its very high frequency. The channel models are also different at such high frequency. It is because the propagation environment has different effects on small wavelength signals. The diffraction is lower, scattering is higher as the roughness of the material is more. It also results in greater penetration losses.
2. **Network Architectures**: The existing communication systems are incapable of handling the data traffic required in beyond 5G systems. Every strata of the communication system needs to be upgraded.
3. **Embedding Intelligence in Environment**: In order to achieve true wireless connectivity, we need to embed intelligence in every possible aspect. Use of LIS is a step in embedding intelligence to increase the coverage area as well as the data rates. These panels can be installed anywhere making the environment smart. However, there are many challenges in the use of LIS. The most important challenge is the acquisition of channel knowledge between the transmitter and the receiver. Other challenges are as follows:

    - Performance Analysis:
        - Capacity analysis
        - Impact of hardware impairments on capacity
        - Uplink/downlink data rate analysis
        - Outage probability
    - Estimation of user location
    - User assignment
    - Power allocation
    - Resource allocation problem
    - Hybrid radio frequency/visible light communication.

The most important parameter of millimeter waves is observed on human health. The photon energy of mm Waves ranges from 0.1 to 1.2 milli electron volt (meV). As the frequency increases the conductivity of the skin also increases. At higher frequencies, the energy absorption is limited to surface layers of the skin. The unit considered for compliance above 6 GHz is termed as power density (PD), as specified by Federal Communications Commissions (FCC). In order to limit the exposure limits at frequency greater than 6 GHz, the maximum emitted power have to be lower than the power levels consumed by current technologies. The mm wave handsets are likely to be used close enough to the body and will be having a very high gain directional and adaptive antenna arrays. This will cause the radiation energy to focus in one directions. This may result to increased heating if the main beam is pointing towards human body.

The key technologies that can be envisioned for beyond 5G communication systems are as follows:

Intelligent Communication Environments: As the demand for data increases, a time has now come that now the infrastructure has to be intelligent and smart. There should be some mechanisms to control the interaction of electromagnetic waves with the communication environment. This can be achieved by the use of LIS. Large Intelligent Surfaces (LIS) are considered as the constitutional components of beyond 5G and 6G wireless systems. Fundamentally it is a planar array consisting of a very large number of nearly passive, low cost and low energy consuming elements. These elements help in reflecting the EM signals and consists of reconfigurable parameters. Each element induces a certain phase shift on the incident EM wave. Thus these elements interact with the incident signal by reflecting them. This helps in improving the coverage area and rate of the wireless systems. These surfaces can be easily mounted on man-made structures, such as buildings, walls, roads, etc. Therefore, these structures can be made electromagnetically active. They help to realize a smart radio environment which can be controlled using software.

Terahertz Band Communication: Due to the extensive rise in the data traffic various technologies have emerged in the domain of wireless communication. The main aim of these technologies is to increase the coverage area and data rates. To satisfy these communication requirements, the terahertz band can be a promising technology. This band can provide the rate up to terabits per second which can be used for a pool of applications. The design of transceivers needs to be optimized in order to gain all the benefits of terahertz communication. The fabrication and testing of THz antennas is a major challenge.

Extensive Artificial Intelligence: The area of Artificial Intelligence (AI) has emerged tremendously in the last few years in a wide range of applications. In terms of communications AI can be applied to various aspects like cognitive radio and network management. Predominantly in the field of wireless communication, AI can be applied in developing algorithms in areas like massive MIMO, LIS for channel estimation. AI can be implemented in almost all the layers of wireless communications. The machine learning tools can be used specifically for this purpose. It can also be used in the management of various networks. The network management problems can be broadly classified into supervised learning, unsupervised learning and reinforcement learning.

2 Overview of Deep Learning and Reinforced Learning for Wireless Communication

The need of the hour is to develop a faster transmission technology. It should be able to make the infrastructure intelligents by automatically adapting to the wireless layout changes. This can be done by furnishing each network segment with Artificial Intelligence. By using AI techniques, the network nodes will be able to determine the best policy to be implemented based on the experience of processing previous

data. This would reduce the dependence on mathematical models. The framework that enables us to develop AI based wireless networks is machine learning. Deep learning is one of the technique of Machine Learning, that qualify the computers to learn by themselves instead of writing complex programs. Few machine learning techniques like support vector machines, genetic algorithms, rule based learning are already implemented in various communication systems. The deep learning implements the learning process by means of Artificial Neural Networks. The recent advancement in technology makes deep learning an extremely feasible technology for future wireless communication systems that needs to produce very large datasets [5, 6]. Therefore, the acquisition of dataset is an important challenge in implementing deep learning algorithms. To implement the deep learning algorithms in an effective manner a large amount of data is required. Various issues of acquiring the required amount of data in a cost effective manner by considering various latencies especially in high mobility applications pertains. The solution is use of so called intelligent materials called as meta materials that have data storage as well as processing capabilities [2]. These meta surfaces form the base of LIS. These surfaces are low cost passive elements which are responsible for lower power consumption in LIS. They can be powered with energy harvesting modules. Thus, these surfaces are the base of future AI based wireless communication techniques.

The foundation of reinforcement learning is not directly related to deep learning. It is rather a different machine learning approach that implements the learning procedure in a flexible way. This is achieved by interacting with the environment by taking actions and receiving feedback on the actions that have been taken. There are several approaches of reinforced learning to determine the sequence of actions to be taken. They are broadly classified as: value based approaches, policy based approaches and actor-critic approaches.

The application of deep/reinforced learning in the design of physical layer has gained a lot of research attention. Two main research directions of DL/RL can be identified: either to operate the physical layer or to manage the physical layer. The former includes the tasks such as data detection, channel estimation, decoding etc. whereas the later helps in simplifying the resource allocation task.

The work in [7] propose the idea of using ANNs for network resource management, providing an overview of potential applications of AI for network resource management in future 5G wireless networks, and discussing supervised, unsupervised, and reinforcement learning. In [8], a fully connected FNN is used for sum-rate maximization in interference-limited networks, by learning the input–output map of each iteration of the iterative weighted MMSE power control algorithm.

3 Conclusion and Future Research

The tools from deep/reinforced learning have become essential in designing the complex 5G and beyond 5G wireless communication systems. The technological

advancements in the field of computers make the use of deep learning more approachable. However, there are various research problems related to deep learning based wireless communication systems. The first challenge is the need of large amount of data required in order to guarantee a satisfactory performance. The acquisition of large datasets in the field of wireless communication might be too expensive and highly impractical. Gathering accurate data especially in outdoor environment might be very difficult. The most encouraging approach is the joint use of data driven and model based approach. Leveraging the tools of reinforced learning could be helpful in view of this challenge. The integration of ANN into wireless architectures is another challenge which will affect the existing transmission technologies. The current scenario also demands robustness of the deep/reinforced based learning systems against the corrupt data.

In conclusion, the deep/reinforced learning is a most promising tool for implementing a smart environment by making actually making all the manmade structures smart in line of implementing a LIS. LIS can be a promising technology for B5G systems in physical layer. It will also reduce the power consumption to a greater extent. However, this is at the cost of a large amount of data and time to achieve the desired performance.

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Comprehensive Literature Survey for mm-Wave Massive MIMO Using Machine Learning for 6G

Rohini Devnikar and Vaibhav Hendre

Abstract Sixth Generation (6G) wireless communication networks are highly trained and more capable to overcome the limitations of Fifth Generation (5G) wireless networks. 6G will be expected to fulfil the demands of users from all aspects such as data rate, latency, security, privacy, and so on. Millimetre Wave (mm-wave) massive Multiple inputs multiple outputs (MIMO) will continue to contribute the benefits of higher data rate and better connectivity in 6G wireless systems. Machine learning (ML) is important for mm-wave Massive MIMO, because of its wide range of applications and its incredible ability to adapt and provide solutions to complex problems efficiently, effectively, and quickly. This paper presents the comprehensive literature survey which comprises of how to use the ML/Deep Learning (DL) techniques for the physical layer to optimize different parameters like channel coding and modulation, synchronization, beamforming, positioning, and channel estimation. DL techniques are most suitable for the physical layer to optimized better performance in Bit Error Rate (BER), Symbol Error Rate (SER), and Signal to Noise Ratio (SNR).

Keywords Adaptive channel coding and modulation · Deep learning (DL) · Machine learning (ML) · Massive multiple inputs multiple outputs (MIMO) · Millimetre wave (mm-wave)

1 Introduction

People are highly influencing by smart technology. Users demand the best quality of service and quantity of data rate to use for day-to-day routine life. Most urban people used highly advanced gadgets, wearable accessories, and home appliances which are the Internet of things. Every one of look forward to demands more efficient and effective wireless communication without any interruptions. Before Sixth Generation (6G) wireless networks, Fourth Generation (4G)/Fifth Generation (5G) wireless networks are there but they are not up to that level to satisfied users' requirements and

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demands such as peak data rate, latency, throughput, security, privacy, and so on. 5G innovation incorporates a few new extra procedures, like new recurrence groups (e.g., Millimetre Wave (mm-wave) and optical spectra); advanced spectrum uses management and the connecting of authorized and unlicensed groups [1]. 5G does not fully support Artificial Intelligence (AI), Virtual Reality (VR) devices, so need to switch towards beyond 5G, because they require a minimum of 10 Gbps data rates [2]. 6G wireless network which promises to trigger more powerful capacities in terms of low latency, ultra-reliability, and supermassive access [3]. In 6G, optical systems administration would assume greater jobs than any past generation. Energy efficiency will be 10–100× and spectral efficiency 5–10× that of better than 5G communication. Device densities and Internet of things network will be a lot denser than the 5G. The connectivity density of 6G will be 10^7 Devices/km^2. The real advanced ecosystem system would be acknowledged in 6G. The peak data rate of 6G is around 100 Gb/s, where 5G peak data rate is up to 20 Gb/s. So, the overall quality of the performance would matter a lot in wireless communication. Security is expected to be more in 6G than 5G network [4, 5]. A more complex device to device communication is anticipated in 6G [6]. Mm-wave is key enable innovation for 6G communication. Wireless communication in mm-wave bands, which range from 20 to 300 GHz, is looking forward to being a key enabling technology for 6G wireless communication systems because a large number of bandwidths can accommodate the ultra-high data rate communications [7]. Massive Multiple Inputs Multiple Outputs (MIMO) is a major role in the 6G system (Fig. 1). Massive MIMO is connecting a large number of antenna arrays which provides applications such as better spectral efficiency and better throughput. It supports ultra-High Speed with Low Latency communications (uHSLLC), massive Machine Type Communication (mMTC), and ultra-High Data Density (uHDD) services [8]. The high-capacity satellite ground transmission will be deployed with mm-wave communications. Massive MIMO fully completed the requirements such as latency, overhead, reliability, and throughput in 6G networks with highly efficient and advanced Partial Least Squares (PLS) Regression techniques would be developed but it requires a more complex architecture. It will be included Machine Learning (ML) and AI in the wireless communication system. Mm-wave massive MIMO has been taken into consideration as a key enabling technique for 5G and beyond it. ML tools will assume a significant part to solve issues in a wireless network domain. ML techniques traditional methods are characterized by mathematical models [9]. The basic ML methods are supervised, unsupervised, and Reinforcement Learning (RL). Accordingly, basic model categorized such as Deep Learning (DL) in that Artificial Neural Networks (ANNs), Convolutional Neural Networks (CNNs), Multi-layer Perceptron's (MLPs), Recurrent Neural Networks (RNNs), and Generative Adversarial Networks (GANs) is used for probabilistic methods, reproducing kernel Hilbert Space, Federated learning, and Reinforcement learning [10]. ML or DL to restructure the RF design as well as addressing a large array of RF design areas and developing new wireless use cases. In 6G wireless networks using ML will allow actual time analysis and zero-contact operation and control will be automatic. ML is a more significant technique for mm-wave Massive MIMO, because of its huge range of applications. ML techniques look forward to

Fig. 1 Overview of 6G wireless system [11]

helping the 6G system make more upgraded and versatile information in driven choices, mitigate communications difficulties, and meet prerequisites from arising services. ML helps to obtained worth end to end mapping mode easily. For joint optimization at the physical layer, the use of different ML techniques will be worth exploring in the future.

This survey is organized as follows: Sect. 2 ML Based 6G Wireless System Model for mm-wave Massive MIMO, Sect. 3 Conclusion.

2 ML Based 6G Wireless System Model for mm-Wave Massive MIMO

The use of ML at different layers of wireless networks such as Physical Layer, Medium Access Control Layer, Application Layer as shown in Fig. 2. The wireless system layer is explaining as follows which mainly focused on Physical Layer. This is applicable on mm-wave massive MIMO using ML techniques/algorithms to optimize different parameters like as Channel Coding and Modulation, Adaptive Channel Coding and Modulation, Beamforming, Synchronization, Positioning, and Channel Estimation (Fig. 2).

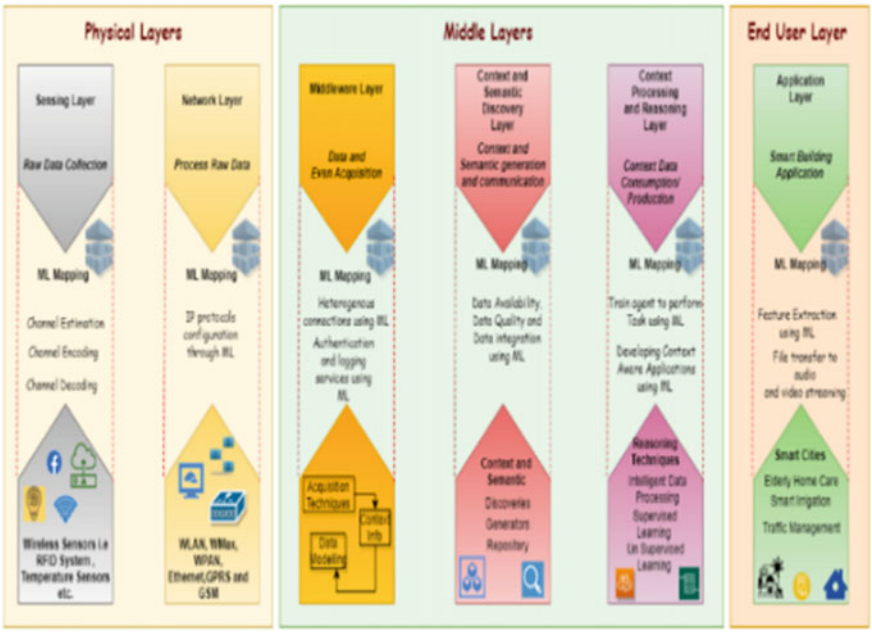

Fig. 2 ML-based 6G wireless system [12]

2.1 ML for Physical (PHY) Layer

2.1.1 Channel Coding and Modulation

Channel coding is required to correct the error that occurs on the channel. RL is the most suitable algorithm for solve channel coding problems. AI and ML applications more will be found in 6G. For cognitive heterogeneous networks Modulation and Coding Scheme (MCS) selection algorithm based on Deep Reinforcement Learning (DRL) techniques proposed for primary transmission to reduce system overhead caused by MCS switching [13] (Table 1).

Adaptive Channel Coding and Modulation

In 5G system to improve spectrum, efficiency used an Adaptive Modulation and Coding Scheme (AMCS) given under Gaussian channel and obtained Signal to Noise Ratio (SNR)-Block Error Rate (BLER) curve of different MCS and proposed SNR mapping algorithm with improved adjustment factor optimization [16]. Based on the perspective of statistical analysis and ML to efficiency improvement to underwater using AMCS systems using data-driven sparse learning methodology to both channel estimation and channel scheme switching [17]. For beyond 5G, CNNs based

Table 1 Typical ML techniques/algorithm for channel coding and modulation

Sr. No.	ML technique	Optimize parameter	Author, year and references	Optimization objective	Performance optimization
1.	DRL	Channel modulation and coding	Zhang et al. 2019 [13]	Transmission rate maximization	SNR, SER, PDR
2.	DNN	Channel encoding	Fritschek et al. 2020 [14]	Mutual information maximization	Channel information estimation
3.	Q-DRL	Channel Coding	Carpi et al. 2019 [15]	Data important value decode maximization	BER

automatic modulation to the best suited for classifying the modulation type of signal in different SNR conditions and in which Gaussian noise successfully reduces over-fitting with improved accuracy and reducing computing time of the system [18]. The AMCS is based on the environment information even when the information is biased or only partially available [21] (Table 2).

2.1.2 Synchronization

Synchronization process is required to all kind of devices which go through time, frequency and cell synchronization without any difficulties. Synchronization techniques gives accuracy even in poor radio channel conditions, largest Carrier Frequency Offset (CFO) conditions and speedy mobile conditions. The requirements of all the standards like as 4G Long Term Evolutions (LTE) and 5G New Radio (5G-NR) standards, synchronization is the beginning stage. Deep Neural Networks (DNNs) learning technologies are widely used to synchronize signals separately from signal detection/decoding [23, 24].

2.1.3 Positioning

DNNs location-based technology is suitable for positioning with adaptive technology to adapt to the actual environment. Positioning technology in terms of current mobile device signals or mathematical based wireless channel signals helps to identified the position/location of users in outdoor condition or indoor conditions. If there is Non-Line-of-Sight (NLoS) multi-paths with mathematical way due to this harmful problem take place like as excessive positional errors [25].

Table 2 Typical ML techniques/algorithm for adaptive channel coding and modulation

Sr. No.	ML technique	Optimize parameter	Author, year and references	Optimization objective	Performance optimization
1.	AMCS	Adaptive modulation and coding	Wang et al. 2020 [16]	Throughput maximization and spectral efficiency	SNR, BLER
2.	DL	Adaptive modulation and coding, channel estimation	Huang et al. 2020 [17]	Underwater system efficiency maximize	SNR, BER
3.	CNN	Automatic modulation	Hermawan et al. 2020 [18]	Overfitting and computing time of minimizing. Accuracy maximizes	SNR
4.	SVM	Adaptive modulation	Huang and Diamant 2020 [19]	Throughput maximization	SNR, BER
5.	HMDS	Adaptive modulation and data schedule	Chen et al. 2020 [20]	Energy efficiency and QoS maximization	SNR, BER
6.	AMS	Adaptive modulation	Rivera and Sean 2020 [21]	Satellite downlink transmission rate maximization	SER
7.	AMS	Adaptive modulation	Gomes et al. 2020 [22]	Transmission rate maximization	PDR

2.1.4 Channel Estimation

The transmitted signal distorts by channel that information provides through channel estimation. Through the training of the Neural Networks (NNs) regardless of the complex channel environments optimized by the use of DL based Channel Estimation. In mm-wave massive MIMO systems to improve the beam space channel estimation perform accuracy proposed a prior-aided Gaussian Mixture-Learned Approximate Message Passing (GM-LAMP) based on DL techniques used [26]. For Large Intelligent Surface (LIS) aided, mm-wave massive MIMO introduced DL framework for channel estimation and performance of this proposed system compared with state-of-the-art DL-based techniques and higher-level execution is illustrated [27] (Table 3).

Table 3 Typical ML techniques/algorithm for channel estimation

Sr. No.	ML technique	Optimize parameter	Author, year and references	Optimization objective	Performance optimization
1.	DNNs	Channel estimation	Wei et al. 2020 [26]	Normalized mean square error minimization	SNR
2.	CNN	Channel estimation	Elbir et al. 2020 [27]	Normalized mean square error minimization	SNR

2.1.5 Beamforming and Beam Space Management

To reduce energy consumption and delicacy to interferences, large coverage, allows advanced mobile applications and reliability of throughput, these all features given by Intelligent beamforming and smart antenna solutions [28]. For real-time adaptive massive MIMO beamforming DL can be represent the most efficient solution. DL based Beamforming constructed for large-scale antenna array with Beamforming Neural Networks (BFNNs) to learn how to optimize the beamformer for enhancing spectral efficiency with limitation of the hardware and imperfect Channel State Information (CSI) [29]. CNN framework proposed for the joint estimation of precoder and combiners in hybrid beamforming problem in mm-wave massive MIMO system and gives better spectral efficiency than optimization and greedy based algorithms [30] (Table 4).

3 Conclusion

This paper presents the importance of ML algorithms to mm-wave massive MIMO for 6G communication at the Physical layer. ML is the most suitable techniques at the physical layer for optimizing different parameters such as beamforming, channel coding and modulation, synchronization, positioning, and channel estimation. ML is used to optimized the performance of this techniques in terms of SNR, Bit Error Rate (BER), and Symbol Error Rate (SER) of mm-wave massive MIMO for next-generation 6G. DNNs and CNNs are the techniques suggested to optimize the beamforming, channel estimation, and beam space management to maximized sum rate and spectral efficiency and minimized the normalized mean square error. The ML algorithms are also proposed for adaptive coding and modulation in order to maximize the throughput and to optimize the Quality-of-Service (QoS) parameters in mm-wave massive MIMO for 6G and beyond wireless communication system.

Table 4 Typical ML techniques/algorithm for beamforming

Sr. No.	ML technique	Optimize parameter	Author, year and references	Optimization objective	Performance optimization
1.	BFNNs	Beamforming	Lin and Zhu 2019 [29]	Spectral efficiency maximization	PNR, SNR
2.	CNNs	Hybrid beamforming	Elbir 2019 [30]	Spectral efficiency maximization	SNR
3.	DNNs	Hybrid beamforming	Peken et al. 2020 [31]	Channel capacity maximization	SNR
4.	BFNNs	Beamforming	Xia et al. 2020 [32]	Sum rate maximization, power minimization, QoS maximization	SINR
5.	Adaptive RLS	Channel prediction & beamforming	Bogale et al. 2020 [33]	Sum rate maximization & MMSE estimation	SNR

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Machine Vision Based Fruit Classification and Grading—A Review

Dipali Chaudhari and Surendra Waghmare

Abstract The appearance or external features is one of the important aspect, it impacts the consumer's market value, desires, and choice but also, to a certain degree, its internal consistency. Color, texture, size, shape, and visual faults are commonly addressed while evaluating the external quality of food. Manually managing the external quality of fruit is possible, but it takes time and effort. For decades, computer vision technologies have been widely employed in the food business for automated external quality management, and they have proven to be a scientific and useful tool. Based on image processing investigations, the application of machine and computer vision approaches in external fruit quality control has been described. This paper provides a detailed description of the fruit detection and classification procedure. The typical characteristics of fruits such as color, shape, and texture are presented with specific extraction techniques such as SURF, HoG, and LBP. ML methods like KNN, SVM, and CNN are also discussed. The approach, benefits, drawbacks, and challenges of fruit classification and grading are explored in this study.

Keywords Fruit image classification · Deep learning · CNN · Machine learning · Computer vision

1 Introduction

India is a rural nation. Compared to the Foreign comparisons, India's average yield usually is 30–50% of the world's highest average output. Agriculture accounted for 16.5% of GDP by sector (2016) with about 50% of labor (2014) and 10% of overall exports. The 2017–2018 budget called for further changes in the agriculture sector and expanded support for nearly all agricultural sectors [1]. In 2020, according to UN FAO, India was the leading producer of vegetable, milk and spices while second largest producer of wheat and rice [2]. Vision analysis is a general function of our

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brain. Our brains have no attempt to read and understand a symbol, distinguish a lion and a jaguar, or identify individuals from their ears. For humans, all of this is too easy. Where computers are involved, these are the real problems to overcome. Thanks to advancements in vision-based computer technologies and image-analysis algorithms, it is now possible to create applications that understand what we're looking at and what actions we need to do [3]. There are already several computer vision (CV) algorithms available [4–6]. Tempo, economic benefits, proper inspection, computation, and evaluation operations are all common uses for these algorithms. CV algorithms are used to acquire fruit and vegetable detection, size and weight and vegetable recognition, leaf area and yield prediction, seeds, classification and ranking, autonomous selective sprayer use, and other agricultural knowledge [7].

Among the above, one of the most critical and challenging tasks is fruit classification and grading, as the need to know the various categories of a fruit element in the supermarket to decide its price [7]. To improve fruit grading efficiency, we may utilize image analysis and ML techniques to eliminate manual classification and sorting effort. Classification and grading of machines may be done automatically if specific basic rules for grading criteria are defined. An automatic sorting mechanism can work efficiently due to the ever-increasing demand for high-quality fruit. Citrus fruits, orange apples, oil palm fruits, strawberries, mangoes, lemons, dates, and other fruits, several automated classifications and sorting systems are available [8–11]. It can also provide maturity indices for fruit scoring, such as flesh color, skin color, and fundamental gravity [12].

2 Process of Fruit Classification and Grading

The detailed process of the fruit classification and grading system is explain in this section.

2.1 Image Pre-processing

The image of the fruit is taken initially by every image capture system. To do so, three systems are most widely employed in morphological inspection of food and agricultural goods: conventional, hyper-spectral, and multi-spectral CV systems [13]. To achieve this, pre-processing techniques use a tiny pixel neighborhood in an input image. Filtration is also the term for such pre-processing operations. According to the processing purpose, local pre-processing methods can be divided into smoothing, noise suppression in an image, equal to stopping high frequencies. Unfortunately, critical data regarding the image was also smoothed by the rough edges. Gradient operators are based on local function derivatives, which are particularly relevant towards the edges of the image when the image function changes quickly. The gradient operators' goal is to highlight specific areas of the image.

2.2 Image Segmentation

Image segmentation seeks to make an image more realistic and easier to understand by simplifying and altering its representation. Image segmentation methods are categorized based on two disc features.

2.3 Feature Extraction

The extraction of functionality is a low-level application for image processing. The role is the "interest" aspect of a picture. The name attribute is commonly used to identify a descriptor in the pattern recognition literature. The beneficial property of a functioning detector is repeatability. The next step after image segmentation is to obtain image characteristics helpful in describing fruits. From the image, various features can be extracted: color, form, scale, texture. For object detection and classification, there are several local attribute detectors and visual descriptors that are used. Speed Up Robust Functionality (SURF), Histogram of Directed Gradient (HOG), and Local Binary Pattern are some of them (LBP).

- **Color Feature Extraction**
  Because color is the most visually appealing feature of any shot, it is critical in classifying, grading, and distinguishing defective from typical fruits. The majority of the existing framework compares the color of the fruit to established reference colors to evaluate its maturity. HIS, HSV, JPG, L*a*b*, GALDA, RGB, sRGB, and other color variants are available. Savakar [14], Deepa [15] provides a detailed list of these color models.

  Author of [16] provides a full explanation of how color features are extracted. Back projection is utilized in [17] to measure the ripeness and consistency of the date fruit, and 2D color histograms are used to determine the frequency of co-occurrence. Various segmentation methodologies, color models, and feature extraction methods for diagnosing and ranking fruit disease are studied in [18].
- **Size feature extraction**
  The fruit scale is also one of the important criteria for determining fruit consistency. Fruits with a larger size command a greater price. Because of the fruit's intrinsic irregularities, measuring its size is difficult. For size feature extraction, the most commonly utilized scale dimensions are perimeter, area, height, and weight. Other scale purpose indications include radius, equatorial diameter, and principal and minor axes.
- **Shape feature extraction**
  While buying fruit, classification, and grading, the form is considered quite significant. The shape definition aims to describe the shape such that the values are similar objects in the same shape group and different objects in various categories. This is the state of individuality. Aside from the uniqueness and invariance of transformations, such as conversion, rotation, and scaling, non-ambiguity

or completeness is another appealing feature of any shape definition system. Compactness, elongation, convexity, roughness, and other size-dependent shape measures are included. Region-based (spatial knowledge statistics) and boundary-based measures, on the other hand, are size-independent shape measurements [18] clarifies certain form descriptors and approaches.

- **Texture Feature Extraction**
  Image texture is a collection of two-dimensional arrays used to quantify image texture. It describes how colors or intensities are organized spatially in an image. Texture features that do not adequately reflect the texture of the fruit image are either ignored or used in traditional fruit recognition algorithms. In computer graphics, there are two techniques to evaluating image texture: structured and statistical approaches.
- **Histogram of Oriented Gradients (HOG)**
  HOG is a CV object recognition feature descriptor that counts directed gradient frequencies in an image's localised region. HOG is a useful descriptor because it retrieves directed gradients, and the gradient amplitude is significant at corners and edges, where strength fluctuates and edges represent object shape [46]@@. To locate HOG, the [−1, 0, 1] filter is first applied in both horizontal and vertical directions. To begin, use formulas to determine the size and path of the gradient. The gradient histogram is established, and the HOG feature vector is constructed when the image is partitioned into 8×8 cells.
- **Local Binary Patterns (LBP)**
  LBP is a texture descriptor that operates on image texture and is used to solve the classification problem. Texture can be defined using Multi-resolution Grayscale Invariant Texture Detection of Local Binary Patterns, 2002. LBP employs a local texture representation that contrasts each pixel with its neighbors. It is deemed uniform if LBP has up to two 0–1 or 1–0 transformations.

2.4 Machine Learning Algorithms

ML algorithms play a vital role as classifiers and decision-makers in the fruit categorization and grading technique since the last stage is knowledge-based comparison and decision-making. K-NN, SVM, ANN, and CNN were all briefly mentioned.

- **K Nearest Neighbor (KNN)**
  KNN is a geometric classifier that focus on sample likeness assessed by distance metrics. It's aim is to distribute data to the most likely group of its k closest neighbors. To conduct KNN, we first pick number K of neighbors; second, we select k closest neighbors of the new point based on Euclidean distance; finally, the number of data points is counted in each column, and a unique point is established.
- **Support Vector Machine (SVM)**
  SVM is a classification approach that has produced cutting-edge results in a wide range of classification applications. The high-dimensional space's purpose is to find the best linear hyper plane for separating data with the most margin. SVM

was created to solve two-class problems, but it has now been expanded to multi-class problems using near-against-one or one-against-all strategies. To minimize the gap between support vectors, SVM attempts to create a hyper-plane between classes. SVM is unusual because of its help vectors, which are just extreme points in both categories.

- **Artificial Neural Network (ANN)**
  Biologically based computer systems are developed to mimic how the human brain manages knowledge, a process known as artificial neural networks (ANN). ANNs are computer programmers that have been programmed to function similarly to our brains. Artificial neural networks can be used to extend several categorization approaches. ANNs are good at dealing with unclear data and problems that require huge amounts of data to be interpolated. There are three layers in an ANN: input, hidden, and output. Each layer contains nodes known as neurons. Activation functions based on applications are chosen. Tangent rectifier, sigmoid, and hyperbolic activation functions are all possible. Weights connect nodes in links and links. See the diagram below. An example of an ANN structure and layer connections may be found here.
- **Deep Learning/Convolutional Neural Networks**
  DL and convolution neural networks (CNN) have been shown to be beneficial in image categorization and recognition applications, including fruit recognition. DL learns the attributes of photos automatically. It extracts global features and contextual data, resulting in a significant reduction in image identification error. DL has recently gained more traction than any other ML algorithm. The linked study on fruit classification utilizing this method, on the other hand, is scarce.

The summary of some reviewed papers is tabulated in Table 1.

Table 1 Summary of survey

Fruit type	Reference	Features	Classifier	Accuracy (%)
Date	[19]	Color, texture	Nearest neighbor, DA, ANN	83–98
	[20]	Size, shape, texture	LBP, WLD, FDR	98
	[21]	Color	BP	–
Mango	[22]	Size, volume	R, ANN	96.7
	[23]	Shape, weight	FD, DA/SVM/weight	98.3/100/95
	[24]	Color, size	GMM	88.3–90.5
	[25]	Color, fractal analysis	LS-SVM	Up to 100
Tomato	[26]	Color, shape, texture	PCA, SVM	92
	[27]	Color, shape, texture	PNN	84.4
Orange	[28]	Color, texture	ANN	88
Apple	[29]	Color, size	Naive Bayes	91

3 Conclusion

In this paper, different grading and sorting systems based on image processing are reviewed. Machine-based fruit grading systems can replace labor for fruit grading inspection. Various researchers used image segmentation algorithms, extraction features, fruit disease training, and classification. The most accurate features were morphological, color, and texture. The HIS color model is widely used for human perception grading. ML approaches such as LS-SVM (Support Vector Machine) provided the most accuracy, while DL algorithms produced the best results. Furthermore, while Fuzzy has the lowest accuracy, it is simple to apply.

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Novel Chest X-Ray 4-CH-CNN COVID-19 Diagnosis

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Abstract The COVID-19 diagnosis using Chest X-ray image processing algorithms can offer a significant influence on medical diagnosing. The sparseness in the progression of COVID-19 and its respective diagnosis limitation shows the main challenge involved in the algorithm for detection from X-ray images. For processing such images require more robust approach and deep neural networks can provide the better solution in terms of accuracy along with less complexity in processing for faster detection. This paper contributes in terms of Convolutional Neural Network (CNN) model with 4 channel (4-CH) for COVID-19 identification with less processing requirements and less effects of neighboring pixels during convolution operations. These convolution operations are the main processes that improve the accuracy of the network. The performance evaluation shows better results in terms of accuracy, specificity and sensitivity.

Keywords COVID-19 · Chest X-ray · CNN · 4-CH · Detection · Accuracy · Specificity and sensitivity

1 Introduction

The outbreak of the 2019 novel coronavirus disease (COVID-19) in Wuhan, China, and spreading rapidly worldwide forces the research community to work on early detection of COVID-19. The coronavirus was named as severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) by the World Health Organization (WHO) and International Committee on Taxonomy of Viruses was first discovered at Wuhan, China and spread rapidly worldwide. The pandemic infectious disease announced by WHO on 11th march 2020 have several diagnostic variations and symptoms were cough, fever, dyspnea, and pneumonia. Till date vaccines developed for COVID-19 are still under testing cycles and may prove effective after sufficient level of

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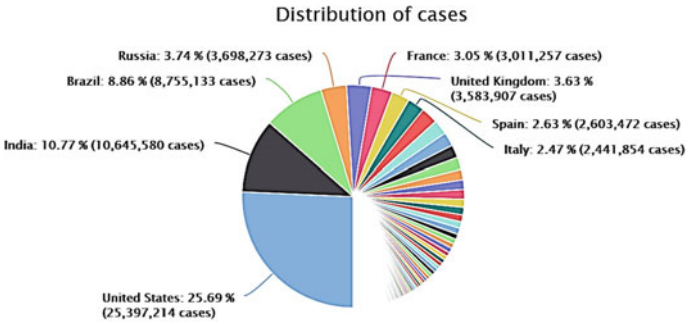

Fig. 1 Country wise infections chart [1]

volunteered analysis. The prognosis and severity of COVID-19 is important in terms of reduction of mortality risks. According to 'worldometer' [1] indications, country wise count of COVID-19 infected patients (as on 23rd January, 2021) has been depicted in Fig. 1.

The pandemic caused by COVID-19 have triggered the priority need of assistive diagnosis methodology to outline right method of treatments for the patients for successful recovery. Initial pathological tests are sufficient to identify the COVID-19 positive patients without any doubt. However, the progression of infection caused due to disease towards the respiratory region and especially inside the lungs is the main challenging concern while deciding the treatment patterns required for faster and successful recovery. Doctors and medical experts usually follow the predefined and proven strategies during the treatments. So far, it can be seen that the pandemic caused by COVID-19 have shown sparse nature of progression towards respiratory systems of the patients there by decreasing the success rate of recovery with various combinations of treatment patterns. Apart from unavailability of right vaccine for COVID-19, developing the immunity power and increasing the resistivity using available medicines with systematic patterns of treatment have shown considerable success rate although it depends on the time of diagnosis or early diagnosis and identification of severity level.

The methodology adopted for exact diagnosis of lung infections, radiology based screening methods are used to check the chest X-ray images. While doing so, identification of the hazy regions and severity of the infections becomes the prime objective. Preserved bronchial and vascular markings in lung show blockages responsible for breathing problems and respiratory problems. It is the specific sign of observing acute alveolar disease and infection and chronic interstitial disease. Identifying such regions of lung infections due to COVID-19 and differentiating them from other pneumonia disease types is the challenging task and this challenge level increases for the patients having background of lung diseases. In case of the COVID-19, a novel strain of coronavirus, due to similarity in lipid rafts, has almost 80% similar identity with severe acute respiratory syndrome coronavirus (SARS-CoV) [2]. It's important to observe the hazy region of lung to diagnose the COVID-19 disease and

its progression of infection in the lungs for defining the treatment and medicinal dosage patterns for the patients for faster and successful recovery.

2 Literature Survey

There are many researchers who have contributed in the development of methods for detection of COVID-19 diseases from chest X-ray and CT scan images. Few of them are neural network based methods. The clinical findings for this disease consist of diagnosis with radio graphical images [3, 4]. However, one should not ignore the false negative diagnosis and depth of knowledge of COVID-19 progress in such type of clinical findings. In other words, not only the detection of COVID-19 infection but also the progression of COVID-19 impact is equally important. In order to finalize the treatment patterns required for patient's speedy recovery, the detection of progress of COVID-19 plays a critical important role. At this juncture of pandemic situation, processing Chest X-ray or CT scan images is important in terms of correct diagnosis and early treatment of the patients [5]. In radiology, in recent days, much of the study has concentrated on the chest CT of COVID-19 [6, 7]. With reference to a strong advice, the COVID-19 detection could be diagnosed with radiological images [8–10]. To contribute in the process of detection of COVID-19 and its impact, the researcher have provided the public datasets containing COVID-19 X-ray images of infected patients.

Ardakani et al. [11] have used ResNet-101 for detection of COVID-19 on 1020 CT from 180 infected patients and 86 other patient's data. 99.51% accuracy is obtained. The main drawback in the accuracy estimation is dependency upon number of images used in the experimentation. The count is very less and as sparseness increases the accuracy decreases.

Ucar and Korkmaz [12] have used SqueezeNet model for COVID-19 diagnosis. They also used Bayesian optimization for reduction of complexity of the neural network computational requirements. The processing optimization is main objective in the experimentation while the dataset consist of very few original images and additional augmented dataset is used which predefines the pattern of recognition and hence increased accuracy in the performance.

Ozturk et al. [13] have shown use of DarkNet for detection of COVID-19 with processing of Chest X-ray images with binary classification. The sample size used contains 1125 images and CNN model consist of 17 convolutional layers. The complexity of processing is high compared to actual accuracy as an outcome.

Hemdan et al. [14] proposed a CNN model named as COVIDX-Net. The results obtained in terms of accuracy are better and comparative with VGG-19 shows improvement on the other hand comparison with ResNet models is not considered.

Wang and Wong [15] used CNN model termed as COVID-Net for COVID-19 cases detection from dataset of chest X-ray images. The sample size used for experimentation consists of 13,800 chest radiography images. The sample size is very large and respective accuracy is considerably high. The model has sequential running

strategy and hence requires larger time or higher hardware configuration platforms for the training purpose.

Along with these papers additional papers with their respective methodology and outcomes are included in Table 1.

This study provides the direction of requirements of datasets and their construction strategy used for experimentation and comparative models considered for the performance evaluation. The method is proposed in this paper which shows less complexity and novel neural network based Chest X-ray processing approach for the better results of accuracy.

3 Proposed Methodology

The proposed 4-CH-CNN COVID-19 detection method is novel because of its simple processing approach in identifying COVID-19. Obliviously, the objectives of this approach consist of:

1. Minimum number of preprocessing steps involved while giving input to 4-CH-CNN model architecture, and
2. Feature based approach with less complexity by keeping minimum number of convolutional layers in the architecture.

The proposed work consist of a novel design of 4-CH-CNN based 4 channel (4-CH) model in which input of a lung X-ray image is going to be processed to detect the COVID-19. The lung X-ray image has most of the information about coughs and nodules even in a gray scale mode. The image size of input image has to be set to 256×256. However, if input image from the dataset is not having 256×256, it has to be resized as a part of pre-processing work.

The images of 256×256 in size can be processed using 4-CH-CNN models which focus on features using kernel functions. When such image is split into half and processed using convolutional layers, the specific features are responsible to change the convolutional values due to presence of neighboring pixels. The effect of neighboring pixels can be nullified by increasing the focus on specific location by various methods such as attention models. The simplistic and less complex approach is considered in which input image is split into four parts and processed independently using similar layered models for each channel of convolutional layers. Finally, all the featured vectors of convolutionalized images are combined into dense layer. The three dense layered combination is responsible for giving binary output which identifies the COVID-19.

The proposed 4-Ch-CNN model architecture is shown in Fig. 2. The processing is performed using publicly available "**Covid-Chest-Xray-Dataset**", which is made available by Minaee et al. [35]. In total 5100 images from the dataset out of which 80% images are used for training and 20% are used for validation. The training and validation is performed for 100 epochs with 10 steps per epoch. The loss analysis graph is shown in Fig. 2 for entire 1000 steps in the processing.

Table 1 Literature survey of various methods from various researchers

[Ref], Year	Methods/models used	Application disease type	Image type	Performance/remark
[16], 2020	InfNet, parallel decoder based model for feature map generation and classification	COVID-19	X-ray	Edge map consideration for nodule of COVID-19, instance segmentation method 95% Augmented dataset, less images
[17], 2020	3D ResNet, Prior attention residual learning (PARL), residual net, attention model based classification for	Multiple types of pneumonia	X-ray	96% accuracy High computational requirements
[18], 2020	Encoder decoder model using CNN, binary classification	COVID-19	CT	3D CNN model for lesion region segmentation and classification accuracy of 87.5%, less effective in terms of accuracy and less sensitive to sparseness
[19], 2020	RTSU-Net	COVID-19	CT	Accuracy 95.3%, less sensitive to sparseness
[20], 2020	A patch-based convolutional neural network	COVID-19	X-ray	Accuracy 91.9%, less sensitive to sparseness in the infection patterns
[21], 2020	ResNet18, ResNet50, ResNet101, ChexNet, InceptionV3, Vgg19, DenseNet201, SqueezeNet, and MobileNet	Tuberculosis	X-ray	The accuracy, precision, sensitivity, F1-score and specificity of best performing model, ChexNet in the detection of tuberculosis using X-ray images were 96.47%, 96.62%, 96.47%, 96.47%, and 96.51% respectively. TB only
[22], 2020	Transfer learning using VGG16	COVID-19	X-ray	Precision of up to 86% for X-ray, 100% for Ultrasound and 84% for CT scans. X-ray testing not done

(continued)

Table 1 (continued)

[Ref], Year	Methods/models used	Application disease type	Image type	Performance/remark
[23], 2020	deep learning-based chest radiograph classification (DL-CRC)	COVID-19	X-ray	Accuracy of 93.94% compared to 54.55% for the scenario without data augmentation
[24], 2020	MobileNetv2, SqueezeNet, ResNet18, ResNet101 and DenseNet201	COVID-19	X-ray	The classification accuracy for both the schemes were 99.7%, 97.9%, 97.95%, 97.9%, and 98.8%, respectively. Less COVID-19 samples in dataset
[25], 2020	Custom CNN model	COVID-19	X-ray	Normal or healthy, COVID-19 type pneumonia with 98.8% precision
[26], 2020	GeminiNet	Pneumonia	X-ray	At IoU (intersection over union) D 0.5, AP reached 0.4575, 0.078 higher than ResNet50, and reached 0.7758 on the AUC indicator. General pneumonia detection considered. COVID-19 specific sensitivity is not evaluated
[27], 2020	B-CNN	Tuberculosis (TB)	X-ray	96.42% accuracy, TB detection and not tested for COVID-19
[28], 2020	Custom CNN model	Tuberculosis (TB)	X-ray	Accuracy 95% useful for TB and not tested on COVID-19
[29], 2020	Gray-level co-occurrence matrix (GLCM) texture-based features, and local binary patterns features, multi-objective genetic algorithm, image feature based modular neural network	COVID-19	X-ray	95% classification accuracy, machine learning approach and hence limited sensitivity to sparseness patterns of infection

(continued)

Table 1 (continued)

[Ref], Year	Methods/models used	Application disease type	Image type	Performance/remark
[30], 2021	Texture features, custom CNN	COVID-19	X-ray	94.3%, only texture features are considered
[31], 2021	VGG-16, Grad CAM	COVID-19	X-ray	94% accuracy increment in accuracy with the use of GradCAM by 0.8. Less sensitive to sparseness, complex
[32], 2020	ResNet18, ResNet50, ResNet101, VGG16, and VGG19	COVID-19	X-ray	94% accuracy, highly complex networks
[33], 2020	Inception V3 faster RCNN	Bacterial, viral pneumonia, TB and normal image detection	X-ray	90% accuracy, multiple disease. Non-specific for COVID-19
[34], 2020	Binary grey wolf optimization (BGWO), HOG, GLCM features, SVM, ANN, DT, KNN, NB	COVID-19	X-ray	91.3% accuracy, machine learning and less accurate compared to deep neural networks

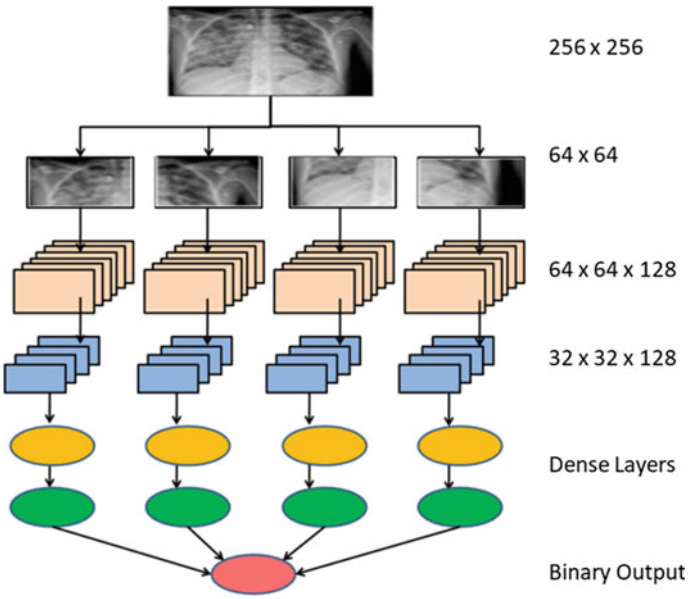

Fig. 2 Proposed 4-CH-CNN model architecture

Table 2 Network layer details

Layer no.	Type	Dimensions	Activation
1	Conv2D	64 × 64 × 128	Relu
2	Conv2D	64 × 64 × 128	Relu
3	Max-pool	32 × 32 × 128	–
4	Conv2D	64 × 64 × 128	Relu
5	Conv2D	64 × 64 × 128	Relu
6	Dense	128	Relu
7	Dense	32	Relu
8	Dense	1	Softmax

The implementation is done using tensor flow, keras platforms with Python based programming for model configuration, training and testing on Intel i7 8th generation CPU based processing having 16 GB RAM. The model is also tested for parallel processing capability using JAVA based front end application and Python API with developed architecture. The processing performance increases in parallel pools for all four channels simultaneous processing (Fig. 2).

Table 2 shows the layered architecture used in each channel from 4-Channel architecture. Each channel has similar layered architecture as in Table 2. The convolution layers along with Max-pooling layer is responsible for extracting features that highlight the detection of COVID-19 infected image from set of X-ray images (Table 2). The total number of convolutional layers used in particular model is compared as shown in Table 3.

The performance evaluation is also done with manual testing on set of 35 images taking one at a time with nominations true positive (TP), true negative (TN), false positive (FP), false negative (FN). The sample output for 10 images from set of test images is shown in Table 4.

Table 3 Comparative analysis for architectural understanding

Method	Custom CNN architecture	Total number of convolutional layers	Number of channels	Parallel processing
InfNet [16]	No	8	1	No
Encoder Decoder CNN [18]	Yes	68	1	No
MobileNet V2 [24]	no	22	1	No
Custom CNN [25]	Yes	121	1	No
ResNet, VGG, [32]	No	16, 19, 50, 101, 151, 201	1	No
4-CH-CNN (Proposed)	Yes	$4 \times 4 = 16$ (4 layers for 4 channels)	4	Yes

Table 4 Performance evaluation (10 images sample)

Image no.	Actual type	Result of detection	Nomination
1	COVID-19	COVID-19	TP
2	COVID-19	Normal	TN
3	COVID-19	COVID-19	TP
4	Normal	Normal	FN
5	COVID-19	COVID-19	TP
6	COVID-19	COVID-19	TP
7	Normal	Normal	FN
8	Normal	Normal	FN
9	Normal	Normal	FN
10	Normal	Normal	FN

The comparison with VGG16 model for COVID-19 detection is considered and in this case proposed 4-Ch-CNN model shows improvement by almost 9% that is 88% of accuracy which is 79.8% as per VGG-16 model [36]. The sample size used in test set consist of 35 chest X-ray images out of which 23 are COVID-19 infected and 12 are normal.

Equations 1–3 show the formulae used for calculations of accuracy, sensitivity and specificity respectively. The accuracy depends on all the outcomes of the experiments and given by,

$$Accuracy = (TP + FN)/(TP + FN + TN + FP) \tag{1}$$

where, True positive (TP) stands for input image as COVID-19 infected as ground truth and detected as the infected one. True negative (TN) stands for COVID-19 infected as ground truth but detected as normal. False positive (FP) and false negative (FN) stand for input as normal ground truth for both and detected as COVID-19 infected and normal respectively.

Similarly, sensitivity and specificity can be calculated as,

$$Sensitivity = TP/(TP + TN) \tag{2}$$

$$Specificity = TP/(TP + FN) \tag{3}$$

Figure 3 shows the graph of estimated performance parameters. The result in terms of accuracy, specificity and sensitivity is found improved compared to VGG-16 model with attention layer included. During the study of comparative analysis the models which comprise transfer learning with larger convolutional networks are avoided. The less number of layers and less number of convolutional layers was the fundamental approach while comparing the results. Also, the results compared with one of the

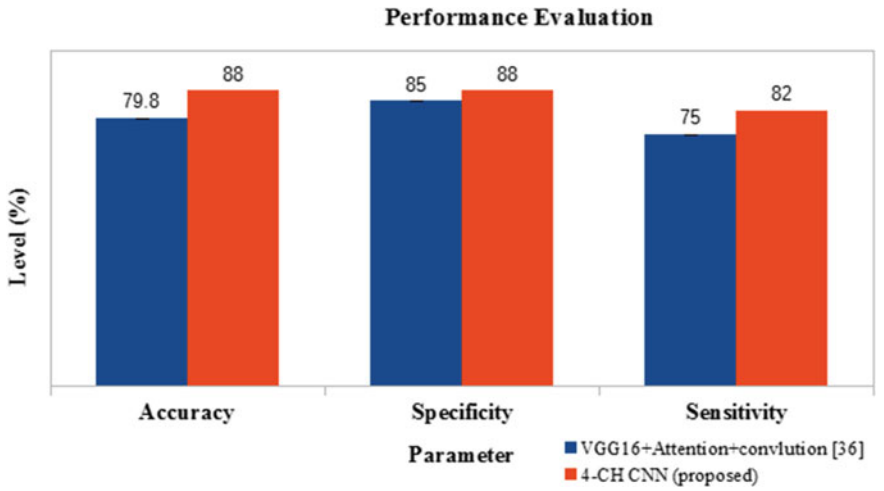

Fig. 3 Performance evaluation

transfer learning approach given in [36] and which constitutes minimum number of layers compared to other standard neural networks such as ResNets and Inception networks. The results are thus sufficient to understand that the less complexity of proposed 4-CH-CNN model, and shows better performance as shown in Fig. 3.

The increased accuracy of 4-CH-CNN model is because of attentive convolutional processing on split image parts on the other hand the model considered for comparison from [36] is also including attention model and total number of layers are also 16 from VGG-16. On the other hand split image processing in proposed 4-CH-CNN model shows better performance and speedy processing.

Another comparison in terms of complexity level is considered while considering ResNets and Inception models. Table 5 shows the comparative analysis of complexity level during training of the models. The complexity depend on various parameters of the model such as the number of layers used in the model, number of iterations during training, number of feature parameters obtained from convolution layers and number

Table 5 Complexity level comparison

Model	Complexity
VGG16 + Attension + Convolution	Medium
ResNet-50, ResNet-101, ResNet-151, ResNet-201, VGG-19 [32]	High
InfNet [16]	High
MobileNet V2 [24]	High
Encoder decoder CNN [18]	Highest
4-Ch-CNN (proposed)	Low

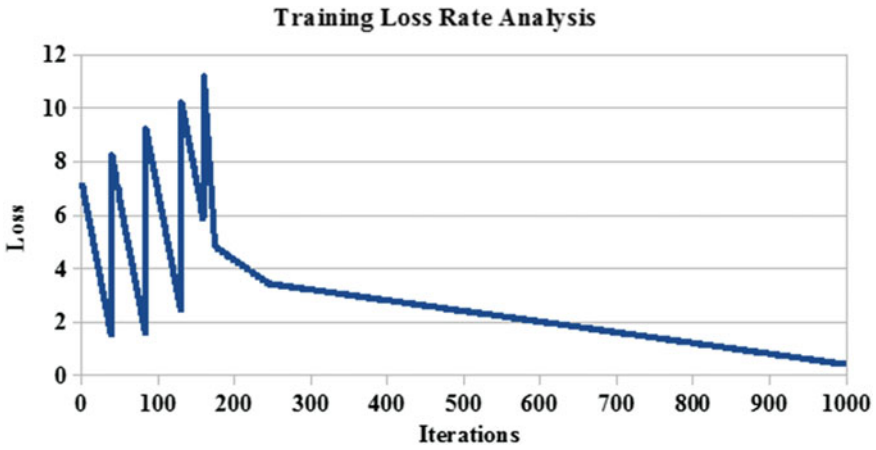

Fig. 4 Loss rate analysis during training of model

of samples used for training (Fig. 4). The sample size parameter not only defines the complexity but also accuracy of the model during performance evaluation.

4 Conclusion

This paper contributes in terms of a novel processing method for COVID-19 detection using 4 channel CNN model along with very less preprocessing requirements. The only preprocessing requirement is resizing of the input lung X-ray image and splitting it into four parts. The four parts split idea proves to get better features of each part with more details using similar number of layers and having no effect of neighboring pixels thereby acting as a feature boosting technique or attention mechanism. The performance of the 4-CH-CNN model is satisfactory for detection COVID-19 and normal images and almost 88% which is 79.8% for VGG-16 along with attention and convolution model. The work further can be extended by adding up scaling layers for specific segmentation of lung nodules as an additional processing for improvement of accuracy.

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Classification and Performance Evaluation of Phishing Email or URL Using Random Forest

Vidya Mhaske-Dhamdhere and Sandeep Vanjale

Abstract Phishing email turns out to be more risks issue in online bank truncation preparing issue just as long range interpersonal communication destinations like Facebook, twitter, Instagram. Typically phishing is completing by ridiculing of email or text installed in email body, which will incite clients to enter their qualification. Preparing on phishing approach isn't so much powerful in light of the fact that clients are not for all time recollect their preparation stunts, cautioning messages. It is absolutely rely upon the client activity which will be performed on certain time on notice messages given by programming while at the same time working any URL. The present world is online advanced world. Each client's web for online correspondence and internet banking measures for their every day life for their own just as expert work. While utilizing on the web email or banking exchange administrations, clients may share their accreditation or disregard security cautioning due to occupied planned or ignorance of web safety efforts. These explanation causes phisher to trap to in phishing.

Keywords Phishing URL · Anti-phishing · Phishing attacks

1 Introduction

End client phishing preparing or schooling can be given by utilizing different sort of game planning or recreation apparatuses are utilized. However, end client may fail to remember preparing or disregard cautioning messages. Second methodology is programming recognition in which mostly boycott based phishing identification should be possible, yet it tedious cycle and boycott updatation required often. Google safe API and yippee sign these are two boycotted are utilized for location of phishing pages.

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Second methodology in programming discovery is heuristics mean apply various standards for arrangement of phishing pages. In this methodology relying on number of rules are suitable highlights are chosen or separated for order should be possible. In any case, this methodology experiences multi day phishing assaults. In programming identification third methodology are visual pictures shows up on URL for grouping.

Pages of phishing and genuine look and feel are same with minor changes or phisher may change URL structure or missing spell URL to cause to feel to end clients. Phisher may send email implanted URL to divert to phish site pages and ask client their username and secret phrase. This methodology is very tedious so we will for last methodology that is AI. In this strategy existing just as altered calculations are utilized for phishing pages arrangement.

2 Literature Review

2.1 Phishing Web Pages Classification

In this paper author has applied associative classification predication model [1] using machine learning. This predication occurs on dataset variables automatically from training dataset. To enhance effective predication with good accuracy feature set select effective feature.

New approach of Random forest called Phishing identification by learning on features of email received (PILFER) [2] uses C4.5 decision tree on 860 phishing email and 695 ham emails with various features such as IP, URL length, HTML message, time, Space java scripts. It is giving 85% accuracy.

Combine RIPPER classification [3] and Fuzzy logic approach to pick up email features and then rank them based on probity value classify as ham or phish. For this author have uses to components of email: metadata of email and email content data

Authors have developed Intelligent rule based phishing websites classification [4] statically analysis of security dataset having 2500 instances with 16 features. It will compare with RIPPER, C4.5 PRISM. It is giving 87% accuracy. Authors have developed Intelligent rule based phishing websites classification [4] statically analysis of security dataset having 2500 instances with 16 features. It will compare with RIPPER, c4.5 PRISM. It is giving 87% accuracy.

Web site feature classification intelligent [5] quality performance assessment done on six rules. It uses 4 algorithms RIPPER, PART, PRISM, C4.5 with focus of accuracy. It detects 83% phishing websites. Associative classification (AC) techniques [6] uses dataset with 24 features applied on CBA, MCAR on Weka tool. AC shows higher correlation on features URL, Domain name, Encryption of data.

In this paper author has design more domain specific AC anti-phishing problem with 3 class [7] values of Phishing URL, Suspicious URL, and Legitimate URL is very hard to detect phishing URL or Legitimate URL using typical machine learning algorithms which increases false positive. In this vertical mining approach used

for discovering frequent item sets and uses for extracting 100% matching predication method to classify data of landing page [8]. Diffset keep track of a data item transaction id is not occurs.it will applied on 10 fold cross validation on Weka tool.

In this paper 5 machine learning algorithm CART, NN, RF, BART, LR used for classification [9] on data to identify given web pages are Phi shy, Ham, Suspicious. Total 2889 email and 43 features used on 10 fold cross validation for evaluation of precision, recall. RF achieved low error rate. With highest predictive classifier.

ANN back propagation algorithm [10] on 2000 instances. It will correlate between feature and target attribute for analysis. It will increase accuracy when compared with other algorithms. Author has implemented on multilayer feed forward NN (FFNN) based on back propagation model [11] applied on phishing email. Author has used 18 binary feature with value (1, 0) for extracting data as email header and HTML body. It uses 6000 instance for live browser testing.

3 Proposed System

First stage is dataset preparation and collection. After collecting data find out useful features or heuristics rules used for phishing email classification. There are total 31 features or attributes are considered for classification on dataset of size 11055 instances. Then dataset is divided into two parts as training and testing dataset. Training data train on machine learning algorithm with classification which will give result of J48 and random forest (Fig. 1).

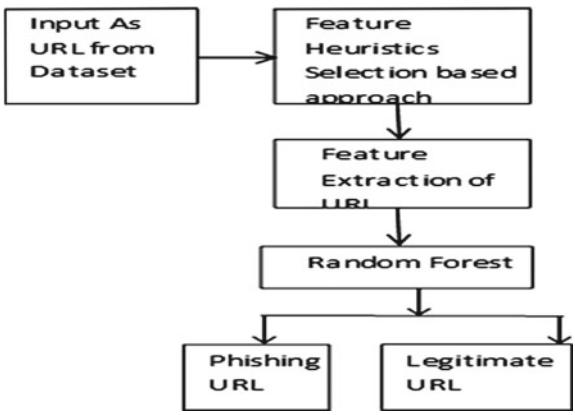

Fig. 1 Heuristics based hybrid approach for classification using machine learning algorithm

4 Result and Analysis

Ten-fold data with cross validation with 66% split give True positive value 98.2 % with all evolution parameter result in Fig. 2.

15-fold data with cross validation with 66% split give True positive value 98.2% with all evolution parameter result in Fig. 3.

20-fold data with cross validation with 66% split data give True positive value 98.3% with all evolution parameter result in Fig. 4.

20-fold data with cross validation with 75% split data give True positive value 99.0% with all evolution parameter result in Fig. 5.

20-fold data with cross validation with 30% split data give True positive value 96.7% with all evolution parameter result in Fig. 6.

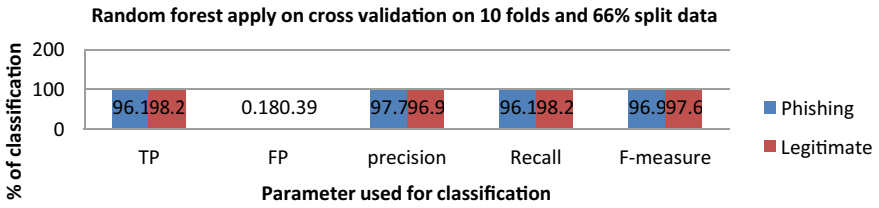

Fig. 2 Random forest apply on cross validation on 10 folds and 66% split data

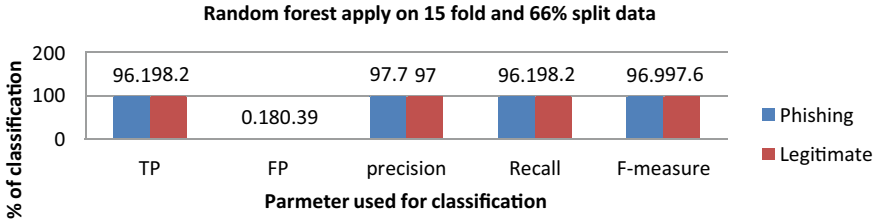

Fig. 3 Random forest apply on cross validation on 15 folds and 66% split data

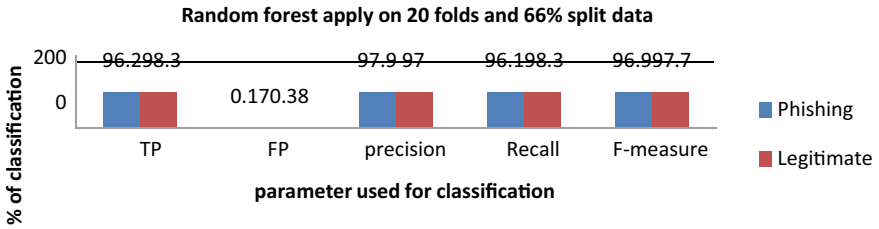

Fig. 4 Random forest apply on cross validation on 20 folds and 66% split data

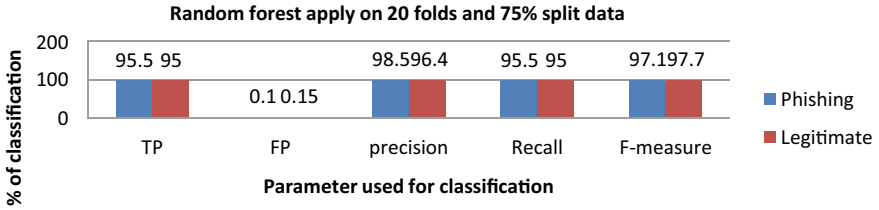

Fig. 5 Random forest apply on cross validation on 20 folds and 75% split data

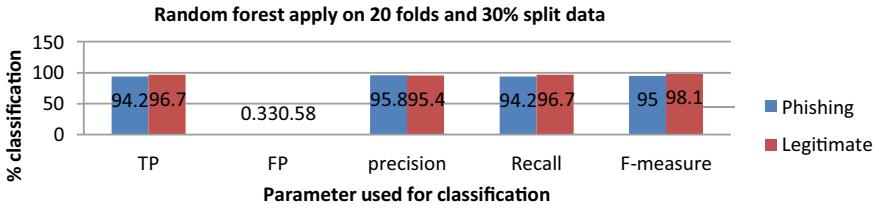

Fig. 6 Random forest apply on cross validation on 20 folds and 75% split data

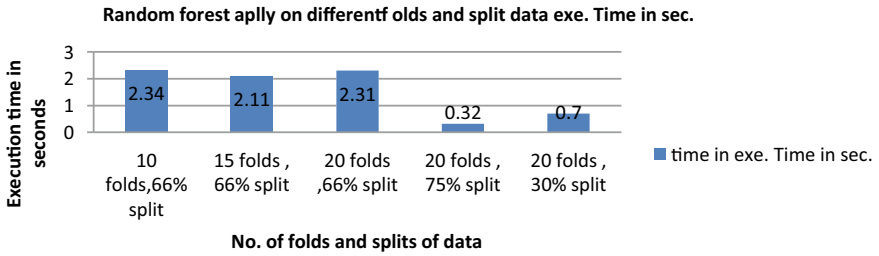

Fig. 7 Comparison of different fold and split data execution time

If we increase number of folds and number of percentage of split data execution time required is less. As shown in Fig. 7 shows 2.34 seconds on 10 fold 66% split data and 20 folds and 66% split data.

5 Conclusion

Phishing is one on most basic assaults the present online clients are confronting a result of social designing. It can distinguish utilizing existing AI calculations with Heuristics with in limited capacity to focus time. Yet client's mindfulness and phishing schooling material isn't up to marks. Indeed, even clients disregard cautioning messages and phisher are all the more mechanically sufficiently able to dispatch the new kind of assault.

I future work we need decrease execution time, might be choosing more helpful highlights.

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Performance Evaluation of Cellular Networks Base Station Using Water Filling Algorithm

Shruti R. Danve, Manoj S. Nagmode, and Shankar B. Deosarkar

Abstract The main aim to make cellular network energy efficient is to maximize the mutual information between input and output of a channel without any additional transmission power at the base station (BS). In wireless cellular systems, energy consumption is basically due to the circuit energy consumption and the data transmission energy at the base station. The optimum resource allocation technique helps in managing and minimizing data transmission energy. In this paper, we tend to focus on reducing data transmission energy using optimum power allocation. The performance of the cellular network is analyzed by evaluating the bit error rate (BER) of M-QAM and orthogonal frequency division multiplexing (OFDM) with 64 QAM. The simulation result shows that by increasing the number of subcarriers in OFDM, BER is decreasing. For maximizing cellular network capacity, spatial multiplexing multiple-input multiple-output (MIMO) with singular value decomposition (SVD) using a water filling algorithm (WFA) is implemented. The simulation result shows that the capacity of 4×4 MIMO-SVD with WFA is greater than the single-input single-output (SISO) system.

Keywords Cellular network · QAM · SNR · BER · OFDM · MIMO · SVD · WFA

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1 Introduction

In modern times, the smart technology-savvy population is demanding rich multimedia interactivity. So, the commercial cellular systems have to tackle this demand with their significant data rates.

The performance evaluation of energy-efficient and bandwidth-efficient cellular networks is principally based on the wireless channel environment. The nature of the wireless channel is dynamic and random so understanding its nature is quite complex.

Also, optimization of the wireless communication system is critical because of the advanced telecommunication and heavy broadband internet services. For the development of bandwidth-efficient and high-performance wireless transmission technology, understanding wireless channels are extremely vital.

Radio propagation is a complicated and less predictable method. In a wireless channel, there is a variation of the signal strength over frequency and time called fading. Wireless communication systems suffer from a very high level of inter-symbol interference (ISI) because of delay spread and multipath propagation. To reduce ISI, the multicarrier OFDM technique is the best solution. Further to achieve a high system capacity in wireless communications, the use of MIMO is a promising technique to increase performance with acceptable BER. Practically, the MIMO channels are frequency selective and responsible to increase ISI. To eliminate ISI, MIMO is combined with OFDM which helps in making the channel frequency flat.

The paper is organized as follows: Sect. 2 describes a literature review done on the performance of the MIMO-OFDM cellular system using water filling algorithm while Sect. 3 proposes the methodology. Section 4 describes the system model, Sect. 5 illustrates the simulation results of the proposed methodology and Sect. 6 concludes the paper.

2 Literature Review

The survey for the MIMO-OFDM cellular network using WFA is done based on various parameters like channel capacity, spectral efficiency, bit error rate, data rate, throughput, and SNR.

Licea et al. [1] implemented WFA using sparse code multiple access (SCMA). Data rate improvement is achieved by comparing equal power allocation with water filling method. Low complexity channel estimation for massive MIMO is implemented by Saraereh et al. [2]. Compressed sensing is considered to reduce pilot overhead due to CSI feedback. Moon and Hwang [3] worked on power allocation for new radio (NR) with millimeter-wave-based MIMO-OFDM. Hybrid pre-coding with WFA is implemented to maximize channel capacity. Elsanousi and Ozturk [4] considered MIMO-OFDM under different fading channels using USRP and shown improvement in SNR. In reference [5] BER of MIMO-OFDM decreased using WFA

in by a novel technique. Agarwal and Mehta [6] analyzed MIMO-OFDM performance with various antenna configurations for achieving better SNR. Performance of different water filling algorithms for MIMO-OFDM cellular networks is compared to improve the network capacity [7]. In reference [8] the adaptive resource allocation using WFA on MIMO-OFDM technology is discussed. Gour et al. [9] developed WFA on OFDM-MIMO using different modulation techniques to improve BER. Also, MIMO-OFDM cellular network performance is analyzed using SVD and WFA [10–12].

To summarize the literature review, the main goal of the cellular communication system is to handle maximum users with the provision of the highest data rate by improving SNR and reuse of the resources respectively. As per the survey gap analysis is done, performance evaluation of the cellular network is completely based on the wireless channel environment. To tackle multipath fading, delay spread, and ISI of the random channel, integration of MIMO with OFDM is the best solution. Further MIMO with optimum power allocation technique maximizes the system capacity.

3 Methodology

For developing a channel environment, we have proposed the following steps:

- Develop AWGN with M-QAM
- Apply OFDM to reduce ISI
- Use of MIMO for improving the data rate
- Apply Water filling Algorithm to the channel for optimum power allocation

3.1 Optimum Power Allocation

A typical channel with feedback in terms of channel state information at the transmitter (CSIT) with power allocation is as shown in Fig. 1. We need to allocate power to the good quality channel and zero power allocation to the bad quality channel using water-filling algorithm. Here we assumed that CSI at the transmitter is perfect and instantaneous, where α_n is fading coefficient and η_n is AWGN noise. Estimated SNR at the receiver is fed back to the transmitter so that optimum power is allocated to the channel.

Optimum power allocation for a poor channel can be done using multiple options like,

- Fixed data rate and Increased transmitted power
- Fixed power and decreasing data rate
- Increasing power and reducing the data rate
- Zero power transmission

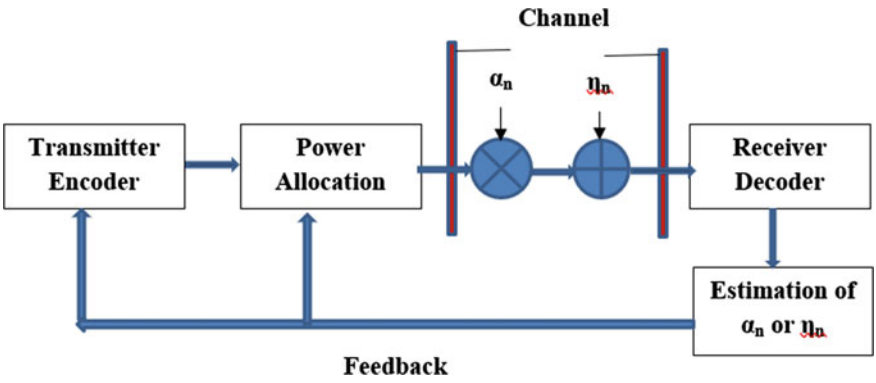

Fig. 1 Typical channel with CSIT

3.2 MIMO-OFDM

The bit error rate of a wireless channel is very high. To improve the performance of the wireless cellular network, spatial multiplexing MIMO is used for data rate enhancement. But in practical situations, the MIMO channel is frequency selective. MIMO is generally combined with OFDM, to make the channel a frequency flat. Detailed cellular network base station using MIMO-OFDM technology with optimum power allocation is shown in Fig. 2.

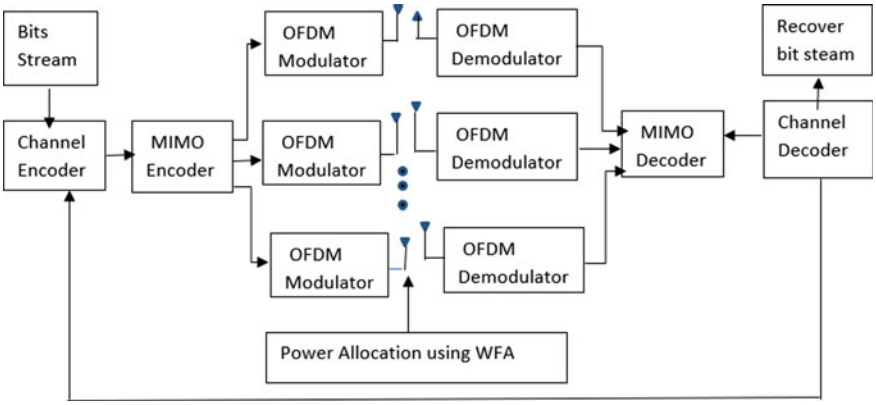

Fig. 2 OFDM-MIMO system with optimum power allocation

4 System Model

Consider a cellular network for downlink communication with one base station equipped with MIMO technology and I users. MIMO system model with T_M are transmitter antennae and R_M are receiving antennae is

$$Y = HX + \eta \tag{1}$$

Closed-loop MIMO with $Y(R_M \times 1)$ as received vector, $X(T_M \times 1)$ as transmitted vector, H is $R_M \times T_M$ channel information matrix. η is AWGN with mean zero and variance as σ^2.

$$H = \begin{bmatrix} h_{11} & \cdots & h_{1T_M} \\ \vdots & \ddots & \vdots \\ h_{1R_M} & \cdots & h_{R_M T_M} \end{bmatrix}$$

$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ \vdots \\ y_{RM} \end{bmatrix} = \begin{bmatrix} h_{11} & \cdots & h_{1T_M} \\ \vdots & \ddots & \vdots \\ h_{1R_M} & \cdots & h_{R_M T_M} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ \vdots \\ x_{TM} \end{bmatrix} + \begin{bmatrix} \eta_1 \\ \eta_2 \\ \eta_3 \\ \vdots \\ \eta_{RM} \end{bmatrix}$$

As transmitted symbols $x_1, x_2, x_3, \ldots x_{T_M}$ crosses the wireless channel will interfere at receive antennae from $R_1, R_2, R_3, \ldots R_M$. The use of SVD will help to avoid this interference and ensure spatial multiplexing in MIMO.

$$H = U \sum V^H \tag{2}$$

where, H—Channel information matrix, U—Unitary matrix containing left singular vector ($R_M \times R_M$), Σ—Rectangular diagonal matrix containing singular values of H and V—Unitary matrix containing right singular vector ($T_M \times T_M$)..

Application of SVD on MIMO help to decouple the MIMO channels. MIMO system model with SVD is

$$y\prime = Hx\prime + \eta\prime \tag{3}$$

SVD pre-coding and beamforming helps to remove interference at receiver antennae

$$\begin{bmatrix} y\prime_1 \\ y\prime_2 \\ y\prime_3 \\ \vdots \\ y\prime_{RM} \end{bmatrix} = \begin{bmatrix} \sigma_1 \cdots & & \\ \vdots \quad \sigma_2 & & \vdots \\ & \ddots & \\ \cdots & & \sigma_{TM} \end{bmatrix} \begin{bmatrix} x\prime_1 \\ x\prime_2 \\ x\prime_3 \\ \vdots \\ x\prime_{TM} \end{bmatrix} + \begin{bmatrix} \eta\prime_1 \\ \eta\prime_2 \\ \eta\prime_3 \\ \vdots \\ \eta\prime_{RM} \end{bmatrix}$$

where, $\sigma_1, \sigma_2, \sigma_3, \ldots \sigma_{TM}$ are singular values of the channel and these singular values are in decreasing order $\sigma_1 > \sigma_2 > \sigma_3 > \ldots > \sigma_{TM}$

$$\text{SNR of } i\text{th parallel channel} = \frac{\sigma_i^2 P_i}{\sigma_n^2} \tag{4}$$

where σ_n^2—Noise Power, σ_i^2—Channel gain/Singular value, P_i—power allocated to i^{th} channel.

Capacity of i^{th} parallel channel is

$$\log_2(1 + \frac{\sigma_i^2 P_i}{\sigma_n^2}) \tag{5}$$

Net MIMO Capacity is

$$C_{MIMO} = \sum_{i=1}^{T_M} \log_2\left(1 + \frac{\sigma_i^2 P_i}{\sigma_n^2}\right) \tag{6}$$

Capacity with Single Input Single Output

$$C_{SISO} = B \ \log_2(1 + SNR)$$

Capacity with Multiple Input Multiple Output

$$C_{MIMO} = M * B \ \log_2(1 + SNR)$$

where M is the minimum of $(T_M \times R_M)$.

Maximum channel capacity with optimum power allocation is

$$\max \sum_{i=1}^{TM} \log_2\left(1 + \frac{\sigma_i^2 P_i}{\sigma_n^2}\right) \tag{7}$$

But there are power constraints like allocated power to be nonnegative and the sum of allocated power equal to the total power. To find allocated power need to take the help of the Lagrange multiplier λ.

Optimal Power allocation Pi is

$$\mathrm{Pi} = \frac{1}{\lambda} - \frac{\sigma_n^2}{\sigma_i^2} \tag{8}$$

Water filling algorithm is allocating more power to channel having more SNR means will allocate less power to channel having more noise power. If $1/\lambda$ is water level then no power is allocated to the channel having noise power more than water level.

5 Results

The performance of the cellular network is evaluated using SNR versus BER.

1. Implemented the AWGN channel with M-QAM. The use of higher-order quadrature amplitude modulation (QAM) increases data rates within a limited bandwidth. This is validated as shown in Fig. 3. For 16-QAM SNR is 15 dB and after increasing, QAM order to 1024-QAM SNR is 29 dB as listed in Table 1.

2. BER performance of OFDM with 64 QAM is as shown in Fig. 4. As OFDM is multicarrier modulation, increasing the number of subcarriers helped to decrease BER means an improvement in SNR which in turn increases the data rate as per the result listed in Table 2.

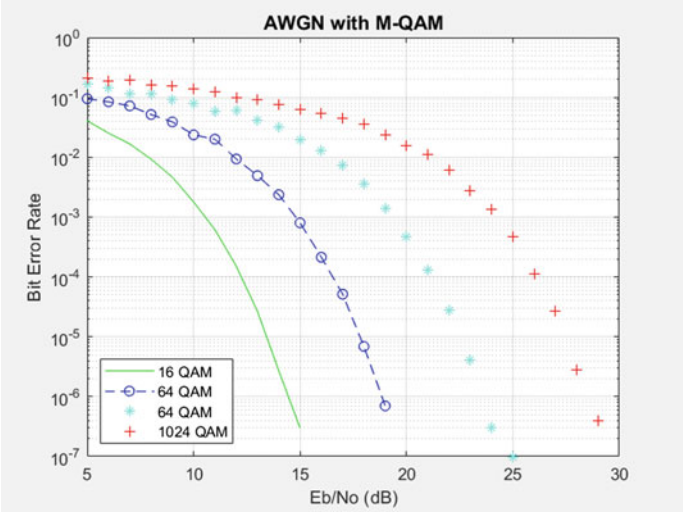

Fig. 3 Eb/No versus BER for AWGN with M-QAM

Table 1 BER performance of M-QAM

M-QAM	Symbols	SNR dB	BER in 10^{-6}
1024 QAM	100	29	0.4
256 QAM		25	0.1
64 QAM		19	0.7
16 QAM		15	0.3

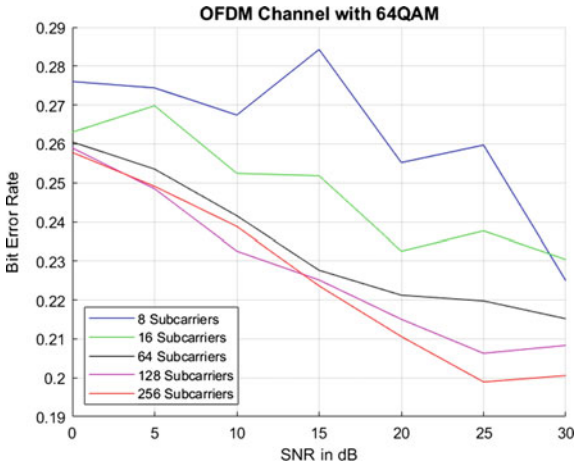

Fig. 4 SNR versus BER for OFDM with 64 QAM

Table 2 BER performance of OFDM at 20 dB SNR

No. of subcarriers	BER
8	0.2552
16	0.2325
64	0.2212
128	0.215
256	0.2106

3. To maximize the channel capacity, MIMO-SVD with WFA is implemented as shown in Fig. 5. By increasing the number of antennae at transmitting and receiver, capacity goes on increasing as listed in Table 3. For SISO system capacity is 5.58 bits/s/Hz and for 4 × 4 MIMO is 22.26 bits/s/Hz.

6 Conclusion

Leading towards green communication, implementation of optimum power allocation using water filling algorithm is helpful to achieve the improvement in the cellular network's energy efficiency. Along with energy efficiency, water filling algorithm

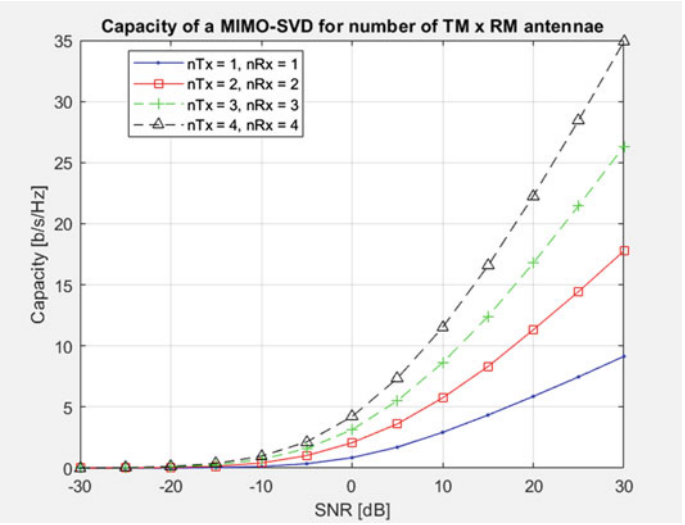

Fig. 5 SNR versus capacity for MIMO-SVD with water filling algorithm

Table 3 MIMO capacity at 20 dB SNR with WFA

No. of T_M and R_M antennae	Capacity bits/s/Hz
4 × 4	22.26
3 × 3	16.79
2 × 2	11.31
1 × 1	5.58

gives better network capacity. To address the tremendous increase in the count of mobile-connected devices and heavy demand on high data rates with limited bandwidth, the 5G network is evolving with various advanced technologies. For improving data rate and system capacity MIMO technology is suitable without the requirement of additional power and frequency spectrum. With the use of advanced technologies like OFDM-MIMO, there is a drastic increase in circuit power consumption. To manage data transmission energy optimum power allocation is used which is helping in reducing the total energy consumption in the cellular network. In this paper, the BER performance of the cellular network by using higher-order QAM and OFDM with 64 QAM is simulated. For 16-QAM SNR is 15 dB and after increasing, QAM order to 1024-QAM SNR is 29 dB. Multicarrier OFDM performance is also validated, more the number of the subcarriers help to reduce BER. As per simulation, 8 subcarriers give 0.26 BER and for 256 subcarriers BER is 0.21. Further MIMO with SVD using water filling algorithm is implemented to maximize the system capacity. For 4 × 4 MIMO, the capacity obtained 22.26 bits/s/Hz is greater as compared to the SISO system capacity of 5.58 bits/s/Hz.

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EEG Based Computationally Optimized Solution for Non-epileptic Seizure Detection

Varsha K. Harpale, Vinayak K. Bairagi, Swati P. Kolat, and Varsha S. Bendre

Abstract Abnormal movement and unconsciousness are responsible for the generation of seizures which in turns causes temporary loss of control. Seizures observed due to sudden abnormal electrical discharges in the brain are epileptic seizures. The stress-related seizures are referred to as psychogenic non-epileptic seizures (PNES) and other non-epileptic seizures (NES) are also observed in various patients. PNES or NES are similar to epileptic seizures and thus mostly misdiagnosed as epileptic seizures. NES and PNES are the impact of physiological and psychological behavior of the brain respectively, but not due to electrical discharge as in epilepsy thus referred as pseudo-seizures. These seizures should not be treated with Antiepileptic drugs (AEDs) thus there is a requirement of classification of NES and Epileptic Seizures. This paper presents recent trends in the diagnosis of NES, efficient and computationally optimized classification techniques used to classify epileptic seizures and NES using EEG signals. The paper demonstrates EEG based analysis using new method of feature extractions Singular Spectrum Empirical Mode Decomposition (SSEMD) for identification of epileptic or non-epileptic seizures. The accuracy observed using EEG instead of Video-EEG and SSEMD is 87.6%, which contribute in reducing computational complexity due to usage of EEG signals.

Keywords Epilepsy · Psychogenic non-epileptic seizures (PNES) · Non-epileptic seizures (NES) · Video-electroencephalography (V-EEG) · Singular spectrum empirical mode decomposition (SSEMD)

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1 Introduction

NES sometime also referred as 'pseudo-seizures, psychogenic seizures, non-epileptic seizures' or a sign of stress. They can be recognized if seizures are having some unusual behavior such as movements, duration, triggers and frequency. PNES is not due and physical brain disease, but because of psychological experiences such as emotion, generated stress, and past recollection problem. It is observed that 10–20% of patients or 1 in 5 of the patients sent to epilepsy centers found to have non-epileptic seizures but diagnosed as epileptic [1]. Most of the patients about 80% of PNES patients are treated with antiepileptic drugs, thus the correct diagnosis of PNES is a big clinical challenge. Need of correct diagnosis of NES and PNES is to avoid side effects of incorrect epileptic drugs or implementation of appropriate physiological treatment [2]. PNES is divided into six stereotypic categories viz. PNES due to: rhythmic motor; hyper-motor caused by aggressive behavior; complex motor; dialeptic seizures observed by insensitivity without motory sign; non-epileptic sensation by subjective without external indication; and mixed seizures with combinations of the earlier behaviors [3].

2 Basics of Psychogenic Non-epileptic Seizures

PNES mainly causes various physical movement but its occurrence and post activity response is very low. The observed activities that can be captured by video are non-real sleep, abnormal motion activity, irregular head movement, pelvic excitation, stammering, abnormal bowing and any bilateral movements and continuous eye blinking. The frontal seizures are observed in case of PNES patients. This is mostly misdiagnosed as frontal epilepsy [4]. As per survey 70–80% incidence rate of PNES is observed in female, but the incidence varies on attribution of causes of psychogenic non epileptic seizures (PNES). The transient behavior observed in children and it imitates actual epileptic seizures without abnormal electrical discharges. The subjects may show signs of side-to-side head activities, strong eye closure, and ictal vocalizations. Post-ictal features are easy to recognize, superficial, random, and quiet breathing pattern, as well as the absence of confusion, headache, and fatigue [5]. The 'non-epileptic seizure' (NES) is observed due to both physiologically and psychologically mediated paroxysmal events as epileptic manifestations. Psychogenic term added to NES to indicate psychologically mediated non-epileptical events [6].

Various psychosocial factors and psychological mechanisms are non-systematically associated with PNES. Figure 1 describes the assumed relationship between such factors:

- Factor 1: Traumatic experience of the patient is one of the important factors in psychological analysis.

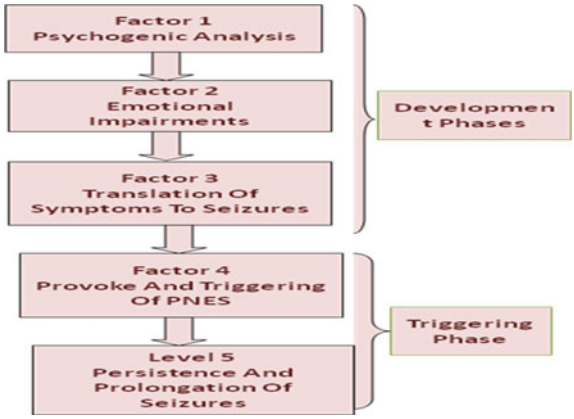

Fig. 1 Model of psychological factors involved in PNES

- Factor 2: Physical parameters such as age is categorize as 0–15 years, 15–60 years, 60 years and above as stated by WHO (2015) [7]. Similarly other parameters such as gender, neuro-physiological impairment and any other neurological disability also have impact on to the neurological disorder.
- Factor 3: Basic clinical classification of the seizures is the symptoms and technical classification is on the characteristic of signals or related statistical features.
- Factor 4: Dissociation and somatisation are triggering factors for abnormal emotion states and thus the seizures occurrence. Triggering factors gives details of occurrence for the day, or cluster details about period of retention.
- Factor 5: Prolongation factors define persistence of seizures. Triggering factors are important in occurrence of PNES. These factors track its frequency and response to treatment [8].

Normally the most uncertain motory actions, random sensations and cognitive behavior considering level of consciousness or social distress are the symptoms of psychogenic non-epileptic seizures (PNES). Baslet [9] summaries hypothesis about PNES as incidences for PNES usually has emotional consequences and processed unknowingly. PNES are mostly observed because of brain dysfunction.

3 Comparative Study of Video-EEG and EEG in Seizure Detection

3.1 Video EEG for Seizure Detection

Video-EEG monitoring refers to continuous EEG recording for continuous period along with simultaneous video recording. Recorded behavior (video) and the EEG activity are correlated which is used in diagnosis of seizures or non-epileptic attacks. Long-term video-EEG monitoring, is known as video telemetry.

The long-term video-EEG monitoring provides information about:

- Temporal information such as location of affected area of brain and time of seizure arrival.
- Classification characteristics to separate epileptic seizures from psychogenic non-epileptic seizures
- Severity and evaluates need of surgery in specific patient.

Video electroencephalogram (EEG) monitoring is a significant method that can differentiate between psychogenic non-epileptic seizures and epilepsy [3]. Normally patient who continues to have seizures even after applications of anti-epileptic drug (AED) need to undergo, prolonged video-EEG monitoring. This video-EEG data helps to classify seizures into epileptic seizures, non-epileptic seizures such as psychogenic non-epileptic attacks (PNEA) and seizure like syncope. Quantitative parameters such as rhythmicity, amplitude, frequency, sharpness, and duration are used to detect occurrence of seizures. Psychogenic non-epileptic attacks (PNEAs) are mostly misdiagnosed as epilepsy. Video-EEG monitoring is well proven tool for a diagnosis of PNEA. Non-epileptic events are then identified by combination of recorded attacks and ictal EEG changes but still it can recognize it as psychogenic. The research carried out by Lekhra et al. [10] explores Video-EEG of 110 cases collected from Tertiary Care Teaching Hospital (TCTH), Indore, India. The analysis could detect 89% of seizure cases, out of 46% patients were suffering from Psychogenic non-epileptic seizures. Thus short term V-EEG are sufficient to detect PNES.

Chacko and McCullagh [11], proposed Home based mobile solution for video ambulatory EEG monitoring system. This proposed real time system is cost effective, scalable and very useful for remote monitoring with limitations such as test can be inconclusive, require wireless infrastructure and has data security issues.

Bhattacharyya et al. [12], introduces neonatal video-EEG monitoring for identifying seizures, which helps in analyzing artifacts in EEG thus avoids false detection of seizures.

3.2 EEG Method for Seizure Detection

The electroencephalogram (EEG) is an electrical method of a recording signal recorded using electrodes placed on the scalp or penetrated in the cortex region as per International 10–20 system. An EEG signal provides non-invasive measurements of the brain activity and state of the brain. The EEG is a medical tool used in the monitoring of the brain and the diagnosis of many neurological illnesses. Current trends in signal processing and machine learning techniques have allowed the automated detection of neurological events for many medical applications. The major challenge observed in detection and prediction of seizures with EEG signals is to achieve reasonable accuracy for real-time applications. The advantages of EEG over other methods are:

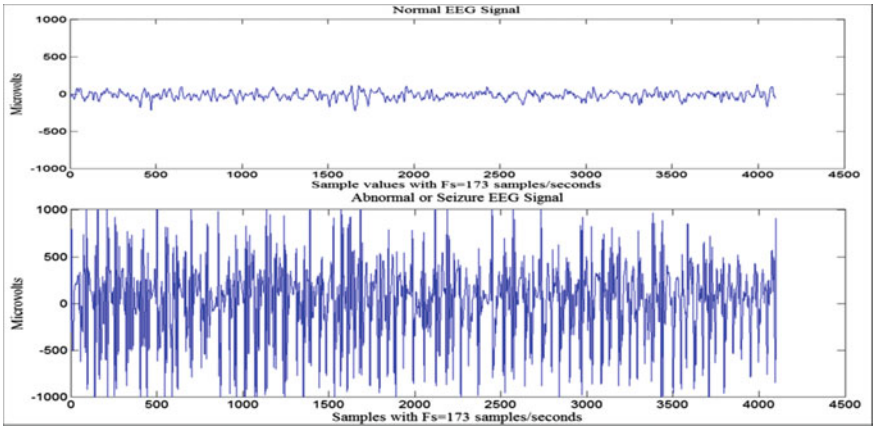

Fig. 2 EEG signal characteristics in normal and seizure state

- It is non-invasive and it is therefore possible to do experiments with normal human subjects.
- It has good time resolution normally in milliseconds which permits to follow up the temporal dynamics of brain processes.

The main challenge of EEG is its small-signal amplitude in the range of micro-Volts and its sensitivity to noise.

As shown in Fig. 2, the amplitude in normal EEG signal is very less about 100 micro-Volts but in seizure state it increases to 1000 micro-Volts or more than that as per strength of the arrived seizure. The frequency of the EEG signals also increases rapidly. The Non-epileptic EEG signals will not have such a clear distinction but frequency information is very important in NES-EEG signal.

3.3 Comparison of Video EEG with EEG Method

The EEG method and Video-EEG method can be compared on the basis of mathematical model required for classification. Let's consider EEG signal, it is a signal recorded by intracranial or extra-cranial method i.e. Needle and scalp based electrodes.

Multiple electrodes are placed on the scalp. So Scalp-EEG signals from 'N' electrodes are recorded with sampling rate 'S' and amplifier gain 'A' with artifacts as a noise 'AR'. Then mathematical model for EEG signal is

$$\mathrm{F(EEG)N} = \mathrm{XN[n]} + \mathrm{ARN[n]} \tag{1}$$

for current instance $\mathrm{n} = 0, 1, 2, 3 \ldots \mathrm{t} * \mathrm{S}$ with channel number 'N'. So the computational complexity depends on O[n] for single channel and N*O[n] for N

channels. In case of Video-EEG, along with EEG model the video processing model also need to consider for motion estimation and moving object detection. Thus the data processing per seconds is as

$$\begin{aligned} \mathrm{F}\,(\mathrm{EEGN} + \mathrm{Video}\ \mathrm{M} \times \mathrm{L}) &= \mathrm{F}\,(\mathrm{Video} - \mathrm{EEG}) \\ &= \mathrm{Average}\ (\mathrm{X[n]} + \mathrm{AR[n]})1 : \mathrm{N} + \mathrm{FR} * (\mathrm{Img}\ \mathrm{M} \times \mathrm{L}) \end{aligned} \tag{2}$$

Whereas FR is the frame rate (No. of Images per Seconds) M × L is the resolution of the image (Row × Column). If motion information is only considered from the frame still it is a complex data to handle. Thus good accuracy with EEG and improved feature extraction is a need in the research. The work presented uses EEG dataset and newly proposed algorithm called Singular Spectrum Empirical Mode Decomposition (SSEMD) to classify seizures as epileptic or non-epileptic seizures.

4 Result and Discussion

The dataset used for experimentation is from Temple University (TUH) [13], which provides EEG data in EDF files for 23 channels and 400 Hz sampling rate. For the proposed work TUH EEG Seizure Corpus (TUSZ) (American Clinical Neurophysiology Society Phoenix, Arizona, USA) dataset is used. It comprises of two parts training and testing with 264 subjects and 50 subjects respectively. The files handled for experimentation are 1989 files of training and 1015 files from testing category in EDF format including all seizure types. The non-epileptic files used are 145 for training and 89 files for testing. The TUH EEG Seizure Corpus database contains seizure files of various seizure types such as tonic-clonic seizures, myclonic seizures, partial seizure along with non-epileptic EDF files as described in Table 1.

Table 1 Classification accuracy for WT, EMD, EWT and SSEMD

Parameters	Kanas et al. [15], 2015	Proposed work
Dataset	Department of clinical neurophysiology and epilepsies in St Thomas' hospital—105 general + 19 PNES subjects, 250 Hz sampling	TUH EEG seizure corpus (TUSZ)—314 subjects, 400 Hz sampling
Features extraction methods	Basic features and wavelet features	Basic features, wavelet features and spectral features from proposed empirical decomposition (SSEMD)
Classifier	LDA, SVM and RF	RF
Accuracy	80% for RF and 96% for SVM	Maximum 87.6%

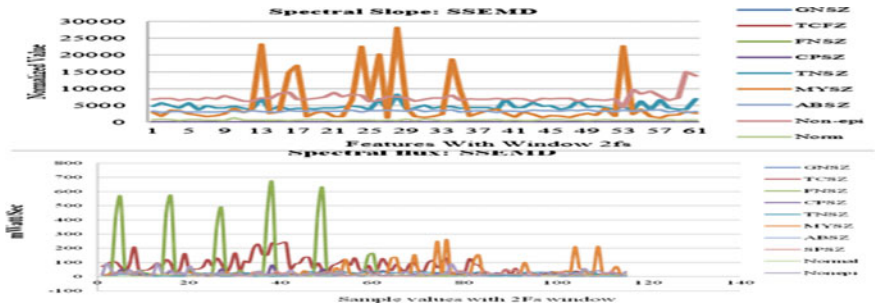

Fig. 3 SSEMD based features. **a** Spectral slope (SS) and spectral flux (SF)

Thus standard labeled database is used for experimentation and results are verified and validated from Neurologist. The features are extracted using existing methodology such as TFD, WT, EMD and EWT and features are extracted from proposed method SSEMD. The features such as mean, Root Mean Square (RMS), Power Spectral Density (PSD), Zero Crossing Rate (ZCR), correlation coefficients, spectral entropy, spectral slope, spectral flux and many more are calculated for each category of seizure and normal EEG signal with window of 2Fs where Fs is a sampling rate of the signal. The feature selection is performed with one way ANOVA [14] (Wrapper Method of feature selection).

Figure 3 shows SSEMD based Spectral Slope (SS) and Spectral Flux (SF) features, which clearly shows feature difference in Normal and Non-epileptic EEG. The Decision Tree based algorithm, Random Forest classifier is used for classification. But main objective is to classify seizures as Epileptic Seizures and Non-Epileptic Seizures. Random Forest is a supervised learning algorithm. The algorithm, is an ensemble of Decision Trees, and trained with the "bagging" method. The bagging method is the combination of learning models which increases the overall result. Random forest builds. Thus Table 1 shows final classification result using 10-fold validation and 70% cross validation method applied to extracted relevant features. It is observed that a new proposed Singular Spectrum Empirical Mode Decomposition method is significant in classifying non-epileptic seizures. As compared to WT, EMD and EWT, SSEMD gives classification accuracy 87.6 %, which 20% higher than the well proven methods.

Table 2 shows performance analysis of the proposed work as very limited dataset available for epileptic and non-epileptic patients the work is compared with Kanas

Table 2 Performance analysis

Class	WT		EMD		EWT		SSEMD	
	A	B	A	B	A	B	A	B
N	89.4	89.9	90.2	91.7	94.3	93.4	94.6	94.4
NE	55.5	53.3	63.5	66.2	67.6	64.4	87.6	84.5

et al. [15], conducted in 2015. The numbers of subjects tested are 19 for non-epileptic category and proposed work uses big database thus significant in comparison.

5 Conclusion

Video-EEG is found to be golden tool for detection of psychogenic non-epileptic seizures (PNES). Psychogenic non-epileptic seizures (PNES) are due to both neurological and psychological problem whereas non-epileptic seizures are due to overall health, food habits, allergies and neurological problems. Early detection of PNES or NES is still a challenge in clinical and technological research. The basic objective is to avoid application of anti-epileptic drug (AED), which may be dangerous to the non-epileptic patient. The proposed method provide less complex solution using EEG instead of costly Video-EEG method and effective feature extraction method using SSEMD to classify epileptic and non-epileptic seizures with accuracy of 87.6% tested and validated with labeled dataset of 314 patients. The dataset used has big size as compared to any other research. The major contribution of paper is using EEG dataset; classification of seizure is demonstrated and validated by neurologist.

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Speech Emotion Recognition Based on Wavelet Packet Coefficients

Rupali Kawade and D. G. Bhalke

Abstract Speech emotion recognition (SER) plays crucial role in human computer interaction. Speech emotion recognition is challenging due to diversity in phonetic information of the various languages, noise, interference, variation in arousal and valence level. In this paper, we present speech emotion recognition based on Wavelet Packet Coefficients (WPC). K-Nearest Neighbor (KNN) and multiclass Support Vector Machine (SVM) classifiers are used for the classification of the speech emotion signal. The performance of the proposed system is evaluated on the Berlin EMODB and RAVDESS dataset on the basis of percentage recognition accuracy. It is observed that proposed technique provides better results compared to traditional wavelet transform and Mel Frequency Cepstrum Coefficient (MFCC) based emotion recognition systems.

Keywords Speech emotion recognition · Wavelet packet coefficients · K-nearest neighbor classifier · Support vector machine classifier

1 Introduction

Speech is an easy and effective way of communication that consists of information as well as emotion. Speech emotion recognition (SER) deals with the recognition of the specific emotion from the spoken content [1]. SER is widely used in human computer interaction, emotion recognition at call center, robotics, voice biometrics, criminal investigation, physiatrist analysis, etc. Human can express various emotions such as happiness, sadness, boredom, disgust, anger, fear, neutral, surprise, etc. [2, 3]. Human speech is typically characterized by valence and arousal. Valence indicates the appeal of positivity and negativity whereas arousal informs intensity of calmness and excitation. Speech emotion recognition is challenging because of diversity in the valence and arousal level due to various factors such as region, language, gender,

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race, environment, etc. [4]. Typical automatic speech emotion recognition consists of speech pre-processing, feature extraction and classification [5, 6].

Various machine learning, artificial neural network (ANN), and deep learning methods have been presented in the last two decades for the speech emotion recognition. Wavelet transform is popular for various speech recognition applications because of its multi-resolution characteristics and efficient time-frequency localization [7, 8]. It can be applied for the processing of non-stationary signal. Various wavelet filters have shown superior performance for the analysis and representation of speech signal [9, 10].

Huang et al. [11] presented speech emotion recognition based on combination of Wavelet transform, MFCC and linear prediction cepstral coefficient features. They have used Vector Quantization for the feature vector reduction and radial basis function network (RBFNN) for classification of speech emotions. Because of fewer features, time consumption is lower. Wang et al. [12] has explored a Long time frame Analysis Weighted Wavelet packet Cepstral Coefficient (LW-WPCC) that collaborate the short and long time frame analysis to cope up with additive noise problem. It is noticed that combined audio-visual emotion recognition improves the recognition results. Hamsa et al. [13] presented speaker independent speech emotion recognition based on Wavelet Packet Transform (WPT). They have used Sequential Floating Forward Search (SFFS) method for the feature selection which has shown significant improvement of 14.9% and 4.3% over traditional MFCC method for EMODB and EESDB dataset. It is observed that, there is need of multilevel and multi-resolution wavelet transform for the speech emotion recognition because of its larger variability. There is need to resolve the problem of shift sensitivity, lack of phase information and poor directivity.

In this paper, we present speech emotion recognition based on Wavelet Packet Coefficients. WPC can capture the vocal characteristics of the different speech emotion signals. The feature vector includes WPC, first order difference and second order difference of the WPC. We have used K-Nearest Neighbor Classifier (KNN) and Support Vector Machine (SVM) classifier for the recognition of the speech emotion. The performance of proposed method is compared with the traditional Mel Frequency Cepstrum Coefficients (MFCC) technique. The extensive experiments are performed on EmoDB and RAVDESS dataset on the basis of percentage recognition rate.

The rest of the paper is organized as follow. Section 2 describes the proposed methodology in detail. Section 3 provides the experimental results and the discussion on the results. Finally, Sect. 4 presents the conclusion and the future scope of the proposed work.

2 Proposed Methodology

The flow diagram of the proposed system is shown in Fig. 1. The features consist of wavelet packet coefficients, first and second order difference of WPC. To increase

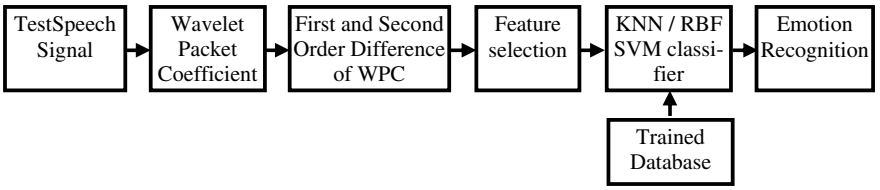

Fig. 1 Flow diagram of proposed system

the discriminant power of the features correlation based feature selection method is used. In this, the features in training data with least correlation are neglected [14, 15].

Wavelet transform of the speech emotion signal $f(t)$ for the time t and scale s can be given by the Eq. 1.

$$Wf(u,s) = \langle f, \Psi_{u,s} \rangle = \int_{-\infty}^{+\infty} f(t) \frac{1}{\sqrt{s}} \Psi^* \left(\frac{t-u}{s} \right) dt \tag{1}$$

In wavelet packet transform, the transformation is applied to the both low and high sub-bands of the signal. Multistage filter banks are applied to obtain the frequency components in each sub-band [13, 14]. The wavelet packets can be decomposed using Eq. 2.

$$\Psi^i_{j,k}(t) = 2^{\frac{j}{2}} \Psi^j \left(2^j t - k\right), i = 1, 2, 3, \ldots. \tag{2}$$

Here, i, j, $kand\ \psi$ represents modulation parameter, scale parameter, translation parameter and wavelet function.

$$f(t) = \sum_{i=1}^{2j} f^i_j(t) \tag{3}$$

$$f^i_j(t) = \sum_{-\infty}^{+\infty} C^i_{j,k}(t) \Psi^i_{j,k}(t) \tag{4}$$

$$C^i_{j,k}(t) = \sum_{-\infty}^{+\infty} f(t) \Psi^i_{j,k}(t) dt \tag{5}$$

Equations 3 and 4 shows the jth level decomposition of the speech signal $f(t)$. The wavelet packets can be computed using Eq. 5. In proposed work, wavelet packets are decomposed up to 4th and 5th level using Daubechie's wavelet filters (DB6). For the fifth level decomposition, the WPCs are $C_{5,0}, C_{5,1}, C_{5,2}, C_{5,3}, \ldots, C_{5,31}$. For the nth level decomposition, WPT generates 2^n wavelet packet coefficients.

Various emotions have shown higher value for the coefficients $C_{5,0}$ to $C_{5,16}$ and lower value for the coefficients $C_{5,17}$ to $C_{5,31}$. Angry emotion has maximum value of WPT coefficients whereas fear emotion contains minimum value for WPT coefficient.

3 Experimental Results and Discussions

The proposed system is implemented using MATLAB software on the personal computer system having core i3 processor with 2.64 GHz speech, 4 GB RAM and windows operating environment. The performance of the proposed methodology is evaluated on the EMODB dataset based on % recognition rate. Seven acted emotions are available in EMODB dataset such as happiness, sadness, anger, boredom, neutrality, anxiety, and disgust [16]. RAVDESS dataset consists of seven emotions recorded by 24 professional actors [17]. For the simplicity we have cropped or appended the original signals to 4 s duration.

KNN and SVM Classifiers are used for the classification of speech emotion. For the implementation of KNN classifier, K = 3 gives better results compared to K = 1 and higher value of K. SVM with Radial Basis Function (RBF) kernel gives higher results because of its capability to separate the speech signal non-linearly [18].

The performance of the proposed methodology is compared with existing traditional SER systems as given in Table 1 and it is found that proposed technique increases the representation capability and characteristics of the various emotion signals. It is observed that proposed correlation based feature selection helps to capture the major discriminative features from the feature set and hence gives improved performance compared with generalized WPC feature based emotion recognition.

Table 1 Performance comparison of proposed system with existing methods

Authors	Feature extraction technique	Classifier	Database	Accuracy (%)
Bhavan et al. [18]	MFCC	EMODB	SVM	92.45
Wang et al. [12]	WPC–SFFS	EMODB	RBF SVM	79.54
Proposed method without feature selection	WPC	EMODB	KNN	80.32
			RBF-SVM	87.98
		RAVDESS	KNN	59.75
			RBF-SVM	79.16
Proposed method with feature selection	WPC–CBFS	EMODB	KNN	89.71
			RBF-SVM	91.11
		RAVDESS	KNN	60.93
			RBF-SVM	92.62

K-Nearest algorithm is simple to implement and need less parameter tuning. KNN gives limited performance due to larger intra-class variability and lower interclass variability. However, RBF SVM has given better performance compared with KNN because of its ability to discriminate the non-linear data. KNN gives better results for EmoDB dataset compared with RAVDESS. The experimental results shows that proposed system gives better performance for RAVDESS dataset compared to EMODB dataset for WPC-CBFS along with SVM classifier.

4 Conclusion

Thus, this paper presents the speech emotion recognition based on wavelet packet coefficients. We have constructed the feature vector based on wavelet packet coefficients, first order difference and second order difference of WPC. Cross correlation based feature selection techniques helped to select the discriminant features for the training of classifier. For the classification, SVM classifiers with RBF kernel have given better performance compared to KNN classifier. The proposed WPC-CBFS gives 89.71% and 91.11% accuracy for the KNN and RBF SVM respectively on EMODB Database. Also, it provides 60.93% and 92.62% accuracy for the KNN and RBF SVM respectively on RAVDESS Database. The future work of the proposed system consists of automatic tuning of wavelet parameters and feature selection parameters.

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Analysis of Machine Learning Algorithms for Retrieval of Ontological Knowledge from Unstructured Text

Dipak Pawar and Suresh Mali

Abstract In this article, we analyzed various machine learning algorithms for extraction of knowledge from unstructured text data. In order to extract meaningful information from unstructured text, we should know ontology of the domain. Ontology can be represented in terms of information tables and ontology graphs. Ontology graph may have taxonomic and non-taxonomic relations. Retrieving taxonomic relations are easier as compare to non-taxonomic relations. Non-taxonomic relations are easier to interpret to non-expert users. Attribution and classification are vital phases in analysis of unstructured text data. To accurately identify non-taxonomic relations from domain, semantics of domain need to be explored. For this machine learning classifiers need to be investigated in depth for feature classification. We evaluated Artificial Neural Network (ANN), Support Vector Machine (SVM) and Bay's classifiers for feature classification. Experimentation shows that SVM machine learning classifier is best suited for extraction of knowledge from unstructured text data.

Keywords Ontology · Taxonomic · Machine learning · ANN · SVM · Feature · D-matrix

1 Introduction

Today's world is internet world. People are using internet for every day-to-day activity. Over the last few years there is drastic increase in use of internet. A study states that around 60% human being are using internet on the earth. Huge amount data is getting generated day by day. This digital data produced may be in terms of huge text files or multimedia files. Huge amount of data is deposited day by day in data ware houses. This large data can be in terms of structured, semi-structured and un-structured format. Structured data is data that adheres to a pre-defined data model and is therefore straightforward to analyze. Structured data conforms to a

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tabular format with relationship between the different rows and columns. Information can be extracted from structured data by executing upfront search query on relational databases. Semi-structured data is the data which does not conforms to a data model but has some structure. It lacks a fixed or rigid schema. It is the data that does not reside in a rational database but that have some organizational properties that make it easier to analyze. Unstructured simply means that it is datasets (typical large collections of files) that aren't stored in a structured database format. Unstructured data has an internal structure, but it's not predefined through data models. It might be human generated, or machine generated in a textual or a non-textual format. It does not have any ordering properties. Unstructured data cannot be represented into relational databases. Survey states that amount of unstructured data is 90% and structured data is 10%. Unstructured data can be in the form of text or multimedia (image/audio/video). To extract knowledge from unstructured text, one needs to explore ontology of the domain. Ontology is represented in the form of concepts and attributes by taking into account semantic connection between classes. Attributes and concepts have association between them. This association can be expressed in terms of taxonomic and non-taxonomic relations. Taxonomy relation is type_of, is_a (instance_of) and part_of relation between ontology classes whereas non taxonomic relation is any relation between concepts except taxonomy relation. Ontology of the domain need to be represented in the form of information tables and ontology graph. Tables and graphs are easier to understand for non-expert users. Detecting non taxonomic relation between concepts and attributes is challenge. Attribution and classification are vital phases in analysis of unstructured text data. To accurately identify non-taxonomic relations from domain, semantics of domain need to be explored. For this machine learning classifiers need to be investigated in depth for feature classification. We evaluated ANN, SVM and Bay's classifiers for feature classification. Manuscript is divided into Sect. 2-Ontology Formation Process, Sect. 3-Methodolgy, Sect. 4-Experimentation and Sect. 5-Conclusion. Castro and Chakravarty [1], proposes Associative Classifier for Entity Resolution (AssocER), which is used for classification of unstructured short texts. They also propose Multiclass Logistic Regression Classifier (MLRC) using Word to Vector as attribute selection and conversion. Results are not optimized. Not able to identify novel classes. It is not able to perform self-training during prediction phase. Pabitha and MaryjenisTino [2], emphasized on characteristic based learning which is used to find out features and also to estimate attributes of unstructured text. It is content based classification technique. This method is not finding non taxonomic relations. Bartoli and Lorenzo [3], proposes entity extractor technique with less human intervention. It is based on genetic programming. Improvements needed in this technique in order to increase accuracy. Hassan and Mahmood [4], proposes joint Convolutional Neural Network (CNN) and Recurrent Neural Network (RNN) approach for sentence categorization. This research has tremendous part in decreasing the number of parameters and designing convolutional layer after recurent layer as replacement for pooling layer. This technique can be used in information retrieval. Tekli [5] proposes a review paper which supplements summarized and exhaustive review of the methods related to semi-structured data processing. Leng and Jiang [6], proposes

extraction of relationships from high level of noisy and unrelated information unstructured text. It is based on semi-supervised learning approach. This method requires annotation from user. Human intervetion is required to analyze unstructured text. Ritter and Rinderle-Ma [7], performed survey on techniques to fetch semantic information from unstructured data. Harleen and Garg [8], analyzed unstructured data on Amazon Elastic Cloud. Analyzed unstructured data for real time data analytics. Author is not focusing on investigating the ontology behind domain. Bavota [9], presents review paper that shows types of unstructured data available to researchers supporting basic data mining techniques to investigate them. This is a survey paper. Chiange I-J [10], proposes a graph model and an agglomerative algorithm for text document clustering. Proposed algorithm is heavily better than orthodox clustering algorithms, such as k-means clustering, division partitioning, auto class and hierarchical clustering algorithm. Between documents there can be overlap which can be resolved by this method which supplies more summarized and detailed clustering results which allows concept overlap. The vulnerability of proposed method is absence of considering ambiguity within documents. Fuzzy model can be solution. Bafna and Wiens [11], proposed a feature learning framework which automatically detects features or abstractions. This research investigated importance of unsupervised learning and non-Euclidian distance techniques. This research also explored dimensionality reduction. Main drawback of this research is that it is only identifying taxonomic relations. Non taxonomic relations need to be explored for correct ontology framework formulations. Reyes Ortiz and Gonazalez-Beltran [12], performed survey on Natural Language Processing (NLP) based approached for unstructured data. Fang and Becchi [13], presents the Unified Automata Processor (UAP), a novel construction that supplies general and efficient support for Finite Automata (FA) required for NLP. Proposed architecture is implemented on CPU and GPU. The main drawback of this system is that it requires external hardware to run proposed algorithm. Rafiqul Islam and Ezazul Islam [14], applies standard encryption techniques on unstructured data. Researchers show that unstructured text categorization with respect to delicacy levels improves the attainment of the system. Shen and Han [15], general architecture for connecting named attributes in internet free text with a hybrid knowledge network. Propose a probabilistic linking model, which consolidates an attribute popularity model with an attribute object model and also propose a knowledge population algorithm to rigorously augment the network. This paper does not address about non taxonomic relation mapping. Sriraghav and Vidya [16], proposes Attribute Based Opinion Mining Algorithm which focuses on user centric attributes. Algorithm forces user to take well-informed decisions focusing on the attributes user is relying most. Author proposes tool that can be applied in any domain which can analyze unstructured data by accepting domain and user specific attributes. Human intervention is needed to input domain specific attributes. Also process of generating graph is ambiguous. Tarasconi [17], proposes emergency management tool using tweeter tweets. Author has performed sentiment analysis on twitter dataset. However this research is not able to accurately find notion of in-formativeness within hazard related streams. Ahmad and Ahmad [18], proposes

framework for text information extraction in terms of context vectors. This architecture is dependent on mappers and reducers developed on Apache Hadoop. Large dimensionality is handled by clustering. Extracted context vectors have large dimensions. Domain specific attributes entered manually. Fikry and Ahmad [19], proposes business analytics framework for unstructured data extraction. However author is not handling non taxonomic relations. Istephan and Siadat [20], proposes framework for unstructured medical data. This framework has in-built module. User can add his/her own unstructured data operation module. Query can be fired to framework. This framework is not able to identify non taxonomic relations. It also needs to manually enter domain specific attributes. Lee and Kim [21], proposes multidimensional model to extract information. This paper presents a text cube model which is based on multi-dimensional text database. This model is not able to identify non taxonomic relations. Domain specific attributes need to be manually entered. Saini and Bhatia [22], proposes domain independent emotion mining framework for unstructured data. This method implements self-learning dictionary. This method is less accurate because of semantic ambiguity in statements. Also method is not addressing about non taxonomic relations. Ali and Fathalla [23], proposes process of Learning Non Taxonomic Relationships of Ontology (LNTRO) from unstructured data. This paper focuses on nontaxonomic relations. Little human intervention is required to perform attributation. If there is a semantic ambiguity, accuracy degrades.

2 Ontology Formation Process

Knowledge of selected domain can be represented by Ontology. Unstructured text file acts as an input to ontology formation process. Unstructured text file is analyzed and words are extracted from paragraphs. Unnecessary data is removed from file. Words are extracted using WordNet library. Dictionary words are considered for classification and attribution. For understanding of the domain semantics and sentiments of domain need to be properly investigated. For this appropriate machine learning classifier need to be investigated. Taxonomic relation between attributes is direct or instance of relation that can be directly derived but non-taxonomic relation is indirect relation which needs to investigate more in detail. Output of ontology formation process is ontology graph and information tables. Graphs and information tables can be understood by non-expert users. Ontology formation process is depicted in Fig. 1.

Ontology formation process is illustrated with example as shown in Fig. 2.

In this example words extracted are ‘Sell’, ‘independent bungalow’ and ‘Pune’. In the attribution phase, user defined domain attributes are mapped as per specified domain and are classified using machine learning classifiers. Taxonomic relations are identified of the selected domain but more investigation is needed to explore non-taxonomic relations. In this paper, we have analyzed ANN, SVM and Bay’s learning classifiers for exploration of taxonomic relations and information tables. Information table can also be represented in terms of D-Matrix.

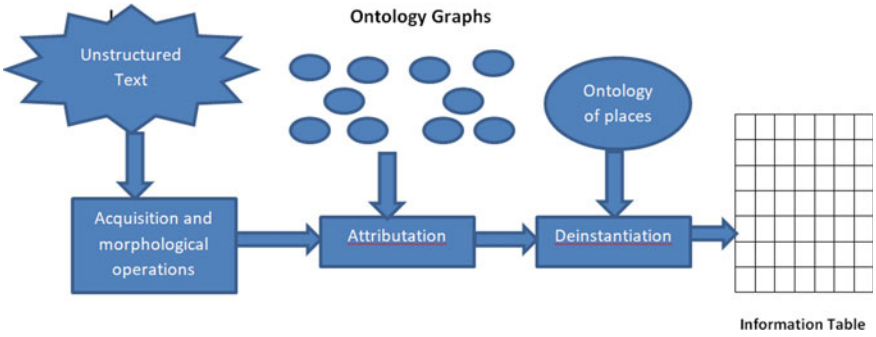

Fig. 1 Ontology formation process

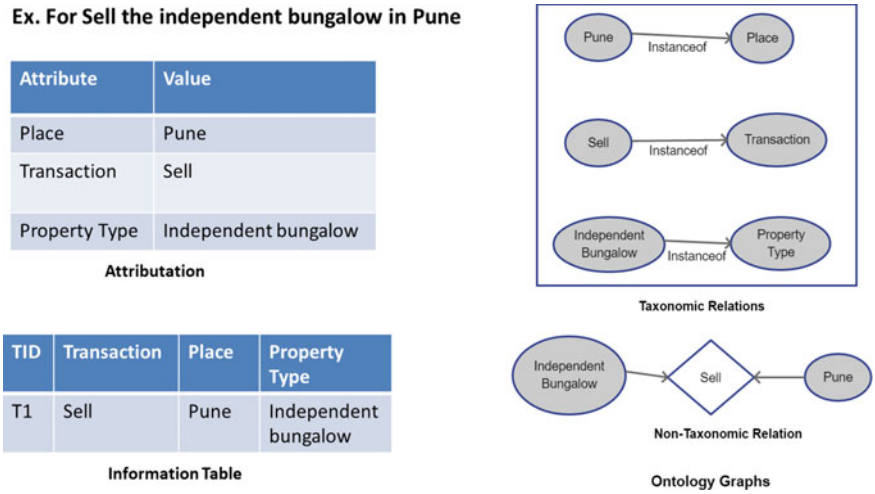

Fig. 2 Ontology graphs and information table

3 Methodology

3.1 Genaral Methodology for Knowledge Extraction from Unstructured Text

Knowledge extraction from unstructured text methodology is depicted in below architecture diagram (Fig. 3).

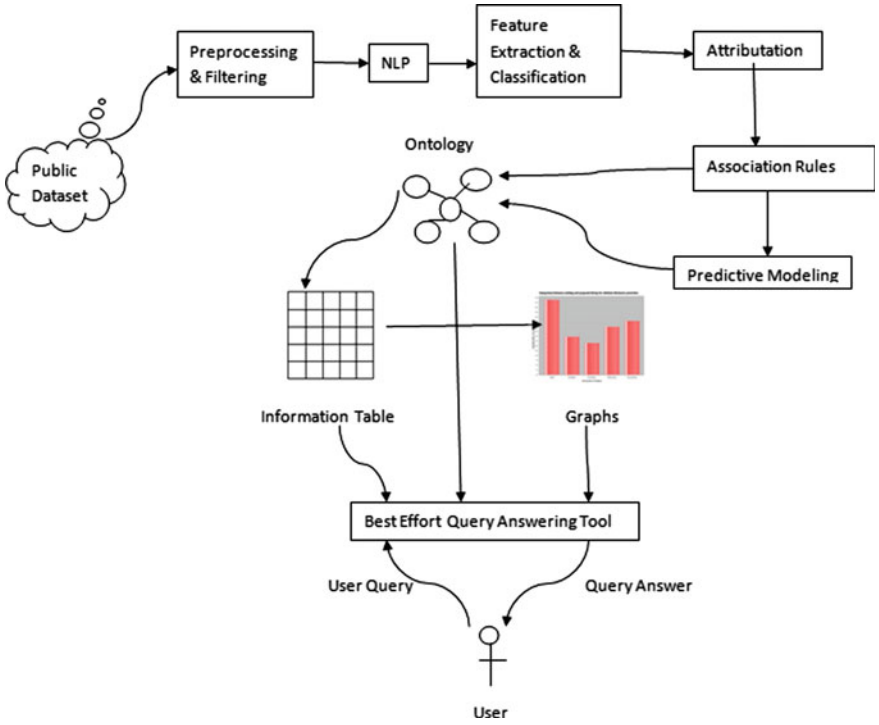

Fig. 3 Architecture for knowledge extraction from unstructured text

3.2 Analysis of Machine Learning Classifiers for Attributation and Classification

Appropriate machine learning classifier need to be investigated for attribution and classification of domain ontology. We evaluated machine learning classifiers like SVM, ANN and Bay's classifier used in literature and proposed below algorithm.

Input: Hundreds of unstructured text for training and for evaluation

Output: Information Table

Conclusion: SVM machine learning classifier's performance is slightly better than ANN and Bay's classifier.

(a) Accept multiple unstructured text files.
(b) Perform document annotation: detect boundary of sentence by checking for full stop and other sentence separators.
(c) Perform term extraction by comparing with domain corpus.
(d) Perform phrase merging: Search for association words. Store terms and association word into relational database.
(e) Generate D-Matrix for each text file.

(f) Combine same field D-Matrices into single D-Matrix. Perform union on D-Matrices.
(g) Perform training using SVM on hundreds of unstructured text file (Combined D-Matrix).
(h) Perform training using ANN on hundreds of unstructured text file (Combined D-Matrix).
(i) Perform training using Bay's classifier on hundreds of unstructured text file (Combined D-Matrix).
(j) Supply test cases on SVM, Bay's classifier and ANN machine learning algorithms.
(k) Evaluate test result using SVM, Bay's classifier and ANN.
(l) Compare SVM, Bay's classifier and ANN on parameters such as accuracy, learning time and evaluation time.

4 Experimentation

We have performed our experimentation on reuter's medical standard data set for all three machine learning algorithms namely ANN, SVM and Bay's classifier. We have analyzed performance on same hardware and software environment for all 3 machine learning algorithms mentioned above. We investigated performance of machine learning classifiers on parameters such as classification false positive (error) in terms of probability density function (PDF) and execution time. We found that SVM algorithm is giving better results in terms of classification accuracy, classification error CDF, classification error PDF and execution time (refer Figs. 4 and 5).

5 Conclusion

In this paper, we have proposed methodology for extracting ontology from selected domain. To accurately identify ontology of domain non-taxonomic relations need to be extracted properly as these relations are easier to understand for non-expert users. To accurately identify non-taxonomic relations, critical step is appropriate classification and attribution. Selecting appropriate machine learning classifier for classification is challenge. We evaluated performance of ANN, SVM and Bay's classifier in terms of parameters such as classification accuracy, classification false positives and execution time. Experimentation result shows that SVM algorithm is better for classification and attribution of ontology for selected domain. Future work in our research is accurately identifying non-taxonomic relations from ontology using SVM machine learning classifier.

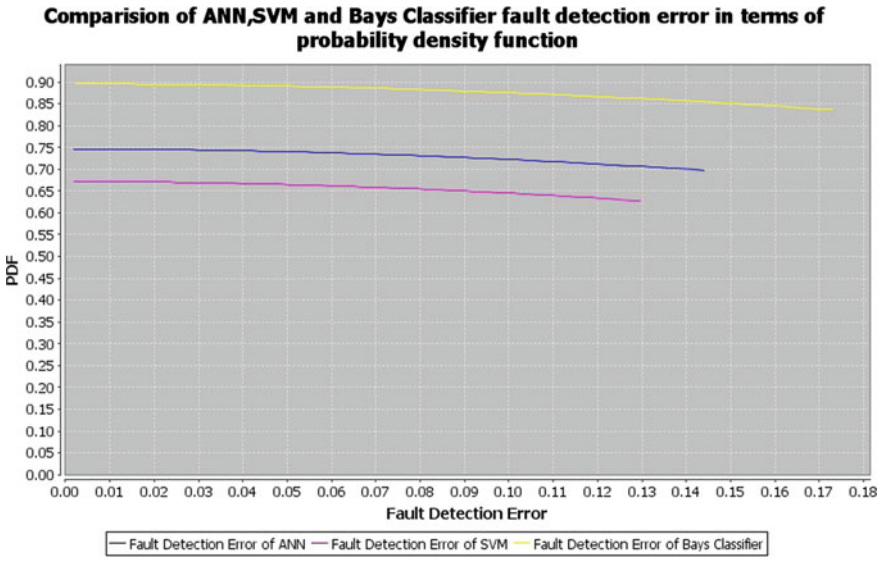

Fig. 4 Comparison of ANN, SVM and Bay's classifier in terms of classification error PDF

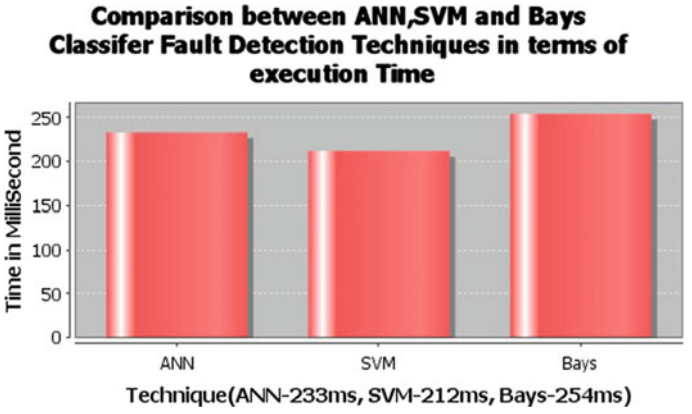

Fig. 5 Comparison of ANN, SVM and Bay's classifier in terms of execution time

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Wearable Electrocardiogram Feature Extraction for Real Time Monitoring Applications

Trupti G. Thite and D. G. Bhalke

Abstract Electrocardiogram (ECG) is the most important electrical signal acquired from the human body to analyze heart problems in individuals. Many devices are available in hospitals for acquiring this signal. But to analyze ECG signal in a non-hospital environment with fewer complications of attaching 12 leads on the body is a current need. Easy to use wearable devices helps to analyze ECG in real-time. The algorithm presented in this paper extracts R-peak using the Pan-Tompkins algorithm. ECG data samples collected from wearable shimmer 3 ECG sensors are used here for experimentation. Experimentation result shows detection of R-peaks from patient data collected at sitting, standing and running conditions.

Keywords Electrocardiogram · Wearable device · Cardiovascular disease · Pan-Tompkins · Shimmer

1 Introduction

Electrocardiogram is the most common and affordable way to diagnosis cardiovascular diseases (CVDs).Arrhythmia is vital disease type among all the CVDs. Delay in treatment may cause high death rate for critical arrhythmic symptoms [1]. Hence patients with uncomfortable heart and also normal patients and needs continuous electrocardiogram (ECG) monitoring. Many doctor's gives preference to holter monitoring system for continuous monitoring of patients ECG data to record for whole one day or two days. Such system unable to perform diagnosis of cardiac disease in real time [1]. For continuous and convenient monitoring of patients now a day automatic wearable health monitoring plays important role in non-hospital environment. All easy to use wearable's helps for live monitoring of patients at a hospital as well as non-hospital location. Various spatial, statistical, temporal and spectral features of ECG helps for wearable heart health monitoring [2, 3]. The technology

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integration of signal processing and Internet of things offers live monitoring, analysis and early treatment of various heart disease. [4]. Handy and wearable sensors can able to record, analyze ECG signal to identify many characteristics of ECG like QRS complex, R-peaks etc. Online Electrocardiogram systems can be implemented using many wireless technologies, cloud and using internet networks in two ways.

System 1: In these type of system Identification of arrhythmia can be done on the smart device itself using suitable classification methods. These smart devices are built using multiple body sensor with computing platforms like controller. But, these types of methods increases memory utilization, life of battery and number of computations [5, 6].

System 2: Some systems proposed in the literature uses the structure of three-layer. ECG is acquired with body attached patches, portable electrodes wearable into cloths. These multi-featured signals are then sent to a gateway node. This node Processes for further diagnosis and classification of the ECG data and sends it to a Tele-monitoring interface with a live connection. In some literature, processing can also be done by tele-monitoring devices which act as the central location [6–9].

In both system 1 and 2 feature extraction is very important part before classifying ECG signal. Accurate R-peak, QRS detection is necessary step for any machine learning based classification technique. Many time domain and frequency domain feature extraction techniques are designed in literature. In [1, 10] author proposed Wavelet based feature extraction technique for real time application. More advanced Hilbert transform cloud based extraction techniques was designed for online monitoring of signal in paper [11]. In [12] author extracted Fiducial features of ECG using new Unbiased FIR smoothing technique. In [3] author designed DSP processor based Pan Tompkins and template matching algorithm for Classification of premature ventricular contractions. Pan Tomkins developed [13] less complex and accurate Real time ECG feature. This paper presents Pan Tompkins based R peak recognition algorithm for wearable ECG data samples collected from shimmer sensor. This paper is ordered in following sections, Sect. 2: Details of proposed system, Sect. 3: Experimentation and result, Sect. 4: Conclusion and future work.

2 Proposed System

The flow diagram of the proposed system is shown in Fig. 1. The wearable ECG data samples are pre-processed using most popular Pan Tompkins algorithm. This algorithm uses filter series to remove background noise [14]. And also highlights rapid heart depolarization contents.

1. Arrangement of Low pass and high pass filter to form band pass filter is used to remove baseline wonder, power line interference, muscle noise etc. Use of 5–15 Hz band with mainly focuses on frequency range of ECG features.
2. After filtering smooth ECG signal is differentiated to get QRS complex slope information. As per suggested by Pan Tompkins 5 point difference is useful to

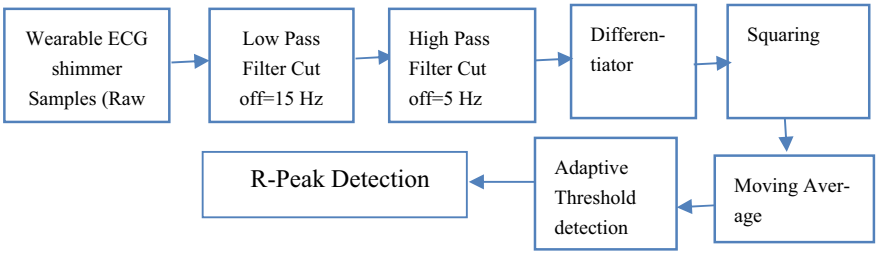

Fig. 1 R-peak detection steps

get appropriate slope, which can be calculated using Eq. 1.

$$y(nT) = \left(\frac{1}{8T}\right)[-x(nT - 2T) - 2x(nT - T) + 2x(nT + T) + x(nT + 2T) \quad (1)$$

3. To enhance dominant QRS peak, sampled ECG signal is squared point by point after differentiation using following Eq. 2.

$$y(nT) = [x(nT)] \quad (2)$$

4. In next step moving average filtering is performed using 'N' Number of Samples in the width of integration window. This step is used to know about duration of QRS complex.
5. In last step every peak amplitude is compared to Threshold mentioned in Eqs. 3, 4 and 5 so that noise peaks should not be detected wrongly.

$$Threshold = Noise\,level + 0.25\ (signal\,level - noise\,level) \quad (3)$$

$$signal\,level = 0.125(signal\ peak) + 0.875(signal\,level) \quad (4)$$

$$Noise\,level = 0.125(Noise\ peak) + 0.875(Noise\,level) \quad (5)$$

3 Experimentation and Result

In order to explore the concept of computerized ECG signal analysis R-peak detection steps are performed using Matlab based simulation. Results of proposed algorithm are tested on Shimmer ECG dataset [15]. Details about this wearable dataset are explained in Table 1.

Table 1 Shimmer ECG dataset details

Source		ADS1292R			
Channels		4 channel (LA-RA, LL-RA, LL-LA and Vx-RL)			
Sampling rate	1024 Hz	Format	24 bits, signed (.csv)	Units	mV
Filtering		None	No. of records	39	
Attributes measured		8 attributes calibrated: ECG LL-RA, LA-RA, Vx-RL, timestamp raw: ECG LL-RA, LA-RA, Vx-RL, timestamp			
Channels		4 channel (LA-RA, LL-RA, LL-LA and Vx-RL)			
Sampling rate	1024 Hz	Format	24 bits, signed (.csv)	Units	mV
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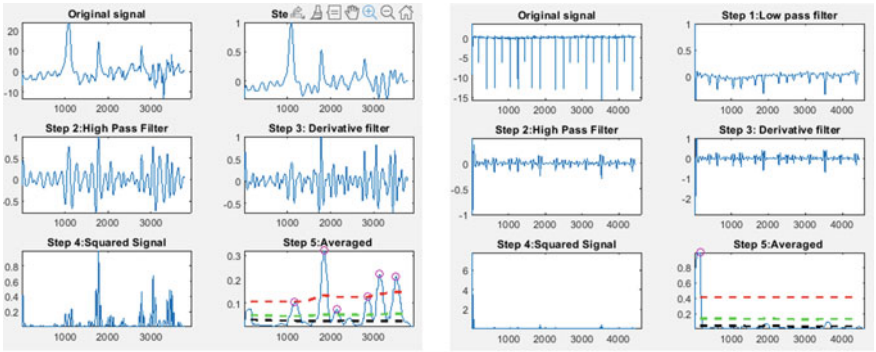

Fig. 2 Output of each stage applied on 2 patient record. **A** Patient 1, **B** patient 2

Algorithm is tested on 2 records out of total 39 records from dataset only Lead I data samples are considered for testing. Output of each stage with marked R-peak for these two records is as shown in Fig. 2. Low-pass and High pass filters are designed at 5 Hz and 15 Hz frequency respectively using help of Butter function.

4 Conclusion and Future Work

Wearable sensors are very useful to keep track on cardiac activity of patients in Non-hospital environment. Shimmer wearable sensor kit help to collect patients ECG sample of during walking, standing and sitting conditions. Because of this motion every patient ECG signal properties vary significantly. It is observed through experimentation that single algorithm not gives accurate result for all ECG records. Hence Patient-dependent feature extraction techniques are required. Any Feature extraction

algorithm can be implemented in real time if and only if the algorithm is tested accurately for variety of records. Hence cross corpus evaluation of algorithm is Necessary. This study extends this experimentation further for classification technique for real time analysis on shimmer ECG record.

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Automatic Emotion Detection Using Electroencephalogram

Deepthi D. Kulkarni and Vaibhav V. Dixit

Abstract Extracting or recognizing emotions is said to be a crucial task in Human Machine Interface (HMI). This emotion detection can make us understand the mental state of a human being. Human feelings and emotions are found by various means of observation, both internally and externally which are measured by their attire of facial expressions or their heart beats, their way of talk, gestures etc. In this paper we shall have a study on various methods adopted to classify the detection of emotion which are extracted by Electroencephalography (EEG) analysis. Latest study has been started on different EEG datasets where deep study has been started in machine learning and deep learning. Especially analysis through EEG and understanding different emotions, made a human analyse the accuracy of his detection is appropriate or not. There are many robust classifiers used to make EEG signals more applicant to detect more accurate emotion. Towards this goal of finding different ways of it, we shall have a systematic literature review on different classification is performed to address the different critical questions. The design of Deep learning network is much useful to get enhanced accuracy of our emotion detection. Many available datasets were analysed in many of above studies. Generally, CNN's, ANN's and DBN's outperformed as compared to other algorithm.

Keywords EEG · Wavelet transform · Emotion recognition · Valence-arousal · Machine learning

1 Introduction

Emotion detection of a human being is the state of that person in accordance with various scenario. It is the different moods where a person is when different situation arises before him. Emotion detection is main interest of psychologists and engineers working in this domain. Human–machine interface (HMI) is a platform where

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machines are expected to understand complete human being with his/her emotions. Among many emotion recognition methods, the signals which are extracted from Electroencephalography (EEG) [1] has become deep study in the area of Biomedical, Signal and neural analysis. These signals are recorded through electrodes which when connected to the scalp of brain and then signals which are derived through them are used to study not only emotions but also diagnosis of neurological related issues such as epilepsy, somnipathy, coma, and encephalopathies. These EEG signals are quite low cost as compared to others extraction of signals and the resolution factor also plays an advantage to make these signals much popular among biomedical area of analysis [2].

Numerous conventional Machine Learning and various algorithms based on calculations are been utilized to investigate these feelings. Deep learning techniques [3] also have come into existence for better accuracy. Feeling identification or acknowledgment is done through content, discourse, outward appearances or motions which are found with less accuracy as they seem to be.

EEG signal consists of various noise or Artifacts in it, hence firstly artifact removal takes place and then the process starts. Its dataset consists of 2D matrix of real values that are generated by brain potentials [4].This highly structured activity makes machine learning with more accurate. The proposed Emotion detection using EEG process is shown and explained through Fig. 1, where the complete process in divided into various stages.

The complete process shown in Fig. 1 is showing the process of emotion detection of any subject step wise. This complete process goes through following procedure:

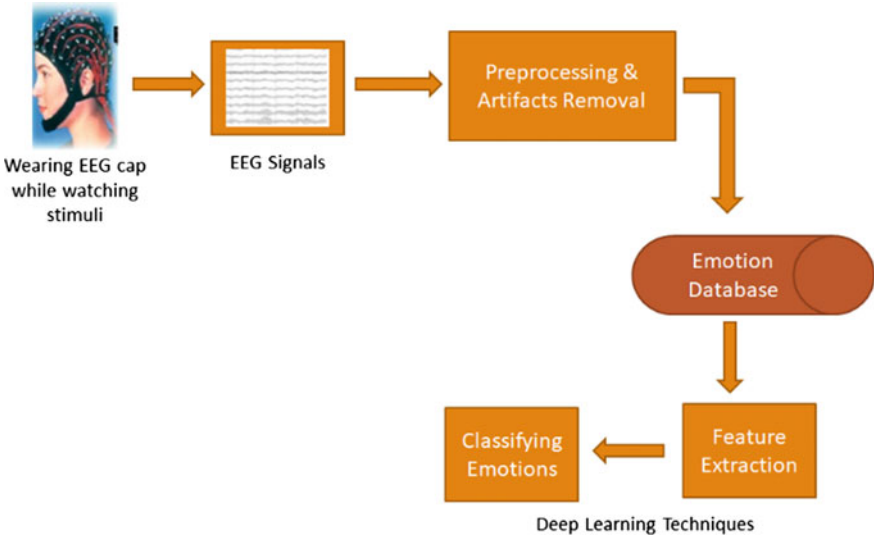

Fig. 1 Proposed emotion detection using EEG

1. **Data Collection**: As we can see in above diagram the data collection is through the electrodes placed on scalp of the subject. Then the subject is being made to watch different scenarios of emotions with help of videos which make the subject go through different emotions and the recordings are being collected.
2. **Pre-processing**: The moment the signals are received through data collection part, these signals are much immune to noise or artifacts. This is to be removed by the process known as Pre-processing, where a data base is being created after all artifacts are removed.
3. **Feature Extraction:** Once this happens the main features which are essential are extracted using Machine learning or deep learning concept, where these extracted features are given to algorithms where emotions are classified.
4. **Classification:** A deep classification is done according to the algorithm assigned where as in this study the scaling done at extraction stage, where indicators are used to obtain emotion.

Human emotion detection is being used in different applications where detection of emotions plays important role, it helps therapists in treating mental disarranges like chemical imbalance range issue i.e. autism spectrum disorders (ASD), anxiety disorders etc. [5]. According to author classification was done into four discrete emotions as: “happy”, “sad”, “angry” and “relaxed” shown in Fig. 2 using Russell’s Circumplex graph [6]. This model explains how emotions of human being are divided into four scales according to positive and negative scale. Detail of this axis is explained by the author in [7].

Classifier algorithm is been made available with all the features of the signal like spectral analysis, wavelet transform and its coherence which makes the algorithm to detect the emotions in their respective scale. Hence task specific extraction and classification features are to be studied for enhancing accuracy of Emotion detection [8].

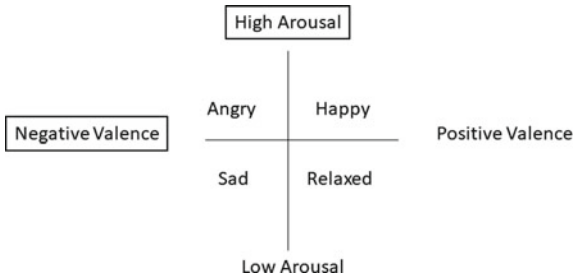

Fig. 2 Russell’s circumplex graph

2 Literature Review

By analyzing overall trends and comparison of different extraction methods, classifiers using different techniques we have found many papers which have explored and found out ways to increase the accuracy, efficiency and reliability.

At the beginning we went through explored a multisource Transfer Learning method (TL) [9], here the new technique is used where existing people are sources, and the new individual is the objective. Here various subjects are considered in this study with fixed classifier which recognizes the emotion appropriately, all these are ensembled during test and EEG are transformed in subsequent sessions. Support Vector Machines (SVM) are used as classifiers, where it reduces calibration data and time. The main advantage of this paper found was Fast acquisition of emotion recognition models for new subjects [10].

Zheng and team also proposed a regression model known as graph regularized sparse linear regression (GRSLR) [11], which finds the emotion in very exact method. They have collected 14 subject's EEG emotions and provided experimental results on various features. Here GRSLR was an extension version of conventional regression method by introducing two types in it, one is graph regularization where, it restricts inner manifold structures while data being transferred by reducing the overfitting of trained models. Whereas other is Sparse regularization which is utilized to expand the channel decision by compelling the space of features of every channel with bunch sparsity. They even given an EEG feeling database called RCLS with 14 subjects each having 15 sessions. Advantage of this paper shows adaptively implement channel selection and reduces overfitting for small database.

Narang and team had diagnostic to epilepsy patient. The main objective was to focus on characterization procedures on EEG signs to decide if the patient has experienced epileptic seizure [12]. They have focused on two classifiers, i.e. Artificial Neural Network and Support Vector Machine, and a comparison different assessment parameters is done accordingly. And ANN classifier was found is superior to SVM. The gap they noticed and removed in their survey was inclusion of maximum types of features for analyzing overall classification accuracy and to optimize feature matrix size, decreasing cost and size. Feature extraction of non-stationary signals was done using Discrete Wavelet Transform (DWT) which was proved to be very good. The other featured used for classification were Shannon Entropy, Line Length, Appropriate Entropy and Dominant Frequency. The classification method which they have used is Multi-layer Perceptron Neural Network (MLPNN). But due to not many disadvantages, including moderate convergence, poor reaction to huge scope issues and utilization of client subordinate parameters other preparing calculations were created to improve these parameters. Although Levenberg-Marquardt (LM) algorithm was proved to have convergence factor faster and more stable.

Authors even discussed earlier had worked on four discrete states, specifically happy moment, sad feeling, angry version and relaxed state [6]. The pre-handled signals from the DEAP database were utilized and the Spectral and measurable highlights are separated utilizing DWT, features are arranged utilizing SVM, and

a new Particle Swarm Optimization (PSO) was introduced where it boosted the classifier performance. By doing so the over view of results gave accuracy exactness of 80.625% for a mix of 32 electrodes with a valence and excitement precision of 86.25% and 88.125%. This paper proved SVM gave better performance in overall detection.

Even study had detected epileptic seizure by considering features as a contribution to support vector machine (SVM) [13]. They have decomposed the signals into frequency using DWT. Principal components analysis (PCA) [14], independent components analysis (ICA) and linear discriminant analysis (LDA) was utilized to decrease the element of information and are given as input to a support vector machine (SVM) to find out whether epileptic seizure is positive or not [15]. They have accomplished 3.47% preferable execution over recently revealed outcomes. Arik and team had explored implementations of DBNs (Deep Belief Network) algorithm, where classification is done on multichannel EEG data. They have used EEG data that was recorded and proposed a very good classifier as compared to the three well known classifiers like: SVM, LDA and ELM [16]. They have concentrated on three DBN architectures one was traditional single-stream DBN, next was multiple DBNs and lastly multi-stream DBN. Hence, they could prove effectiveness of DBN. Study was even done on [17] evaluating a different feature extraction method, and the complete emotion extraction is done using de facto standard dataset (DEAP). Here various frequency bands and EEG channels are used for feature extraction. Hence a new algorithm was proposed, known as minimum Redundancy Maximum Relevance Feature Selection with feature selection and classification using SVM was seen. They even expanded significance of features and EEG areas as compared to the (pre-) frontal and left fleeting projection for EEG emotion grouping.

It was even seen that subject independent emotion recognition technique from EEG signals were studied. A feature extraction technique known as Variational Mode Decomposition was used with classifier as Deep Neural Network. Benchmark used was DEAP dataset and blend of VMD and Deep Neural Network performs better contrasted with the best in class strategies in subject-free emotion acknowledgment from EEG [18].

Authors have employed Independent Component Analysis and Machine Learning techniques such as Support Vector Machine and Linear Discriminant Analysis to vary EEG signals into seven different emotions. They have used a independent dataset while proving that deep learning strategies can separate between ordinary versus irregular EEGs [19]. Classification between normal vs abnormal EEGs could be done in a very simple and accurate method.

Wei-Long have focused on EEG-based effective idols without labelled target data using transfer learning techniques (TCA-based Subject Transfer) where he proves accurate collection of emotions as compared to other techniques. They have used transfer learning and their method which includes three major methods: TCA-based Subject Transfer, KPCA-based Subject Transfer and Transudative Parameter Transfer and for data pre-processing they used raw EEG signals for different entropy (DE) feature extraction. Their results significantly outreached 19.58% [9].

Group of authors have [20] proposed enhanced Semi-Supervised Learning technique to enhance the low results of a classifier task this could even give a solution to noise accumulation problem. They have improved performance of algorithm during supervised phase under audio video feature extraction. It has proved that using SSL technique was best to classify EEG signals with higher accuracy.

K.G. van Leeuwen have prepared a profound convolutional neural system on a heterogeneous arrangement of 8522 routine EEGs from the Massachusetts General Hospital [21], they even found optimizing performance including age and rest stage. The final results are little improving with consideration of age factor and sleep stage factor but not above average. But still they tried on independent data set which could not improve the results finally.

Field of deep learning is focused by Gao et al. [22], they have shown an optimization of model construction, they have focused on deep learning models such as CNNs. Hence forth they have proposed an automatically streamlining structure utilizing binary coding framework and GPSO to choose different structure. Such existing work focus on models with firm networks. This GPSO method had allowed CNNs to get better performance over dataset available.

3 Conclusion

In this paper, we have gone through few theories and approaches in emotion detection using EEG. Many algorithms were used for extraction and classification of features. EEG signals were used not only to detect emotion detection but also, motor imagery, seizure detection etc. The design of Deep learning network is much useful to get enhanced accuracy of our emotion detection. Many available datasets were analyzed in many of above studies. Generally, CNN's, ANN's and DBN's outperformed as compared to others. But still we have gone through papers who gave good results enhancing accuracy of emotions and even we have shown work so far done using EEG.

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Hybrid Beamforming Based on Kalman Filter Pre-coder for Millimeter-Wave Massive MIMO

Gayatri D. Londhe and Vaibhav S. Hendre

Abstract The tremendous growth in telecommunication and 5G increases the demand for immense data traffic and throughput. A vast increase in the population increases the need for efficient spectral capacity of the network. The massive MIMO uses multiple antennas, which further adds interference in the network. In this paper, Hybrid beamforming based on Kalman filter-based hybrid pre-coding is used to improve the mm-wave massive MIMO network's spectral efficiency. The performance of the proposed system is compared with existing state of arts and simulation results of Kalman based hybrid beamforming have shown significant improvement in spectral efficiency.

Keywords Massive MIMO · Beamforming · Hybrid beamforming · Kalman filter

1 Introduction

A Beamforming is a signal processing technique used for directional signal transmission and reception. Beamforming helps to focus the wireless signal towards a specific directional receiver, despite spreading the signal in all directions from the transmitter antenna. The beamforming helps to deliver a high-quality signal to a receiver. It helps to minimize the interference caused due to other devices trying to capture other signals [1]. In beamforming, antenna elements are organized in an array in which the beam steering towards a particular direction is considered while the rest of the beams are neglected. Beamforming is a massive MIMO that provides improved spectral efficiency, superior system security, better energy efficiency, and applicability to mm wavebands [2].

MIMO has gained wide attention because of the huge growth of users and elevating demand for huge amounts of data. It provides a gateway for improving the spectral efficiency in a wireless network. Massive MIMO is an arrangement of multi-user MIMO (MU-MIMO). Many broadcast antenna elements at the base station and a large number of receiving antenna elements are deployed at the device. In massive MIMO,

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100 or 1000 transmitter antenna elements are connected to the base station continuously works for tens or hundreds of receiver antenna elements. The use of a multiple antenna elements can increase spectral efficiency and capacity. Again, it leads to the interference that can be tackled by the deployment of beamforming antennas instead of traditional antennas. Massive MIMO provides improved throughput performance, low power, low-cost components, and efficient spectral capacity. Nowadays, 5G can handle 1000 $\times$ data traffic compared with 4G system. To meet the requirement of 5G there is a need to shift from the existing frequency band to the millimeter-wave frequency band (mm-wave-30–300 Gz) that provides larger bandwidth. In mm-wave system, the antenna array is enormously small because of the small size of the wavelength and sharp beamwidth. The maximum distance between the base station (BS) and the user is in few 100 m. Depending upon the bandwidth of the signal, beamforming techniques are divided into narrowband and wide beamforming. Wideband beamforming has provided higher speed and capacities in mm-wave beamforming [3].

In this work, Kalman filter-based hybrid pre-coding scheme is presented for hybrid beamforming in mm-wave massive MIMO. The performance of the proposed implementation is evaluated based on spectral efficiency.

The remaining paper is structured as: Sect. 2 gives the related recent work on hybrid beamforming. Section 3 provides details about the proposed scheme. Section 4 offers the experimental results and discussion. Further, Sect. 5 presents the conclusion and future scope of the work.

2 Related Work

Various schemes have been implemented in the past for the hybrid beamforming to improve the spectral capacity of the communication network. Alkhateeb et al. [4] used joint scheme for the selection of best RF combiner and beamformer to get higher spectral efficiency. Further, they have used zero forcing pre-coding to minimize the interference in the network. Further, Nguyen et al. [5] proposed hybrid MMSE pre-coding scheme for the improvement of spectral efficiency and interference minimization in mm-wave multiuser MIMO network. Hussein and Khamiss [6] presented low complexity hybrid minimum mean square error (MMSE) pre-coding scheme for the massive MIMO. It has given less computation complexity and good spectral efficiency. Mao et al. [7] investigated minimum sum-mean-square error (min-SMSE) to develop the digital combiner/pre-coder to get minimum bit error rate (BER). Further to minimize the error they used an over-sampling codebook (OSC) to design analog combiner/pre-coder. Li et al. [8] explored Gram-Schmidt algorithm and MSME technique to deal with inter-user interference at digital and analog beamforming with lower dimensional effective channel matrix.

3 Proposed Methodology

The proposed mm-wave massive MIMO consist of fully connected structure where each transmitter antenna is connected to each RF chain and each receiver antenna is connected to each receiver RF chain. The equivalent channel is obtained using Saleh–Valenzuela model [9] which describes the spatial properties of the mm-wave communication system using Eq. 1.

$$H = \sqrt{\frac{N_t N_r}{N_{cl} N_{ray}}} \sum_{i=1}^{N_{cl}} \sum_{j=1}^{N_{ray}} \beta_{i,j} \cdot a_r\left(\alpha_{i,j}^r, \beta_{i,j}^r\right) \cdot a_t\left(\alpha_{i,j}^t, \beta_{i,j}^t\right)^* \tag{1}$$

where, α and β represent azimuth and elevation angle of angle of arrival (AoA) and angle of departure (AoD) respectively. N_{cl} and N_{ray} stand for number of clusters and scatters respectively.$\beta_{i,j}$ represents the path gain. a_r and a_t corresponds to antenna array vector at transmitter and receiver.

The Kalman filter minimizes the error between transmitted and estimated data to select the proper beamforming to achieve higher spectral efficiency [10]. The Kalman filter state equation for digital beamforming matrix F_{BB} can be given using Eq. 2.

$$F_{BB}(n|n) = F_{BB}(n|n-1) + K(n)E\{\text{diag}[e(n)]\} \tag{2}$$

K(n) represents the Kalman filter gain which is updated for every iteration using variance of Kalman state matrix R(n), covariance matrix of noise Q_n and transpose of equivalent channel matrix H_e^H using Eq. 3.

$$K(n) = R(n|n-1)H_e^H[H_e R(n|n-1)H_e^H + Q_n]^{-1} \tag{3}$$

The variance of Kalman state matrix is computed using Eq. 4.

$$R(n|n) = [I - K(n)H_e]R(n|n-1) \tag{4}$$

The error e(n) between transmitted and estimated pre-coding matrix can be calculated using Eq. 5.

$$e(n) = \frac{s(n) - \hat{s}(n)}{s(n) - \hat{s}(n)_F^2} \tag{5}$$

The error signal calculated using Kalman filter by considering effective channel matrix H_e and baseband pre-coder F_{BB} as given in Eq. 6.

$$E\{\text{diag}[e(n)]\} = \frac{I - \widehat{H_e} F_{BB}(n|n-1)}{I - \widehat{H_e} F_{BB}(n|n-1)_F^2} \tag{6}$$

The hybrid pre-coder based on Kalman filter can be updated as given in Eq. 7.

$$F_{BB}(n|n) = F_{BB}(n|n-1) + K(n)\frac{I - \widehat{H_e}F_{BB}(n|n-1)}{I - \widehat{H_e}F_{BB}(n|n-1)_F^2} \tag{7}$$

The performance of the proposed algorithm is evaluated using spectral efficiency as given in Eq. 8. W_{RF}, F_{RF}, I_{NS}, and W_{BB} symbolizes analog merge matrix, analog beamforming matrix, identity matrix of users, and digital merge matrix respectively [15].

$$R = \log_2(\det[I_{N_s} + \beta_p(W_{RF}W_{BB}) + H_eF_{RF}F_{BB} \times F_{BB}^*W_{RF}^*H_e^*W_{RF}W_{BB}]) \tag{8}$$

where, $\beta_p = \frac{P}{N_s}$ where P stands for average broadcasted power of sender.

4 Experimental Results and Discussions

The proposed system is realized using MATLAB programming on the personal computer having core i3 processor, 8 GB RAM on the windows environment. The uniform planar rectangular structure of the transmitter and receiver antenna array is shown in Fig. 1.

The extensive experimental results show that increasing the number of users decreases the network's spectral efficiency, as shown in Fig. 2. The spectral efficiency has shown improvement when there is an increase in transmitter and receiver antenna elements, as shown in Figs. 2 and 3. The number of transmitter antennas is always kept greater than the number of receiver antennas because of the device's tiny

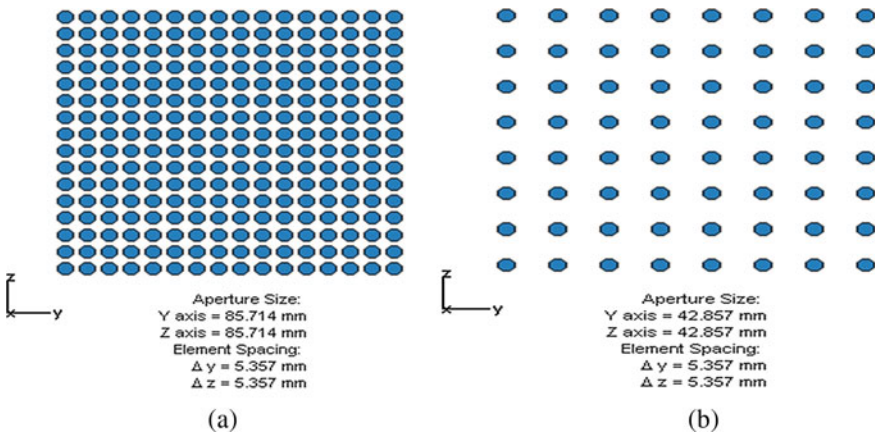

Fig. 1 Uniform planar rectangular antenna array. **a** Transmitter. **b** Receiver

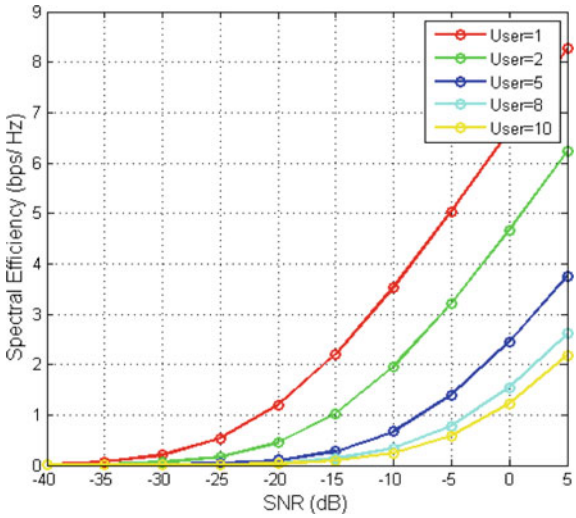

Fig. 2 Performance of SNR versus spectral efficiency for various users

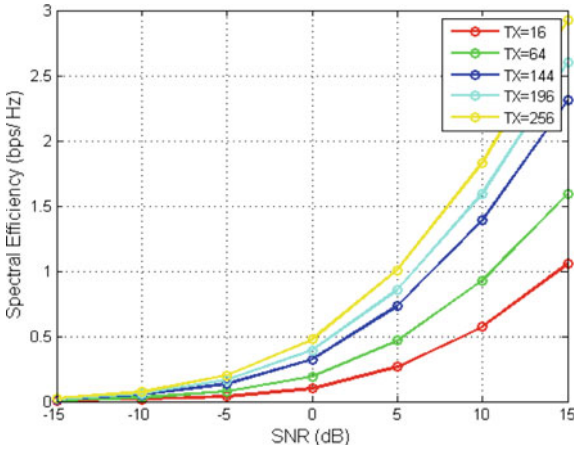

Fig. 3 Performance of SNR versus spectral efficiency for various transmitter antennas

size. It is observed that a higher number of transmitter and receiver antennas giver better performance in a noisy environment.

5 Conclusion

Thus, this paper presents Kalman filter-based pre-coding scheme for the hybrid beamforming in mm-wave massive MIMO. The Kalman filter based hybrid pre-coding technique helps in minimization of error between estimated and transmitted data. It

adjusts the pre-coding matrix to improve the spectral efficiency using hybrid beamforming. Simulation results show that the proposed method provides better spectral efficiency compared to analog beamforming, digital beamforming, and MMSE based hybrid beamforming. Future scope of the proposed work consists of extension of proposed work for mobile scenario, use of joint combiner/pre-coder and incorporation of channel estimation.

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Recent Trends and Techniques of CBIR to Enhance Retrieval Performance

Prajakta Ugale and Suresh Mali

Abstract The vast growth in social media platforms such as Twitter, Instagram, Whatsapp, Facebook, etc. leads to the uploading of billions of images on the web. Content-Based Image Retrieval (CBIR) is essential to improve the performance of the data search. Computer vision research community facing research challenges related to the retrieval of relevant images from large databases. Most of the current search engines use text-based search whose performance highly depends on text Annotation and metadata of the images. In this paper, we aim to present an extensive survey of recent work carried out on CBIR based on various attributes. It also covers the comprehensive review of the recent deep learning based CBIR techniques. Further, it focuses on challenges, constraints, and future scope for further research.

Keywords CBIR · Features · Deep-learning · Image retrieval

1 Introduction

Due to the enormous increase in the use of social media platforms, plenty of images are being uploaded and downloaded per second. Retrieval is the process of extraction of expected data from the pool of data [1]. In CBIR, image retrieval takes place based on the query image's content [2]. Most of the existing search engine uses caption of images or metadata of the images for the CBIR which tends to retrieve incorrect results because of misinterpretation of metadata and content of data [3]. Therefore, there is a need of retrieval algorithm that considers the visual content of the image. The visual content of the image refers to color, texture, edges, shape of the image, or any other self discriminatory characteristics of the image. CBIR's generalized

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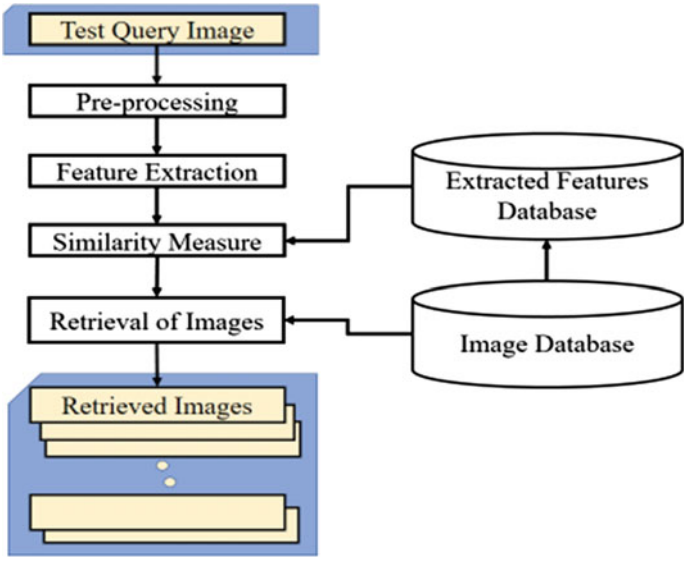

Fig. 1 Generalized process of CBIR

process consists of pre-processing, feature extraction, similarity measure, and data retrieval as shown in Fig. 1 [4, 5].

This paper presents the comprehensive survey of the recent work on CBIR using various techniques based on color, texture, shape features, relevance feedback, machine learning, and deep learning. It focuses on various extracted features, classification algorithms, databases, evaluation metrics, and performance of CBIR.

The organization of remaining paper is given as follow. Section 2 gives detailed comprehensive survey of various CBIR techniques. Section 3 describes the challenges and opportunities in CBIR. Finally, Sect. 4 presents the conclusion and scope for future research in CBIR.

2 Survey of CBIR Techniques

CBIR techniques are broadly categorized into color, texture, shape, relevance feedback, machine learning, and deep learning based techniques as shown in Fig. 2.

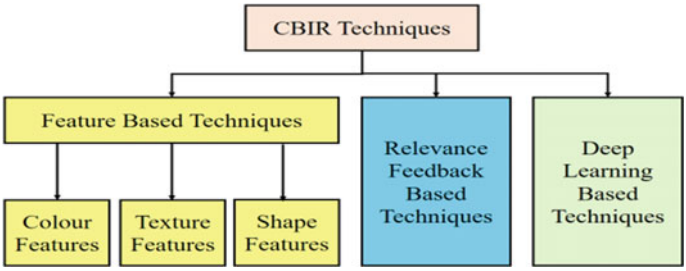

Fig. 2 Taxonomy of CBIR techniques

2.1 Color Based Techniques

Color is one of the essential features of the content-based image retrieval systems for retrieving the image. The first step of color feature extraction is a representation of color space. There are various color spaces such as RGB (Red–Green–Blue), HCL (Hue-Chroma-Luminance), HSV (Hue-Saturation-Value), and YCrCb (Luminance; Chroma: Blue; Chroma: Red) [6]. RGB color space is a combination of three-dimensional planes of red, green, and blue color components. Common techniques for color feature extractions or descriptors in CBIR systems are a color histogram [7], color moment [8], and color coherence vector [9].

Ashraf et al. [10] presented discrete wavelet transform and edge histogram for the color feature extraction of images along with Artificial Neural Network Classifier. There is variation in the accuracy of different classes because of poor image quality and non-robust features.

Hua et al. [11] suggested that the color volume histogram of HSV images has the capacity to represent the color, shape, and texture attributes of the images and can perform better than local binary pattern histogram and multi-texton histogram approaches.

Alsmadi [12] have proposed that Genetic Algorithm (GA) based metaheuristic algorithms that help to improve the CBIR performance for multi-feature approaches.

Artemi and Liu [13] proposed a quantization technique to reduce the bins of color while extracting the features using the improved gray-scale (IGS) method. They used SVM (Support Vector Machine) classifier for image retrieval, which has an accuracy of 80% for 64 color bins.

2.2 Texture Based Techniques

The spatial arrangement of pixels in the image is generally referred to as texture. Texture features consist of directional properties extracted from image texture information [14]. There are six image textures: contrast, directionality, coarseness, line likeness, regularity, and roughness. The texture of the image can be homogeneous

or heterogeneous. Homogeneous textures have a uniform distribution of texture all over the image, whereas heterogeneous textures have a variety or mixing of different textures all over the image [15].

Mistry et al. [16] have used various spatial and frequency domain hybrid features for the CBIR. They have used color moments, color auto-correlogram, and HSV histogram as spatial features, and Gabor wavelet and stationary wavelet transform moments features are used as frequency domain features. It is found that frequency based features give better precision than spatial domain features.

Subash Kumar and Nagarajan [17] explored Local Curve pattern (LCP) that considers the detailed local information beyond the neighbor and hence given improved texture descriptor for the CBIR. Sing and Batra [18] presented two-layered CBIR that consists of image matching based on shape and texture features in first stage and image matching based on shape and color features in second stage.

Cervantes et al. [19] presented LBP and Modified Census Transform (MCT) as local and global features for the CBIR. It has given 85.7% accuracy on the 15 scenes dataset. It is observed that increasing the number of classes decreases the retrieval accuracy.

2.3 Shape-Based Techniques

Shape refers to the region of uniform color or texture in the image. Most of the time, some images may have the same color and texture but different shapes; in such a case, color-based and texture-based approaches perform inefficiently. Edge detection algorithms or segmentation techniques can determine the shape of the object in an image [20].

Fourier shape-based descriptors have been constructed by applying the Fourier transform on the boundary of the shape. Fourier descriptor is known for its robustness and easy derivation. With the help of Fourier descriptor block-based, local shape and global shape of image object can be obtained [21]. Further, the Zernike moments method has been implemented which is also a shape-based descriptor that showed the independence on the boundary of the shape of the object in an image. The drawback of the Zernike method is that it is difficult to obtain higher-order geometric moments of the image [22].

Esther and Sathik [23] have developed the biomedical brain image retrieval system using soft computing techniques. For the feature extraction of brain images, they have used 2D Zernike moment. For the classification of brain image Euclidean distance, quasi Euclidean, city block, and hamming distance have been considered as a similarity measure.

Online similarity learning approach [24] for content-based image retrieval from color invariant edges is by using shape invariant features. For the discriminatory object search, color and shape invariant methods are combined into a higher-order dimensional invariant feature set.

A Geometric Optimum Experimental Design (GOED) [25] has been a novel active learning method to select multiple representative samples in the database. The main problem in GOED can be small-sized training data. A combination of color, shape, and texture attributes can improve the raw feature's discriminative power.

Bhangale and Mohanaprasad [26] offered CBIR using collaborative color, texture, and shape features using color histogram, Local Binary Pattern (LBP), and Histogram of Oriented Gradients (HOG), respectively. Their method has given 82% accuracy on the 102 flower dataset with the help of SVM classifier.

2.4 Deep Learning Techniques

Traditional Machine Learning (ML) based technique's performance highly depends upon the raw hand-crafted features because of poor feature correlation, connectivity, and content description property [27, 28]. Performance of ML based techniques is subjected to the volume of the database, pre-processing techniques, noise, blur, intensity variations, etc. [29, 30]. Recently deep learning based techniques are widely used for the CBIR because of its better representation capability, higher correlation, and connectivity in raw features. Saritha et al. present deep belief network (DBN) to get a higher level of abstraction and distinct feature representation. It has given an accuracy of 98.6% for 1000 images [31].

Tzelepi and Tefas [32] have used CNN for the CBIR training and relevance feedback for the unsupervised retraining of the network to improve the CBIR performance and increase the compactness of the descriptor. On Paris 6 K dataset it has shown mean average precision of 0.83. Li et al. [33] presented the Fully Convolution Network (FCN) and Speeded Up Robust Features (SURF) for the CBIR to improve the feature's discriminancy.

Jin et al. [34] have explored deep saliency hashing techniques to solve the fine-grained object's discriminancy problem in the images. Their method considered a semantic loss, quantization loss, and saliency loss for the network training.

Qayyum et al. [35] presented DCNN for the medical image retrieval to bridge the gap between low level feature semantic and high level human perception semantic. It has given an accuracy of 99.77% for various medical images. The Multi-scalability of CNN can give better spatial and temporal variations of the image which boosts the retrieval performance [36].

2.5 Relevance Feedback Technique

There is a larger semantic gap in the CBIR using low-level image features such as color, texture, and shape; and high-level semantic concepts perceived by a human [37]. Relevance feedback allows the user to suggest proper feedback about the

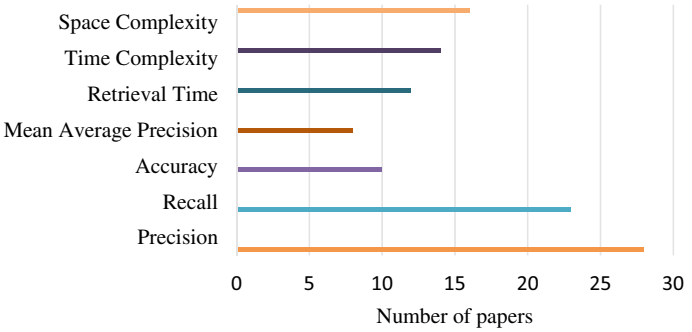

Fig. 3 Performance metrics used in CBIR techniques

retrieval process which further enhances the output of the system. For the improvement of the system, relevance feedback is used which is also called as re-ranking of the process [38].

Relevance feedback means taking feedback for the current result of content-based image retrieval and using it for the next retrieval process [39]. Ahmed [40] investigated the relevance feedback method to improve the CBIR performance using color and texture features extracted using color moment and Gray Level Co-occurrence Matrix (GLCM), respectively. It is observed that a combination of relevance feedback with traditional approaches increases the retrieval rate.

Li and Yuan have proposed a method for content-based image retrieval based on relative feedback. This method improves the relative feedback precision. Feedback on the images is taken from the public and then re-ranking the database for the improvement in the content-based retrieval [41].

An early heuristic-based relevance feedback method for content-based data retrieval has proposed to incorporate the nonlinear issue of retrieval. Kernel biased discriminant analysis has been used for analyzing the relevant feedback obtained from the users [42].

A game-based approach for collection of image annotation has been presented by Seneviratne and Izquierdo [43]. This method allowed the user to annotate the image and tag the image for the improvement of content-based image data retrieval. This approach focused on the social aspect of gaming. The implemented gaming approach has been entertaining and user-friendly [43]. The performance metrics selected by the researchers to evaluate their work are found in Fig. 3. The comparison of various techniques used for CBIR is shown in Table 1.

3 Challenges and Opportunities

- Combining various techniques for CBIR increases the feature vector length and becomes computationally complex. The storage of these feature vectors adds a

Table 1 Comparative analysis of various CBIR techniques

Sr. no.	Year [Reference]	Attribute	Feature extraction	Classification/similarity technique	Database	Evaluation metrics and performance
1	2018 [10]	Color	Edge of histogram and discrete wavelength transform	Artificial neural network	Wang image database	Precision = 0.735
2	2018 [16]	Spatial and frequency domain features	Color auto-correlogram, moments, and HSV histogram	Distance metrics	Corel database	Precision = 0.875
3	2018 [17]	Texture	LCP	X square distance	Corel 1 K, Corel 10 K, Brodatz	Average retrieval precision (Corel 1 k-78.37%, Corel 10 K-43.1% and Brodatz-96.5%)
4	2019 [11]	Color	HSV color volume histogram	L1 distance	Corel-5 k	Precision = 60.13%
5	2020 [12]	Color, texture, and shape	CEH, WT, GLCM, Canny edge method, NCA	Genetic algorithm	Corel datasets,	Precision = 90.15%, recall = 18.03
6	2020 [9]	Color, texture, and shape	HSV histogram, Gabor filter, Zernike moment	Euclidean distance	Corel and GHIM dataset	Average precision = 0.92
7	2020 [33]	Deep features	Fully convolutional network	SURF matching	Wine images dataset (547,857 samples)	Retrieval accuracy = 92.23%
8	2020 [34]	Deep features	Fully convolutional network attention network	Hashing network	CIFAR-10 and NUS-WIDE	Mean average precision (0.37 for CIFAR-10 and 0.57 for NUSWIDE)
9	2020 [13]	Color	IGS	SVM	Coral-1000 dataset	Accuracy = 83.85%
10	2020 [40]	Color, texture, relevance feedback	Color moment and GLCM	Relevance feedback retrieval method	Kvasir dataset	Average precision = 85%

(continued)

Table 1 (continued)

Sr. no.	Year [Reference]	Attribute	Feature extraction	Classification/similarity technique	Database	Evaluation metrics and performance
11	2020 [26]	Color, texture, and shape	Color histogram, LBP, HOG	SVM	102 flower dataset	Retrieval accuracy = 82%

burden on the system memory. Further time is spent during similarity check due to the computation complexity.

- Most of the previous techniques have focused on the same types of images for CBIR; however, developing a generalized CBIR model is challenging.
- Existing systems have shown better performance for the seen data but it gives a poor performance in the case of unseen data.
- Many methods have been used for feature extraction algorithms of images but, an effective method has not been mentioned.
- A fusion of proper algorithms for color, shape, and texture-based feature extraction which results in a high retrieval rate has not been mentioned.
- Many content-based image retrieval techniques have used fewer databases for implementation. Large and variety of databases have not been used yet for image retrieval.
- Hence, there is a need for proper feature selection technique that can consider salient features from the available raw features.

4 Conclusion

Thus, this paper presents a comprehensive survey of CBIR techniques based on color, texture, and shape features, machine learning techniques, and deep learning techniques. It is noted that the fusion of several low level features can improve the CBIR performance. Machine learning techniques have shown significant improvement in CBIR performance but its performance depends upon traditional handcrafted features and it has poor performance for the larger dataset. Further, deep learning techniques have helped to construct robust features that enhance the CBIR performance. In the future, there is a need to use fine-tuning of the ML and DL based approaches to avoid over fitting. Proper feature selection techniques can be applied for collaborative CBIR to minimize the memory required to store the feature vector and time required for similarity match. In the future, there is a need to focus on an unsupervised and more generalized model for CBIR that can retrieve any type of image.

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Device to Device Communication for Next Generation Cellular Network: A Survey

Priyanka Patil and Vaibhav Hendre

Abstract Device-to-Device (D2D) communication has emerged as a promising solution for improving spectrum utilization in next generation cellular networks. Efficient utilization of available resources, reducing latency, improving data rates, and increasing system capacity these are the main advantages of D2D. Existing surveys on this technology focused on the recent advances in various D2D domains such as the discovery process, mode selection schemes, interference management and resource management.

Keywords Device-to-device (D2D) communication · Device discovery · Interference management · Recourse allocation · Mode selection

1 Introduction

The Fifth generation (5G) cellular wireless networks are expected and fulfill the demands in cellular network by providing higher data rates, lower end-to-end latency, and lower energy consumption for devices. To achieve these requirements, a lot of new technologies are introduced in 5G. Such requirements need special technologies to be deployed. The technologies like D2D, Massive Multiple Input Multiple Output (MIMO), Beam forming, Cloud computing, millimeter Waves (mm Wave), Cognitive Radio (CR), Full-Duplex (FD), Non-Orthogonal Multiple Access (NOMA), Green communication, Energy harvesting, are under research to meet 5G needs [1]. Specifically, D2D communications require resource management techniques, device discovery mechanisms, intelligent mode selection, recourse allocation and management, robust security and mobility management procedures. Many research studies in D2D communications that aimed to improve spectral efficiency and interference management [2].

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2 Classification of Bands

In terms of spectrum usage, D2D communication is primarily classified into two types.

2.1 In-band D2D Communication

Here, cellular communication and D2D communication use the same spectrum licensed to the cellular operator. The licensed spectrum may be either divided into non-overlapping portions for D2D and cellular communication respectively (overlay) or may not be divided at all (underlay). In the In band technique Underlay D2D communication devices are only allowed to work under cellular users with the expectation. Overlay communication works only in the vacant spectrum therefore approach is inefficient [3].

2.2 Out-band D2D Communication

In the out-band resource allocation; an unlicensed spectrum is utilized for D2D communications where there is no interference between the cellular users and D2D users. The out-band resource allocation is divided into two types controlled and autonomous. In the controlled out-band resource allocation, the D2D users are controlled by the cellular network. In the autonomous out-band resource allocation; the cellular network does not have such control on the D2D communication [4] (Fig. 1).

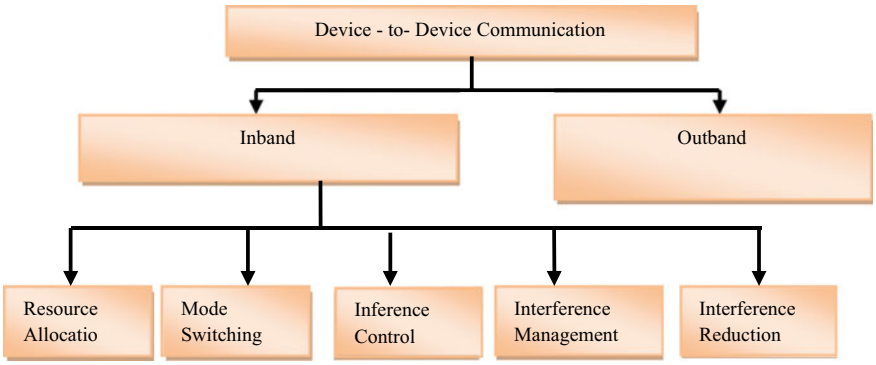

Fig. 1 Classification of bands

3 Integrated Features

3.1 D2D Integrated with Millimeter Wave (mm Wave)

Millimeter wave is most promising technology of next generation network. Effective utilization of bandwidth is possible by enabling D2D communication in cellular network. A scheduling mechanism in mm wave small cell D2D transmission has been proposed in [5]. mm Wave cellular network using D2D communication supports a number of direct concurrent links which results improvement in network capacity with minimum latency and enhance throughput but some challenges are occurs like hardware design, additional interface and interferences [6].

3.2 Internet of Things (IoT)

IoT network performance requires minimum energy consumptions, supporting interoperability and big data handling for different applications. By applying D2D in IoT it fulfill all the requirements. Resource allocation and optimization is very important aspect in multi cell D2D communication for internet of things which is explained in [7].

3.3 Artificial-Intelligence (AI)

AI plays very important role in cellular network because it have a capability to manage resources for massive capacity, reduces interference and nonlinearities of RF components and also it supports network optimization for quality of service (QoS) [8]. By enabling D2D technology with AI it offers more throughput and improvement in QoS [9].

3.4 Handover

When devices are working under D2D communication they selects neighbor cells at some time or other. When they are in close proximity they select a joint handover, if device may not be in proximity it results in half handover [10]. In [11] method of handover procedure for D2D communication is proposed.

Table 1 Summary of device discovery methods

Sr. no.	Method of discovery	References
1	Centralized discovery and distributed discovery	[15–17]
2	In band discovery and out band discovery	[18, 19]
3	Power based and message based discovery	[17, 18]

3.5 Ultra Dense Network (UDN)

Ultra dense networks (UDN) deployment support future wireless network and fulfill user demands. Integrating UDN with D2D results in improvement of different important factors like power consumption, energy efficiency, deployment of large small cells, traffic offloading etc. [12].

3.6 Cooperative Communication

In D2D communication when distance between the users is not sufficient for communication [13] cooperative communication used which improves the quality of D2D communication in data offloading between user equipment's (UE's).

4 Challenges

4.1 Peer Discovery

The demand of D2D communication is more in recent trends. So to fulfill the network requirement there should be an efficient method for discovering peers. Which means users should be discover nearby user with low power consumption. Peer discovery is divided in to two categories (a) Restricted Discovery. (b) Open Discovery [14] (Table 1).

4.2 Resource Allocation (RA)

Resource allocation is important term in D2D communication to improve system performance by considering power consumption, time and available spectrum. In [20] different resource allocation algorithms and methodologies are analyzed and evaluated. As per the involvement of base station in RA spectrum allocation and

Table 2 Resource allocation algorithms with system parameters

Sr. no.	Parameters	Algorithms
1	For secure resource allocation	1. Perfect channel cross-layer optimization resource allocation algorithm [21] 2. Constrained DA algorithm [22] 3. Coalition formation [23]
2	To improve energy efficiency	1. Lagrangian decomposition based (LDB) method [24] 2. Subcarrier assignment [24]
3	Channel allocation	1. Channel allocation algorithm the coalition formation algorithm for the D2D [25] 2. Pairs resource allocation [23]

Table 3 Summary of mode selection and resource allocation algorithms

Sr. no.	Parameters	Algorithms
1	For mode selection and resource allocation	-Multiuser mode selection, resource allocation and scheduling algorithm [27] -Optimal mode selection in local route, direct, and relay D2D communications [28] -A distributed mode selection algorithm based on evolutionary game [26]

management can be carried out by two different allocations (a) Centralized (b) Distributed (Table 2).

4.3 Mode Selection

In D2D cellular network UE's can communicate with base station directly which improve the performance in the form of delay and network throughput. In this case mode selection is very important aspect in D2D communication. Total four mode selection categories are available [26]. (a) Pure cellular mode, (b) Partial cellular mode (c) Dedicated mode (d) Underlay mode (Table 3).

4.4 Interference Management

In D2D technology interference between D2D users and CU's is one of the main challenge. If CU's and D2D users uses same cellular resource then it leads to an interference issue. Interference management is subcategorized in three parts. Depending upon the mode of operation D2D users suffer from intracellular and intercellular interference (Table 4).

Table 4 Summary of different interference algorithms

Sr. no.	Parameters	Algorithms
1	Interference control	-SB (sub band) assignment and intra cell RB (resource block) allocation [29]
2	Mode selection	-CLPR (combined link-selection, power-adaption, and mode-selection) [30]
3	Power allocation	-Iterative distributed power allocation [31] -CLPR [30]

5 Conclusion

D2D communication in cellular technology focuses on different prototypes, advantages, integrated technologies, classification and applications. Different integrated features supports to multiple interdisciplinary applications. D2D integrated with different next generation trends like mm-Wave, Artificial Intelligence, Handover, Ultra dense network, HARQ etc. which results in improvement of cellular parameters like higher data rates, throughput, efficiency etc. According to recent research in D2D communication resource allocation, mode selection and peer discovery are the most promising challenges. Device discovery with minimum power consumption is most challenging part in peer discovery.

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Emerging Features and Classification Algorithms for Speaker Emotion Recognition: A Survey

Shilpa Jagtap and Suresh Mali

Abstract In the world of Artificial Intelligence, human machine interaction plays a significant role. We want to make our machine to behave more like humans. Emotion recognition system helps us to recognize human emotions. Emotions plays important role in behavior of a person as research says that most of the actions performed by human are based on his or her emotional state. In this paper we are trying to Summarizes recent works in the field of emotion recognition. Survey is conducted for factors like use of speaker specific features, different classification methods used for classification of emotions. It also studies what are the results of use of different techniques. Survey shows that with increase in number of features used and combination of different classification techniques improves rate of recognition. Some emotions like sad and fear are having less accuracy rate for classification.

Keywords Speaker emotion recognition · Feature vectors · Classifiers · Neural network

1 Introduction

Speech signal contains the information which a person wants to give to another. Apart from message it also contains an auxiliary information such as identity of speaker, characteristics of room, handset etc. From the words uttered by speaker we also come to know his or her emotions. Human emotions make very large impact on his behavior. Emotions most of the time controls your thinking, behavior and actions and sometimes emotions can affect human health and causes physical illness. In the world of Artificial intelligence we want to make our machines or robots behave like human being. As a part of this emotion recognition plays important role in human–machine interface. Emotion recognition can also be used in other applications such as Robots, call centers, mobile software, in forensic labs for psychological assessment of a person etc.

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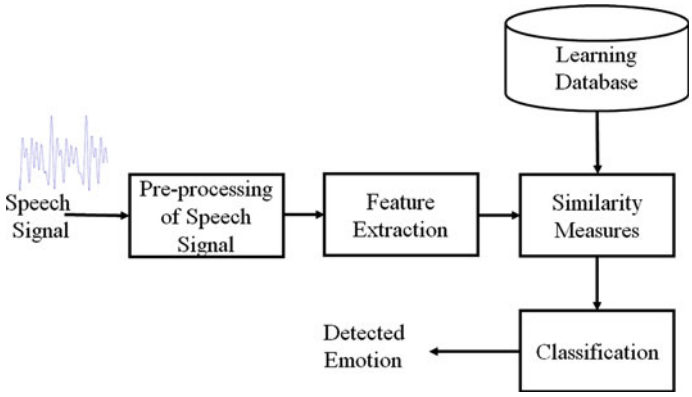

Fig. 1 General block diagram of SER system

Figure 1 shows General block diagram of Speaker recognition system (SER). It consists of block preprocessing of speech signal which is input to the system. Preprocessing may include segmentation of signal, windowing, filtering of signal, detection of voice segments etc.

There are six basic emotions a human have—Fear, anger, happiness, sadness, surprise and disgust. This paper gives insight on different speaker specific features and modeling techniques which are used for speaker emotion recognition.

2 Related Work

A survey has been conducted for different research papers which are based on Speaker emotion recognition techniques used. The survey is mainly focusing on different features used for extraction and different classifiers used detect the emotional state of speaker.

Mencattini et al. [1] have introduced a emotion recognition technique in which single speaker regression models are used. A cooperative regression model (CRM) has been used for classification of speaker emotion. For this purpose Low-Level Descriptors features are used. It shows that from acoustic features system provides better result for arousal than valence.

Xia and Liu [2] proposed the system proposes multi-task learning for leverage activation also information about valence has been gathered. A Deep Belief Network (DBN) framework is used for SER system along with Support vector machine (SVM). Low level descriptor (LLD) are used as features for system. By using both activity detection and valence information, the system shows better performance.

Deb and Dandapat [3] proposed a system which is using vowel like and non-vowel like regions from speech. For feature extraction (Mel frequency cepstral coefficients

(MFCC) has been achieved from both the regions. The main drawback of this system is that the performance varies with change in Databases used.

Zhang et al. [4] proposed a system which is using log Mel-spectrograms (static, delta, and delta delta) as feature for classification. After this AlexNet DCNN model is used for learning high-level features representations on each segment divided from an utterance. DTPM is used for temporal pyramid matching. Finally utterance level features are achieved. Which are further given as input for Support vector (SVM) as classifier.

Chen et al. [5] has proposed a system in which for features learning, a 3D attention-based convolutional recurrent neural networks (ACRNN) has been used. For this Mel-spectrogram with deltas and delta-deltas are used as input. Unlike other SER systems in which sad emotion gets less recognition rate, this system sad emotion achieves high recognition rate compared with happy emotion.

Parthasarathy and Busso [6] proposed emotion recognition system with ladder network. Primary task for system is done for prediction of emotional attributes. The ladder network is used to perform an auxiliary task of reconstructing of intermediate features. For this purpose de-noising auto encoder. As features, a feature vector has been created by using different features such as spectral flux, fundamental frequency and MFCC.

Tao et al. [7] proposed a ladder network which performs two tasks. One task is of minimization of supervised loss and another task is unsupervised cost function. This helps in power discriminative input feature extraction. The proposed system achieves good performance for labelled data of small in quantity.

Ariav and Cohen [8], proposed a system which is used for detection of voice activity in input speech signal. For this purpose a deep residual network (ResNet) is used for feature extraction and WaveNet encoder is used for feature extraction purpose to get audio modality. Further features extracted from both methods are combined using multimodal compact bilinear pooling (MCB) for getting combined representation of speech signal.

Kerkeni et al. [9] proposed a speech emotion recognition using empirical mode decomposition (EMD). This system proposes a feature, modulation spectral (MS) features and modulation frequency features (MFF). In this proposed system combination of different features has been used, such as Mel Frequency Cepstral Coefficients which are based on the Reconstructed Signal (SMFCC), Energy Cepstral Coefficients (ECC) along with Frequency weighted Energy Cepstral Coefficients (EFCC).

Rajan et al. [10] in their research paper, proposed neural network named as End-to-end convolutional-recurrent neural network architecture. This architecture learns features from raw speech data, which are named as conflict-specific features. The overall system performance is good with this new technology of feature extraction.

Gudmalwar et al. [11], proposed a SER system which is focusing on improving performance of SER system. Total 11 number of features were used to generate a feature vector. For classification of emotions ANN has been used. For some features like happy, anger, anxiety, boredom system performance varies with change in database.

Mannepalli et al. [12] in their research paper proposes a SER system which is focusing on use of classifier. In the system, spectral features are extracted from input data. For classification of emotions, Whale-Imperialist Optimization algorithm (Whale-IpCA) is used with Multiple Support Vector Neural Network (Multi-SVNN) classifier. The proposed system shows better performance in speaker emotion recognition.

Peng et al. [13] proposed a SER system which utilizes auditory and attention mechanism. As a feature to be extracted for system temporal modulation cues investigated from front ends of audio. Authors claims that use of temporal cues reduces modulation correlation problem compared with spectral features.

Kadiri and Alku [14] in their research paper proposed a SER system, which is using excitation features as input. Features like strength of excitation and the energy of excitation, instantaneous fundamental frequency are used as excitation features. Once these features are extracted a method of Kullback–Leibler (KL) distance computing is used to measure similarity between distribution of features of neutral and emotional speech.

Busso et al. [15], in their proposes a new database generation which can be used for SER system. The name of corpus is MSP-IMPROV. It is a multimodal emotional database, in which the control has been done for lexical content along with emotions.

3 Speaker Emotion Recognition System

Human speech is a naturally occurring random signal. It contains speaker specific data. Speaker emotion recognition system is used to recognize emotions of speaker. In this speech signal is used as input data. The resonant frequency is approximating around 3 kHz. So while recoding the speech signal minimum frequency should be 8 kHz for faithful reconstruction of signal.

3.1 Feature Extraction Methods

In SER system from input speech different features are extracted and are used for further analysis [17, 19]. Pitch or fundamental frequency, formant, energy of speech signal are some basic features that can be used as a feature. These are prosodic features also called as low level descriptors (LLD) [1, 2]. Features which are derived from speech signal, spectral features get used by many researchers. Features like Mel frequency cepstral coefficients (MFCC) [3, 4], Linear prediction coefficients (LPC), Linear prediction cepstral coefficients (LPCC), Perceptual linear prediction (PLP), Log frequency power coefficients (LFPC) are derived from speech signal.

Out of these MFCC is most popular feature which has been used in emotion recognition. Some of the researchers have combined different features together by forming a feature vector [6, 11, 12]. This in turn helps in improving system accuracy

rate. Few authors have derived new features like temporal modulation cues [13], conflict intensity [11] etc. In few research articles researchers have derived some data from different stages of derived features like MFCC [4, 9], instead of directly using MFCC.

3.2 Classifiers

In SER we are detecting or classifying the emotional state of speaker from speech input. Features are extracted from input speech. By using these features based on which we make classification of feature vectors. For this purpose we use different classification methods. In survey, it is found that most of the classifiers are using different neural networks [18, 20], different traditional classifiers algorithms such Gaussian mixture model (GMM), Hidden Markov model (HMM), Support vector machine (SVM) [2, 4] are used.

Artificial neural network such as deep learning network such as Convolutional neural network (CNN) [4, 5, 16], recurrent neural network (RNN) [4, 10] are also used as classifier in recent years. In some SER systems researchers have used combination of two classifiers to improve system performance [6, 7]. When we use deep learning models, speech signal can be given directly to network. It learns the features itself and removes feature extraction stage from SER.

4 Conclusion

Speaker emotion recognition (SER) is made of different stages such as preprocessing of speech signal, feature extraction, classification. The speech input data can be either acted, natural or elicited. In survey we found different standard databases that can be directly used to train the system. Commonly used features are low level descriptors, in derived features MFCC is the most popular feature. Also combining different features together to form a feature vector also shows improvement in system accuracy. Combination of different classifiers gives better classification results. In most of the systems, real life application is hard to implement. Also emotions like sad, disgust and fear are still gives poor performance accuracy.

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Design and Simulation of 28 GHz Antenna for 5G mmWave Communication

Kailash V. Karad and Vaibhav S. Hendre

Abstract In this paper a square patch type micro-strip antenna structure is designed and simulated at the frequency of 28 GHz for the Rogers RT Duroid 5880 substrate having thickness of 0.508. Nowadays, millimetre wave band has been proposed for the 5G communication to satisfy the demand of high data rate. Due to larger bandwidth availability in mmWave band, the U.S. Federal Communications Commission (FCC) and the European Union (EU) allocated the frequency above 24 GHz for 5G communication. Basically, this band ranges from 30 to 300 GHz out of these frequencies like 28, 38 and 60 GHz are very popular considering the indoor and outdoor applications for future 5G communication. The mmWave signify a beautiful way to deal with eMBB use case particularly in Immersive experience (enhanced mobile broadband), for everything (Massive Machine type communication) and Instant action (Ultra reliable machine type communication). The proposed structure of a micro-strip patch antenna is simulated and analysed for the antenna parameters such as gain, VSWR and return loss.

Keywords mmWave · Micro-strip patch antenna · 5G communication

1 Introduction

In last few years, the number of wireless devices as well as data consumption has continuously increased by an exponential rate. The prices have been abridged for mmWave equipment noticeably because of advancement in silicon manufacturing which is realistic in consumer electronics. With the increased demand of data services, it is very difficult to satisfy with the existing 4G spectrum band because of bandwidth limitation. The alternative to this is to go with millimetre wave band which will satisfy the user requirements and will provide the services at the tip of finger.

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A millimetre wave band has been proposed in the 5G technology to increase the speed of communication, data rate, latency, spectral efficiency etc. [1]. This band typically ranges from 30 to 300 GHz. The frequencies which are identified for the 5G communication are 28, 38 and 60 GHz. The first two frequencies are dedicated for outdoor applications where as third one is best suited for indoor applications considering the absorption of a signal. These frequencies are capable of offering a bandwidth of 500 MHz, 1 GHz and even up to 2 GHz.

The International Telecommunication Union (ITU) and 3 GPP associated on a research plan for 2 phases of 5G standards. The first phase defines the frequencies under 40 GHz for urgent requirement of commercial needs whereas second phase focused on frequencies up to 100 GHz. In order to meet the global standard of mmWave, the ITU has proposed frequencies between 24 and 86 GHz such as 24.25–27.5 GHz, 31.8–33.4 GHz, 37–40.5 GHz, 40.5–42.5 GHz, 45.5–50.2 GHz, 50.4–52.6 GHz, 66–76 GHz, 81–86 GHz [2–4].

Similarly, FCC in the United States after the ITU plan proposed new flexible service rules among the 28 GHz, 37 GHz, 39 GHz and 64–71 GHz bands (Fig. 1).

With ease of frequency availability in mmWave band, Samsung has performed own channel measurements in Feb 2015 and shown that 28 GHz is a workable frequency for cellular communications. Samsung also claimed that mmWave communications link can be supported over a distance of 200 m [2].

Considering the application of mmWave band for 5G communication several antennas can be proposed for high performance like dipole, Horn, MSA (Micro-strip antenna) etc. As the value of frequency is very high in mmWave band, it leads to the smaller size of antenna. Design and fabrication of such antenna at high frequency is a difficult task. At the same, it is also benefitted from space constrain point of view and can be easily accommodated in portable devices as well fitted with small space.

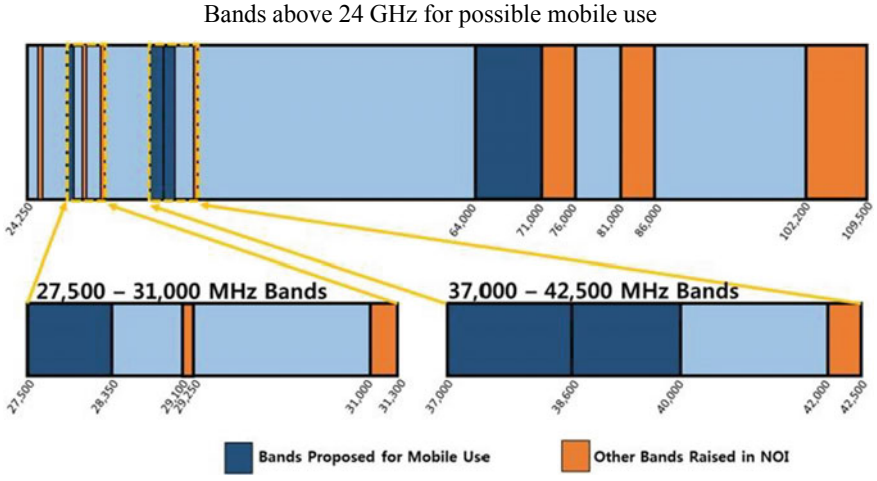


Fig. 1 Proposed bands for mobile use by FCC [2]

Considering all these factors, MSA is a right choice at high frequency because of its low profile structure, simplicity of ease and availability of different types of feeding techniques.

2 Design of an Antenna

A Micro-strip patch antenna has been designed and simulated at the operating frequency of 28 GHz for the substrate RT Duroid 5880 with thickness 0.508 mm, dielectric constant 2.2, loss tangent 0.009 and copper cladding 0.035 mm (trace thickness). Following equations are used to calculate the dimensions of patch antenna.

1. Width of the patch:

$$W = \frac{c}{2f\sqrt{\frac{2}{\varepsilon_r + 1}}} \tag{1}$$

2. Length of the patch:

$$L = L_{eff} - 2\Delta L \tag{2}$$

where,

$$L_{eff} = \frac{c}{2f\sqrt{\varepsilon_{reff}}} \tag{3}$$

and the normalized extension in length is given by,

$$\Delta L = 0.412h\frac{(\varepsilon_{reff} + 0.3)\left(\frac{w}{h} + 0.264\right)}{(\varepsilon_{reff} - 0.258)\left(\frac{w}{h} + 0.8\right)} \tag{4}$$

where, ε_{reff} = Effective dielectric constant, and the equation for it is given below,

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{w}\right]^{\frac{-1}{2}} \tag{5}$$

The radiation impedance of a patch at the edge can be approximated as,

$$Z_a \approx 90 \times \frac{\varepsilon_r^2}{(\varepsilon r - 1)} \times \left(\frac{L}{W}\right)^2 \tag{6}$$

Impedance of transition width is given by,

Table 1 Physical dimension of a proposed antenna

Parameter	Symbol used	Value (mm)
Length of patch	Lp	3.28
Width of patch	Wp	3.28
Thickness of substrate	h	0.508
Trace thickness	t	0.035
Length of feed line	Lf	1.5
Width of feed line	Wf	0.39
Length of ground plane	Lg	6.5
Width of ground plane	Wg	8.5
Length of substrate	Ls	6.5
Width of substrate	Lw	8.5

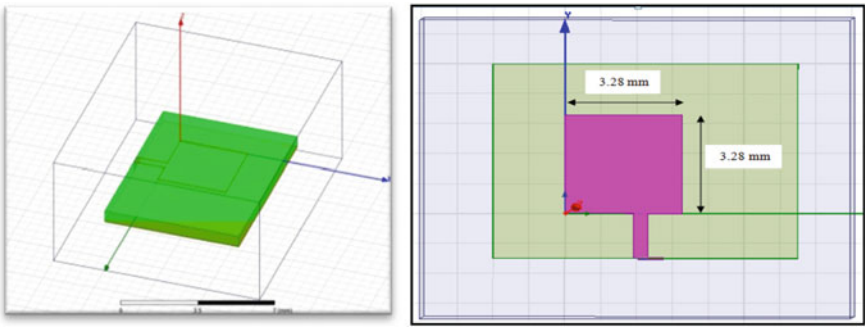


Fig. 2 Geometry model of antenna at 28 GHz

$$Z_t = \sqrt{Z_0 \times Z_a} \tag{7}$$

The summarised parameter values of an antenna design are presented in Table 1.

The designed antenna is implemented and simulated in HFSS software as shown Fig. 2.

3 Results

The designed geometry is simulated in HFSS software to achieve desired results (Figs. 3, 4, 5 and 6).

(see Table 2)

Fig. 3 Plot of S_{11}

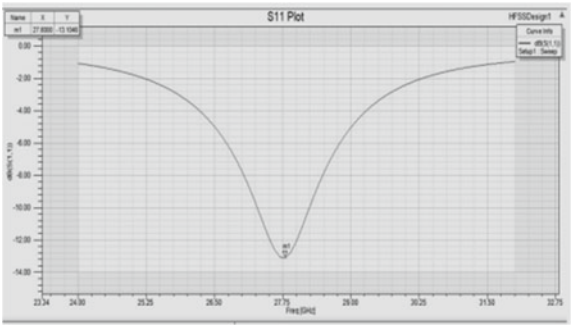


Fig. 4 Plot of VSWR

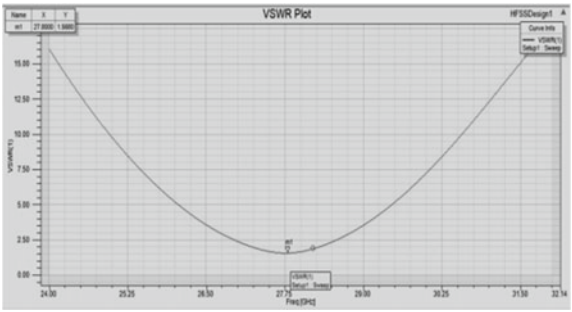
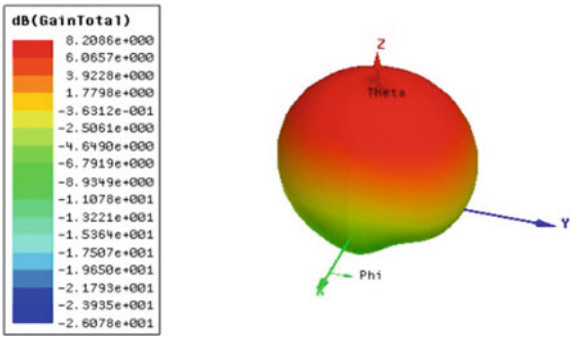


Fig. 5 Plot of total gain



4 Conclusion

As the use of preferred frequencies for 5G technology yet is under deployment from mmWave band. The use of mmWave band will result into large amount of bandwidth which will help to meet the requirements of high speed communication, machine to machine and device to machine communication with increase in the spectral efficiency. A square patch antenna of size 3.28 mm × 3.28 mm is designed and simulated with HFSS simulation software. A micro-strip line feed technique is

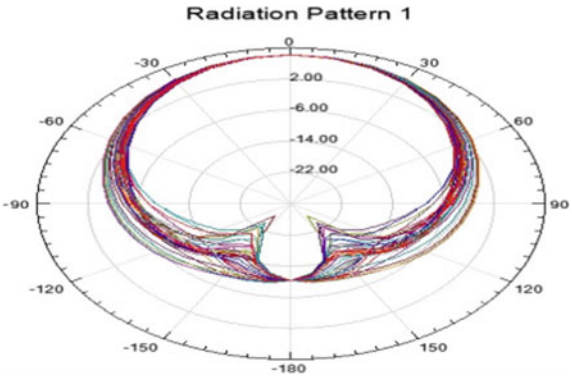


Fig. 6 Plot of radiation pattern

Table 2 Result summary

Sr. no.	Parameter	Measured value
1	Resonating frequency	27.80 GHz
2	S_{11}	−13.1046 dB
3	VSWR	1.5680
4	Total gain	**3.2086**

used to excite and radiate the said patch. The antenna is resonated at 27.80 GHz with the gain of 8.2086 dB. The scattering parameter S_{11} is −13.1046 dB which is giving the bandwidth around 1 GHz.

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Text Processing for Marathi Text-To-Speech Synthesis

Sarang L. Joshi, Vinayak K. Bairagi, and Vastav Bharambe

Abstract A Text To Speech (TTS) synthesizer is a computer based system which converts arbitrary input text into speech. Text processing is the first step which converts the entered text to a sequence of synthesis units, in this paper we have presented the Marathi text processing using python, which is the prerequisite for implementing a TTS system.

Keywords TTS · Speech synthesis · Natural language processing · Text processing

1 Introduction

Speech is one of the most vital forms of communication in everyday life. Marathi is fourth largest spoken language in India and an official language of the Indian state of Maharashtra as well as Goa. Marathi is known to and spoken by over 100 million people not only from India but also from Mauritius and Israel.

User Interfaces for IT applications and services have become more and more prevalent. However, its usage is in English, a language known to only about 2% of Indians. According to Census of India 2011 reports, 17.09% people are illiterate in Maharashtra of which 11,767,278 are female and 5,245,094 are male. As per census 2001, 580,930 people in Maharashtra have disability in seeing.

Developing a Marathi TTS system will not only be useful for people in Maharashtra but also to several migrants coming to the state in search of jobs, business or education.

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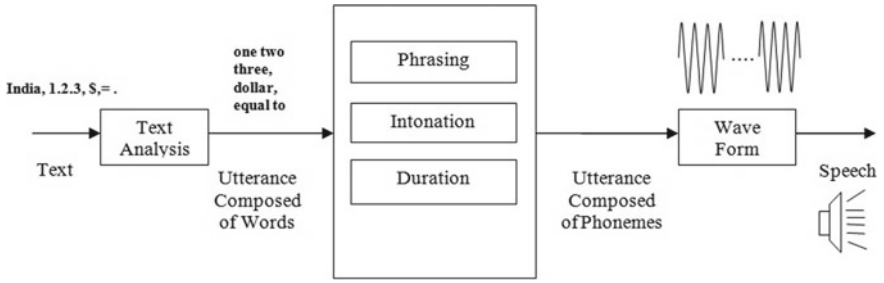

Fig. 1 General framework of a TTS system [1]

2 Text-to-Speech Synthesis

The input text may consists of different numbers (e.g. 8, 3.6, IX), abbreviations such as Mr., Mrs., Prof., Dr., Ar., Er. and/or special characters such as #, &, etc. and/or currency ($, €, £, ₾), punctuation (!, ?,“”), date (23/08/1995), mathematical expressions (=, > , < , ~ , %), acronyms etc. (Fig. 1).

Text normalization is transformation of the input text to a series of pronounceable words e.g. 1838 if a number, to be pronounced as “one thousand eight hundred thirty eight”; however if represents a year then to be pronounced as “eighteen thirty eight”. 23/08/1995 to be pronounced as “twenty third of August nineteen ninety five”. The pronunciation of a certain word may depend on the context. In some cases e.g. currencies, the order of some character and value is changed. For example $30 is converted as thirty dollars while $300 million is to be converted as three hundred million dollars and not three hundred dollars million [1].

There exist different methods for synthesizing speech from input text. The articulatory synthesis is quite rarely used in present systems as it is still very much complicated for high quality implementations. The formant synthesis is rule based and produces unnatural, robotic sounding speech [2]. Now-a-days, the concatenative synthesis has gained the popularity. TTS systems for Sanskrit, Hindi, English, Konkani (Goan), Malayalam have been implemented using concatenative synthesis [3–8]. In this paper we consider concatenative text to speech synthesis method.

3 Speech Units

In concatenative TTS speech is generated by connecting natural, pre-recorded speech units such as phonemes, diphones, triphones, half-syllables, syllables, words or sentences. The unit length affects the quality of the synthesized speech. Longer units, e.g. phrases or sentences increase the naturalness, needs less concatenation points but require more memory to store the large number of units in the database. Shorter units, e.g. phones, require less memory, can synthesize a wide range of words and

sentences but the speech quality is poor [9, 10]. The sample collecting and labelling techniques also become more complex.

3.1 Deciding the Basic Units

The speech units should lead to less prosodic and concatenation distortion for generating natural sounding speech. Table 1 states the advantages and drawbacks of selecting different speech units for synthesis.

Syllables are not influenced by neighboring sound elements, are acoustically and perceptually more stable units than phones. Syllable units perform better than phones, diphones [12]. Indian languages are syllable centered as pronunciations are mainly based on syllables. A grapheme in Indian languages is close to a syllable. Therefore a syllable can be the best unit for Indian language speech synthesis systems.

4 Text Encoding Schemes

American Standard Code for Information Interchange (ASCII) represents upper and lower-case English letters, numbers and punctuation symbols, using numeric codes with 7 bits for each character. Hence, the standard ASCII character set is limited to 128 characters only and can't represent characters from other languages.

ISCII, i.e. Indian Script Code for Information Interchange is a 8-bit coding scheme that represents various writing scripts of India e.g. Devanagari, Gujarati, Gurmukhi, Oriya, Tamil, Telugu etc. Unfortunately, outside of CDAC which promoted ISCII, very few seem to use ISCII.

Table 1 Comparing speech units [11–13]

Basic unit	Pros	Cons
Phones	The database will consist of not more than 50 units	Provide very less co-articulation information across adjacent units, fails to model the dynamics of speech sounds
Diphones	Minimize the discontinuities at the concatenation points	A single example of each diphone is insufficient to produce good quality speech, synthesizers need elaborate prosody rules to generate natural speech
Triphones	Provides more co-articulation information than diphones	Large database required as their occurrence in the language model is rare
Syllables	Requires fewer concatenation points, segmentation of syllables is relatively easy	Naturalness in terms of prosody requires additional processing

Unicode is a universal Single character set with more than 65,000 different characters consisting in one place all the characters needed for writing the majority of languages in use on computers, including ancient scripts along with punctuations, special shapes like mathematical symbols, currency symbols., International Phonetic Alphabet (IPA).

Unicode is standardised while ASCII as well as ISCII aren't. Unicode supports Marathi (Devanagari) script while ASCII does not [14, 15].

5 Database

To build a corpus, a phonetically and prosodically rich text file should be selected which is then read and recorded by a native speaker [10].

Desirable characteristics of database:

- Sentences from diverse sources.
- Grammatically correct, meaningful and natural sentences.

5.1 Text Database

We have collected Marathi text and speech corpus from C-DAC consisting of syllables, most frequently used words, sentences and prosody rich sentences from various fields/domains like Agriculture, Geography, History, Literature, Religion, Science and Technology, Tourism and Economy.

The database consists of: conjunct words: 588, Frequently used words: 969, Marathi Baarakhadi: 423 (including Vowels: 12, consonants: 36), Most frequent sentences: 522, Prosody rich sentences: 516, Vocabulary sentences: 101, Other sentences: 236.

Some of the prosody rich sentences in the database are listed in Table 2.

Table 2 Prosody rich Marathi statements

Statement	Prosody/punctuation
तूझे नाव काय आहे?	Question mark,
तुम्ही ब्रह्मदेव आहात आणि ना	Pause, Jodakshar
कबूतर ताशी 100 मैल वेगानं उडू	Numbers + statement
उषाकडून जोरात पळलं जात	Pause, Anusvara
तो माझं बोलणं ऐकून दुःखी झाला	Visarg (:)
परतताना इकडे येणार ना !	Exclamation
न्यूयॉर्कला आल्यावर नाही,	Comma (,) (pause)

5.2 *Fomart of Input Text*

Marathi (Devanagari) script consists of 36 consonants and 12 vowels (Figs. 2, 3 and 4).

क	ख	ग	घ	ङ	
च	छ	ज	झ	ञ	
ट	ठ	ड	ढ	ण	
त	थ	द	ध	न	
प	फ	ब	भ	म	
य	र	ल	व	श	
ष	स	ह	ळ	क्ष	ज्ञ

Fig. 2 Marathi consonants

Fig. 3 Marathi vowels

अ	आ	इ
ई	उ	ऊ
ए	ऐ	ओ
औ	अं	अः

Fig. 4 Marathi vowel-consonant combination

क	का	कि	की	कु	कू
Ka	Kaa	Ki	Kee	Ku	Koo
के	कै	को	कौ	कं	कः
Ke	Kai	Ko	Kau	Kan/Kam	Kah

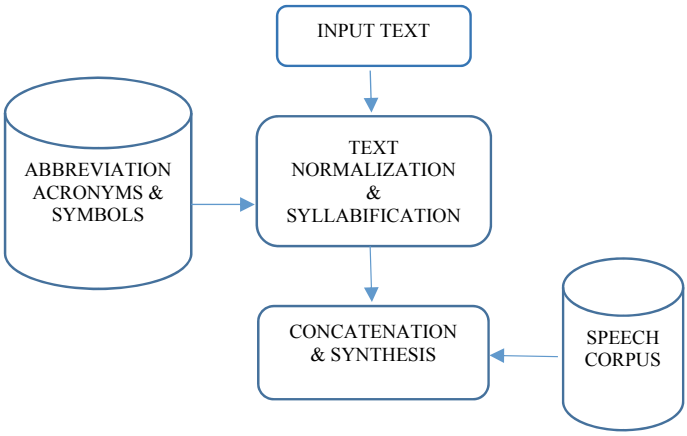

Fig. 5 Text to speech synthesis methodology

6 Methodology

Audio database consists of recorded audio files of consonants, vowels, frequently used words and statements in ".wav" format. Text database consists of the text files corresponding to audio files in the audio database.

6.1 Python for TTS

Python is a general-purpose interpreted, interactive, high-level programming language. With rich set of libraries, packages and support available worldwide, python can be the best option for text to speech synthesis. Python libraries NLTK, Indic NLP, polyglot can be used for text processing of Indian languages [16, 17] (Fig. 5).

The input text paragraph is split into sentences by identifying punctuation marks, sentences are further split into words by identifying white space, words are then split into syllables (CV structures) (Fig. 6).

6.2 Digit Processing Algorithm

1. Check if the user entered input number is greater than 100,000. If no then continue otherwise follow step 5–14.
2. If the number is less than 100,000 and greater than 1000 then follow steps 8–14

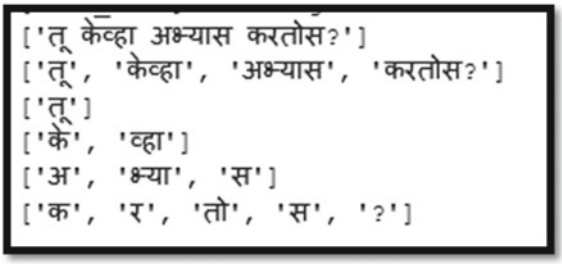

Fig. 6 Splitting sentence into words, syllables and punctuation marks

3. If the number is less than 1000 and greater than 100 then follow steps 11–14.
4. If the number is less than 100 then map the corresponding number in the quo to equivalent Marathi word using dictionary of textual database.
5. Get the quotient of no/100,000 in variable "quotient". Store the remainder of the result in variable "remainder" for further processing.
6. Map the corresponding number in the quotient to equivalent Marathi word using dictionary of textual database.
7. Concatenate with the word " लाख".
8. Get the quotient for rem/1000 in quotient. Store the new remainder in variable remainder for further processing.
9. Map the corresponding number in the quotient to equivalent Marathi word using dictionary of textual database.
10. Concatenate with the word " हजार".
11. Get the quotient for rem/100 in quotient. Again store the new remainder in variable remainder for further processing.
12. Map the corresponding number in the quotient to equivalent Marathi word using dictionary of textual database.
13. Concatenate with the word " शे".

Finally map the corresponding number in the remainder variable to equivalent Marathi word using dictionary of textual database.

6.3 Date Processing Algorithm

(1) Get the input in DD/MM/YYYY format.
(2) Map the number in DD to corresponding Marathi word in dictionary.
(3) Map the number in MM to Marathi word of corresponding month in dictionary.
(4) For number in YYYY follow the steps:

Get the quotient for number/100 in variable "quotient". Store the remainder in variable "remainder" for further processing.

Map the corresponding number in the quotient to equivalent Marathi word using dictionary of textual database.

Concatenate with the word " शे".

Finally map the corresponding number in the remainder variable to equivalent Marathi word using dictionary of textual database.

6.4 Time Processing Algorithm

(1) Get the input in HH:MM format.
(2) Map the corresponding number in the HH to equivalent Marathi word using dictionary of textual database.
(3) Concatenate with the word " वाजून".
(4) Map the corresponding number in the MM to equivalent Marathi word using dictionary of textual database.
(5) Concatenate with the word " मिनिटे".

7 Results

Corresponding English text of entered date in Fig. 7: 10/12/2001.

Corresponding English text of entered number in Fig. 8: 1,234,567

Corresponding English text of entered time in Fig. 9: 12:35.

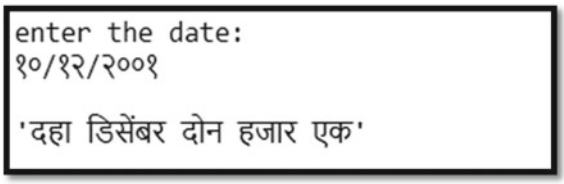

Fig. 7 Text normalization—converting date to equivalent Marathi text

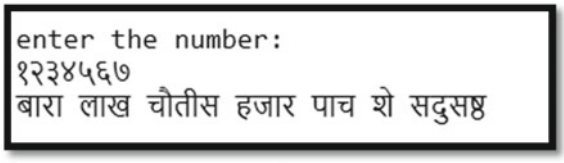

Fig. 8 Text normalization—converting seven digit number to equivalent Marathi text

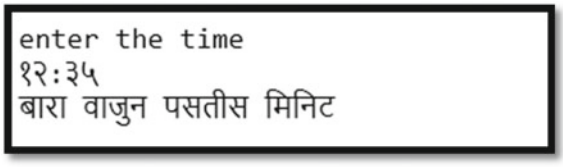

Fig. 9 Text normalization—converting time to equivalent Marathi text

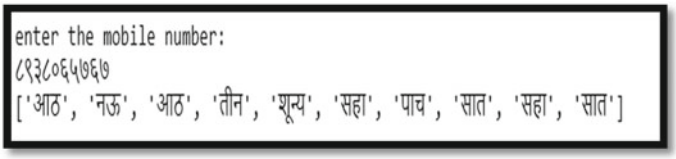

Fig. 10 Text normalization—converting mobile phone number to equivalent Marathi text

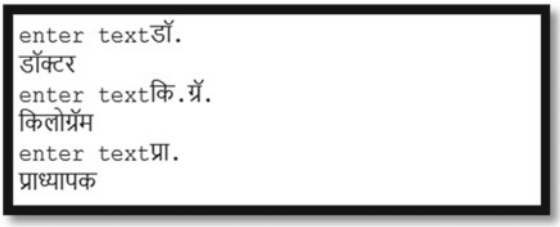

Fig. 11 Converting abbreviations into equivalent Marathi words

Corresponding English text of entered mobile number in Fig. 10: **8,983,065,767**
Corresponding English text of entered data in Fig. 11: Dr., kg., Prof.

8 Conclusion

Speech technology is emerging as the next generation user interface. In a country like India, with relatively lower rates of literacy, the majority of the population is not comfortable using English, hence interfaces in local language needs to be developed to access IT applications, information and services on health, agriculture, travel. As a first step towards developing a text to speech synthesis system, in this paper we have presented Marathi text normalisation using python. We have successfully represented numbers, dates, time, mobile number and abbreviations into corresponding equivalent Marathi pronounceable words. We have also proposed a methodology for Marathi text to speech synthesis.

Acknowledgements The authors are thankful to School of Education, Banaras Hindu University for supporting the research work financially by providing research grant

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Variable Resolution Time Multiplexed Digital Architecture of ADCs for System on Chip Applications

Umashankar R. More, Sanjay N. Talbar, and Ajay D. Jadhav

Abstract Analog to digital converter (ADC) is one of the integral units in most of the real time embedded applications. Recent communication devices like routers, switches, Network on Chip (NoC) and System on Chip (SoC) in mobile chip sets require scalable architecture. One kind of ADC architecture always constrains the programmable SoC to use it for applications demanding other types of ADCs. The work presented in the paper is time multiplexed, digital architecture providing promising solution which will be meet upcoming challenges in development of communication/VLSI and Embedded based applications. For experimentation, digital sections of three ADCs viz. Dual Slope, Folded Pipeline and Successive Approximation with variable resolution capability are considered and optimal design of modified digital architecture is proposed. The architecture is synthesized, simulated for timing issues and implemented on FPGA platform. The work reduces pin count of the SoC during its integration. The results show the trades offs between pin count and chip area without compromising processing time. The synthesis report shows that the modified architecture consumes 65 mW total power at 96 MHz operating frequency with processing time of 7.711 ns and pin count 29.

Keywords ADC · SoC · SAR · FPGA

1 Introduction

In recent developments of VLSI and Embedded systems, designs are constrained due to various design metrics like power consumption, speed of the operation, pin count and area of the chip Many designers employ either general purpose Microcontrollers or SoCs with ADC as an integral part of it.

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A typical ADC architecture is selected as per application requirements. For example, digital voltmeter uses integrating ADCs as it has to exhibit accuracy, linearity at low conversion speed [1]. Data acquisition applications need SAR ADC due to its low power consumption, better resolution capacity, and power efficient but lower sampling rate [1, 2]. For voice band and audio application Sigma-Delta ADCs are better and Pipeline ADCs are part of power-efficient high-speed conversion of wide bandwidth input signals. The pipeline ADC, as compared to SAR, has better sampling rate, high power consumption and limited resolution [3, 4]. Single stage pipeline architecture with feedback employs a comparator, a gain stage, a subtractor and a sample and hold circuit in its analog section. This reduces number of comparators and area requirement [5].

Many Microcontroller families like Microchip, AVR and ARM consist of in-built fixed/variable resolution SAR ADC, and Texas instrument Microcontroller family have 8–12 bits on chip SAR or Sigma delta or slope ADCs. Various attempts are made to increase architectural performance in the direction of resolution optimization, speed and power optimization [6, 7]. In the current scenario, the demand of wireless systems is ever growing for providing multi-standard services as a single chip solution. Such needs strongly specify to design a new class of ADCs those are capable of operating at variable resolution. Variable resolution capability provides the ability to compress the binary data output for slower inputs. It also leads to reduce power consumption [8].

The design of single time-multiplexed digital architecture, comprising of three ADCs is presented in this work and related architectural issues are emphasized. The architecture is compared with individual ADCs' digital architectures on same platform with same operating conditions for performance comparison. The integration of any resource on chip for any Microcontroller/SoC need to consider design aspects like pin count, area, speed of the operation and power consumption. These aspects are considered as in [9].

This programmable eight-bit resolution architecture accepts input from comparator output and implemented on configurable platform to exploit the plurality of applications and performance similar to [10]. The Xilinx ISim IDE is used for functional, timing simulation and synthesis. The design is synthesized on Xilinx Spartan 3E FPGA.

2 Design and Experimentation

HDL modelling approach adopted to design and verify the digital architecture. Figure 1 depicts the diagram of multiplexed digital architectures of three ADCs. The external comparator interface topology, which is not a part of this work, providing input to this digital architecture. This comparator interface topology provides input to all three ADC types but to single type at a time. The components and devices of this topology are termed as external in the paper.

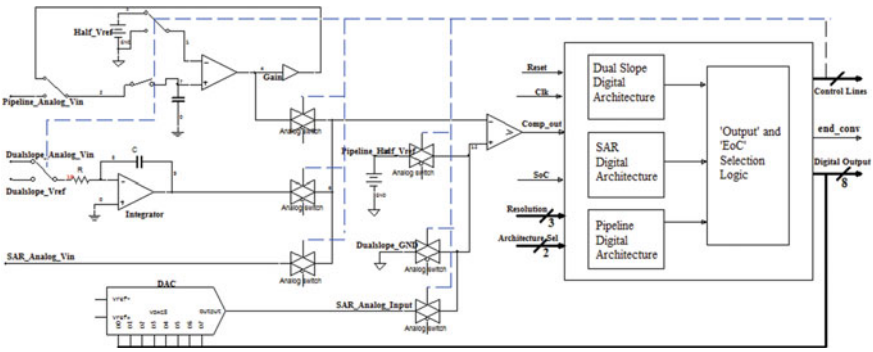

Fig. 1 Block diagram of multiplexed digital architecture of three different ADC's

Signals 'clk' and 'reset' operate as master system control inputs along with user controlled 'start of conversion' signal. The 'digital_out', 'end_conv' and other control signals are the part of output section of this architecture.

2.1 Variable Resolution Digital Architecture: Dual Slope ADC Mode

Selection of architecture among three digital architectures of three ADCs carried out by 'Architecture_Sel' pins. Table 1 shows the selection conditions.

When dual slope ADC architecture is selected in time multiplexed digital architecture (Fig. 1), it operates for variable resolution dual slope ADC using 'clk', 'reset', 'dualslope_soc', 'dualslope_resolution' and 'comp_out' signals. The schematic diagram of Variable Resolution Dual Slope ADC is shown in Fig. 2.

The control logic produces 'dual_slope_latch_en' signal to enable output latch for holding the digital output. Analog inputs 'Vref' and 'Vunknown' are switched through 'dual_slope_sw_to_vref' and 'dual_slope_sw_to_vunknown' signals respectively. 'dual_slope_reset_integrator' signal resets external analog integrator after each conversion cycle. 'dualslope_eoc' indicates end of conversion. 'sig_gen_soc' and 'sig_generic_logic_reset' represent internal signals connected to data path unit of ADC.

Table 1 Digital architecture selection

Sr. No.	Status of *'Arch_sel'*	Selected digital architecture
1	00	None
2	01	Dual slope ADC
3	10	Pipeline ADC
4	11	Successive approximation ADC

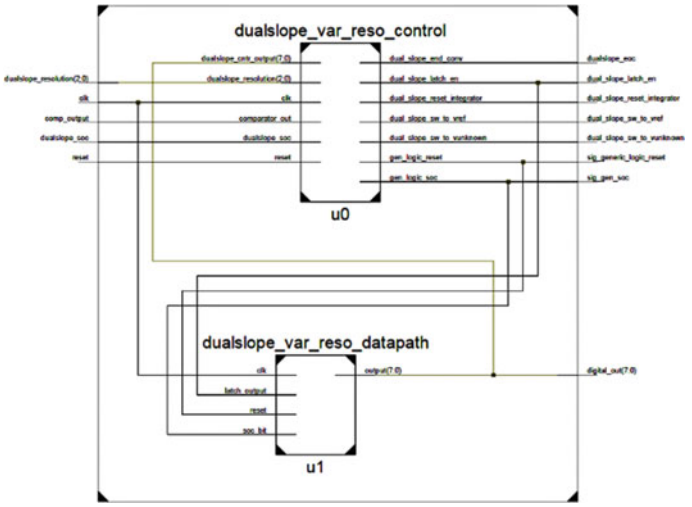

Fig. 2 Schematic diagram of variable resolution dual slope ADC

Data path unit is mod-n ripple binary counter which is configured using programmable resolution bits.

Figure 3 shows functional simulation of this architecture. When external analog integrator gets connected to analog input voltage, counter starts counting for fixed time duration 't1', set by control logic.

After 't1', counter resets and external analog integrator switches to reference voltage. Counter then start counting for time duration 't2' which is directly proportional to the charge acquired by external integrator during time 't1'.

During 't_2', external integrator starts losing charge and reverses the direction of the slope. When external integrator charge gets nullified, external comparator switches to logic '1' and counter is stopped. The count is latched as 'digital_out'; 'dualslope_eoc' and 'dual_slope_reset_integrator' signals become high. In this design switching

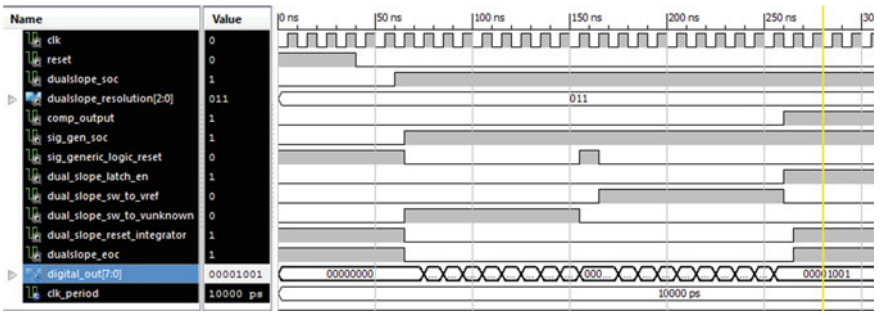

Fig. 3 Functional simulation of variable resolution (4 bit) dual slope ADC

between 'Vunknown' to 'Vref' voltage requires one clock cycle and meanwhile it resets the counter.

2.2 *Variable Resolution Digital Architecture: Pipeline ADC Mode*

Figure 4 depicts the feedback, single stage pipeline ADC with considerations that only one external analog comparator provides input to the digital architecture for all resolutions. Figure 5 depicts hardware realization for this digital architecture with control unit 'pipeline_var_reso_control' and data path unit 'pipeline_var_reso_datapath'.

It operates on 'clock', 'reset', 'resolution', 'soc' signals and analog comparator output. Control unit generates control signals for externally connected switches of input voltage and half reference voltage and controls data path unit using 'reset', 'Mode' of operation', 'soc' and 'rin' signals. When 'Mode' signal is '1' digital output data is shifted from LSB to MSB in data path unit. 'rin' is LSB data input connected to comparator output.

Figure 6 presents functional simulation waveform of this design. When reset is '1', digital output bits are zero. External switch selects analog input 'pipeline_sh_sw_vin' and deselects half reference voltage 'pipeline_connect_to_halfvref'. In the simulation, the start of conversion signal 'pipeline_soc' used to start of conversion and eight-bit resolution is set through 3-bit input 'pipeline_resolution [2:0]'. The signal 'pipeline_eoc' is asserted automatically when resolution meets the set value and 'digital_out' bus registers the output digital data.

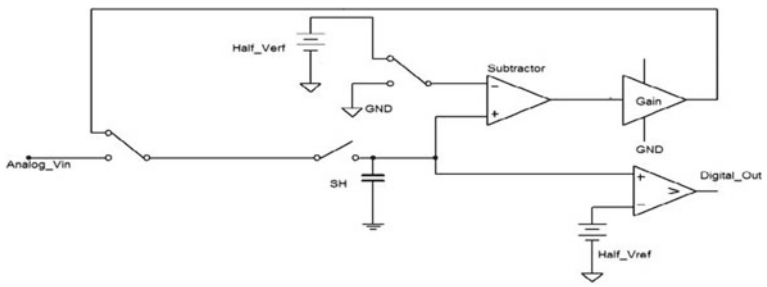

Fig. 4 Feedback pipeline architecture

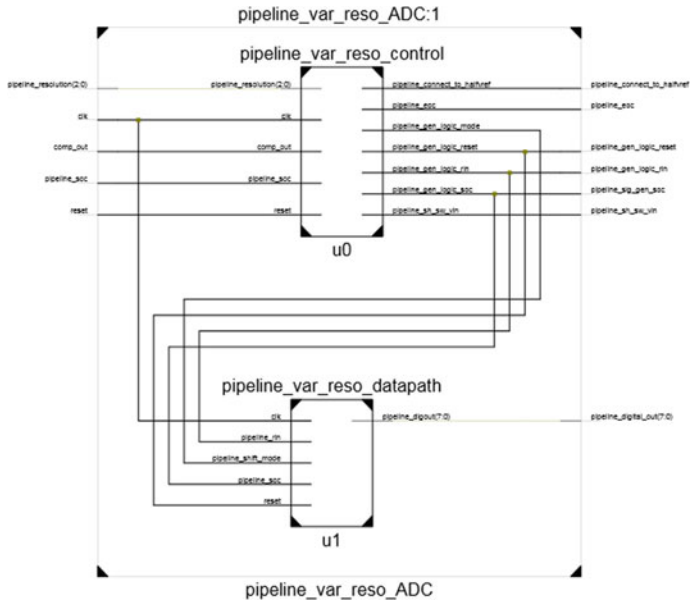

Fig. 5 Digital architecture of variable resolution pipeline ADC

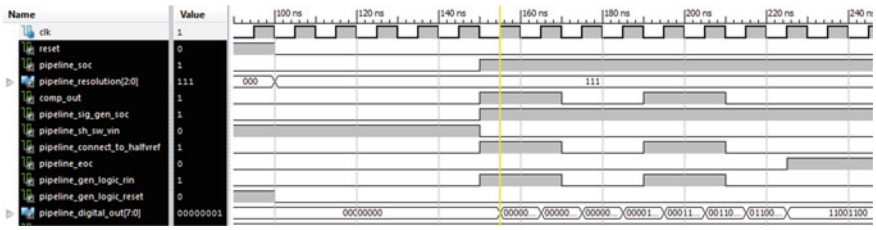

Fig. 6 Functional simulation of variable resolution (8 bit) pipeline ADC

2.3 Variable Resolution Digital Architecture: SAR ADC Mode

In implementation of SAR logic, SAR control unit provides 'resolution' and 'soc' signals to its data path unit. It works on master clock and reset signals. Resolution decoder decodes three bits using one hot logic i.e. "000" means "00000001" and "111" means "11111111" etc. to indicate resolution bits in this SAR logic. Figure 7 shows RTL schematic of digital architecture realized for SAR ADC. SAR logic out is reset to "10000000".

On assertion of 'soc' signal, it polls the external comparator output. The bit is retained to 1 only if analog comparator output is 1 otherwise retains 0. Operation continues for subsequent bits till the limit of resolution.

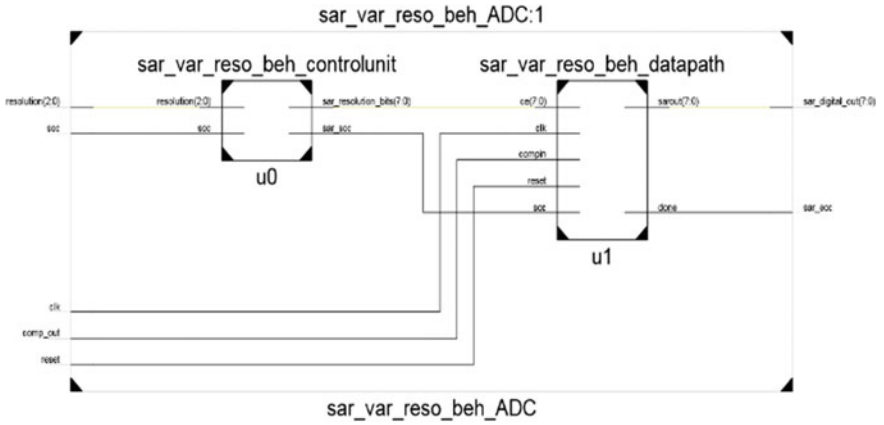

Fig. 7 Digital architecture of variable resolution SAR ADC

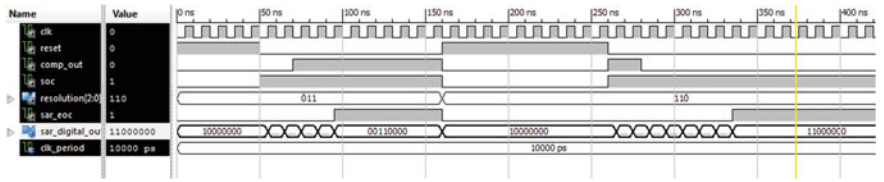

Fig. 8 Functional simulation of variable resolution (4 bit) SAR ADC

After any of these operations, bit next to MSB set to '1' and remaining bits retained as it is. Process continues in subsequent clock cycles till the end of resolution limit. It takes maximum eight clock cycles for eight-bit SAR. Figure 8 depicts functionality of variable resolution SAR ADC for resolution of '011' and '110'. After reset when 'soc' bit asserted, SAR logic starts functioning with "10000000" as 'sar_digital_output'. SAR changes 'comp_out' according to output of external analog comparator. In the last cycle, output latched on 'sar_digital_output'.

2.4 Multiplexed Variable Resolution Digital Architecture

Figure 9 shows multiplexed, variable resolution digital architecture for three different ADCs. It operates on 'reset', 'clock', 'comp_out', 'start_conv' signals and two bits are used for 'arch_sel' to select one of the architectures. Two multiplexers select 'end of conversion signal', output of individual ADC architecture. Table 1 shows selection of architecture using 'Arch_sel'.

Figure 10 shows simulation results for selected 4-bit dual slope mode. Initially 'digital_out' is in high impedance and 'start_conv' is activated after

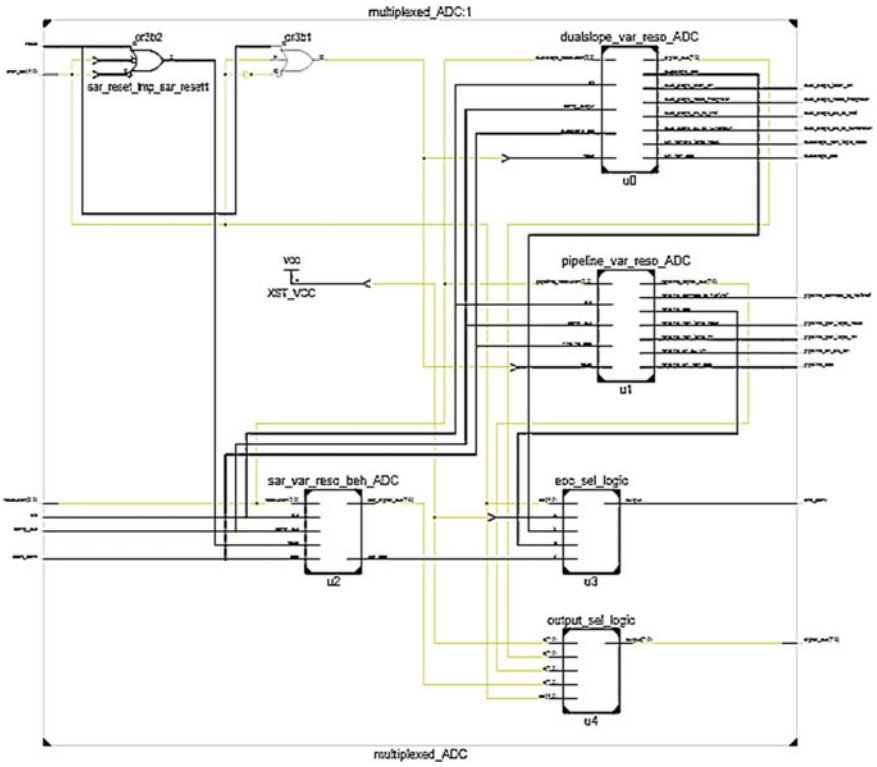

Fig. 9 RTL schematic-digital architecture of multiplexed ADC

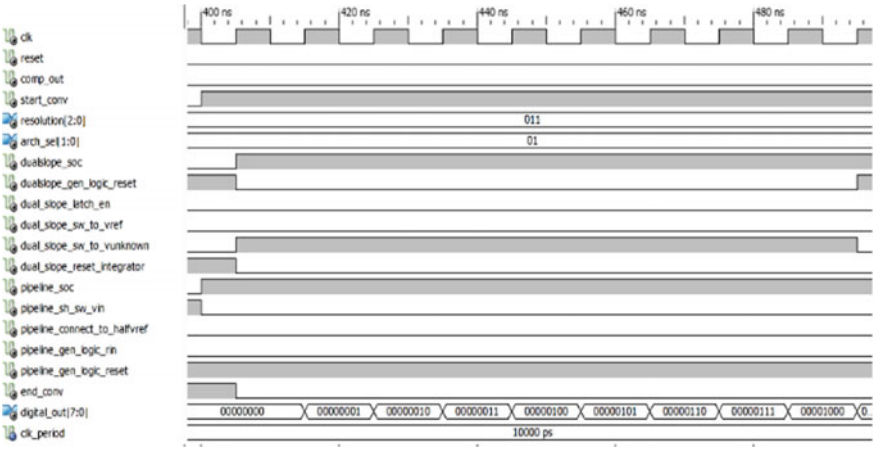

Fig. 10 Simulation of multiplexed digital architecture: 4-bit dual slope mode [Part A]

deactivating reset. When 'start_Conv' activated, 'Dualslope_Soc' is asserted, signal 'Dual_slope_sw_to_vunknown' selects unknown analog input, signal 'dual_slope_reset_integrator' deactivated. On terminal count, external digital logic changes from 'Vunknown' to 'Vref' and activate 'dual_slope_sw_to_vref' signal to reset the counter as shown in Fig. 11. The counter counts until comparator output becomes '1'. At this instance, 'end_conv' signal is asserted and digital output latched and proportional to analog input 'Vunknown'.

When 'Arch_sel' equals to '10', it selects pipeline ADC. Figure 12 indicates functional simulation of 4-bit pipeline ADC. The data path unit is shift left register and the 'end_conv' signal is asserted at 4th bit.

Figure 13 shows simulated waveforms of four-bit SAR ADC. Initially 'digital_out' set to '100000000'. On each positive going clock cycle, successive bits are set equal to the status of analog comparator output till last cycle of operation.

Fig. 11 Simulation of multiplexed digital architecture: 4-bit dual slope mode [Part B]

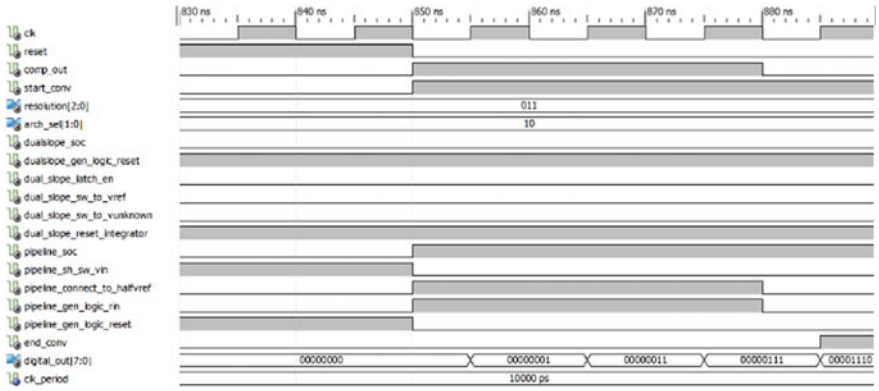

Fig. 12 Simulation of multiplexed digital architecture: 4-bit pipeline mode

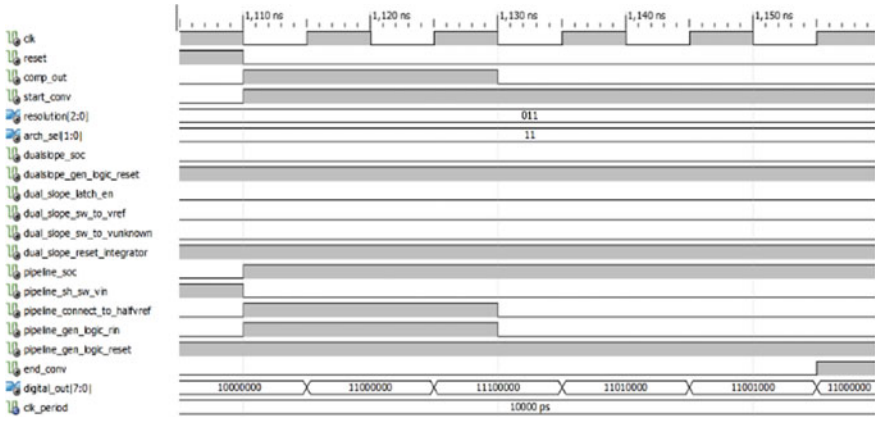

Fig. 13 Simulation of multiplexed digital architecture: 4-bit SAR mode

3 Results

In this work, individual and multiplexed digital architectures of all three ADCs are synthesized at 100 MHz with speed grade of, -4 on Xilinx Spartan 3 device (3s250ecp132-4). Table 2 shows Comparison of Performance of Time Multiplexed Architecture and Existing Architectures.

It is evident that number of slices, flip-flops and LUT (Look Up Tables) required are more in number than individual ADC architecture; whereas clock and power consumption are comparable. The results of the work are device specific.

Figure 14 graphically depicts comparison among architectures for device utilization and timing analysis. It shows Number of slices, flip flops and 4 input look up tables (LUT) required in implementation on FPGA.

Figure 15 depicts minimum clock period and clock net skew as a timing analysis. Synthesis clock period is better than SAR and dual slope variable resolution ADC architecture. In time Multiplexed architecture, selected single architecture is becoming operative at the given instance of the time, utilizes the clock. Table 3 shows power consumption based on post place and route simulation models of each architecture. Test vectors applied for four bits and eight bits resolutions during post place and route simulation. Power analysis performed on XPower Analyzer in Xilnx ISE.

Power analyzed when 1.2 V is applied to Vccint and 2.5 V to Vccaux for 96 MHz operating frequency for all architectures. Quiescent (silent) power shows constant value for all architectures. Power consumption comprises of logic, clock, IOs and quiescent power components. Figure 16 shows comparison of power consumption among all architectures.

Utilization ratio on the FPGA platform is only 4% among 250 K gate count with 31% input output blocks of FPGA. The design is implemented with 96 MHz clock frequency. Post synthesis timing summary illustrates that minimum processing time of synthesized hardware is 7.711 ns; resulted into maximum operating frequency

Table 2 Performance comparison of time multiplexed and existing architectures

Parameters	Dual slope architecture		Pipeline architecture		SAR architecture		Multiplexed architecture
	Fixed resolution	Variable resolution	Fixed resolution	Variable resolution	Fixed resolution	Variable resolution	Variable resolution
Slices	11	28	8	8	47	51	102
Slice flip flops	11	11	12	12	41	41	64
4 input LUTs	21	53	16	11	89	97	195
Synthesis clock (ns)	3.872	7.35	3.44	4.58	7.39	7.57	7.11
I/Os	19	22	18	21	13	16	29
PAR clk fanout	7	7	7	10	25	25	39
PAR clk net skew (ns)	0.003	0.003	0.004	0.005	0.024	0.024	0.045
PAR clk delay (ns)	0.095	0.095	0.094	0.095	0.114	0.114	0.114
PAR slack-setup (ns)	NA	2.85	NA	4.49	NA	NA	0.812
PAR slack-hold (ns)	1.572	1.572	1.409	1.02	1.65	1.65	1.334
Total power (W)	0.071	0.06	0.062	0.061	0.057	0.057	0.065
Dynamic power (W)	0.018	0.007	0.009	0.008	0.004	0.005	0.012

96 MHz. Summary of power consumption indicating, total on chip power consumption including static and dynamic (clock, logic, IOs (Inputs Outputs) signals) power consumption of 65 mW. The architecture implemented on FPGA platform at the cost of device utilization and power consumption, while keeping operating speed constant, it proves the functional viability of multiplexing of three different ADC digital architectures viz. Pipeline, Dual Slope and SAR.

The prototype design has successfully synthesized, implemented and time simulated after place and route at 96 MHz operating frequency.

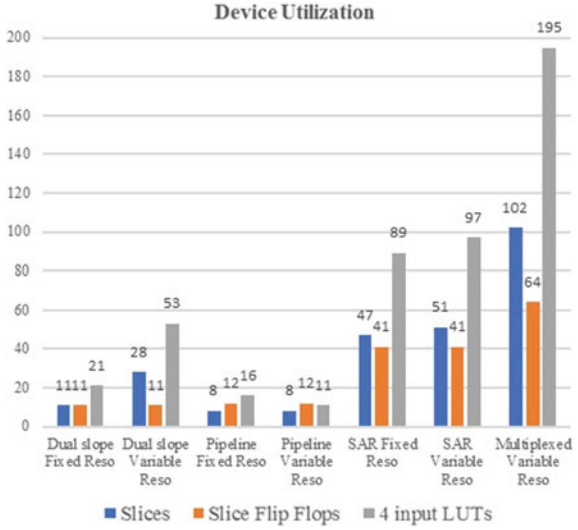

Fig. 14 Device utilization

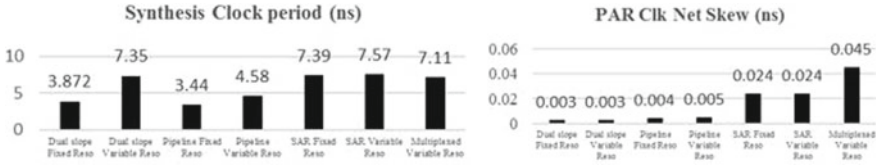

Fig. 15 Timing analysis

Table 3 Power consumption (96 MHz)

Sr. No.	Power consumption (W)	SAR	Pipeline	Dual slope	Multiplex architecture
1	Quiescent	0.052	0.053	0.053	0.053
2	Dynamic	0.005	0.008	0.007	0.012
3	Total	0.057	0.061	0.060	0.065

4 Conclusion

A brief presented a variable resolution, time multiplexed digital architecture for SoC. The architecture is fully synthesized, simulated and implemented on FPGA. It makes the SoC suitable for various applications demanding different types of at the cost of area and power. This architecture saves pin count considerably as compare to three independent architectures on chip if they were separately used. The total pin count is 29 only. It also reduces the requirement of number of external comparators and needs only one for all three types of ADCs. Dynamic power consumption of

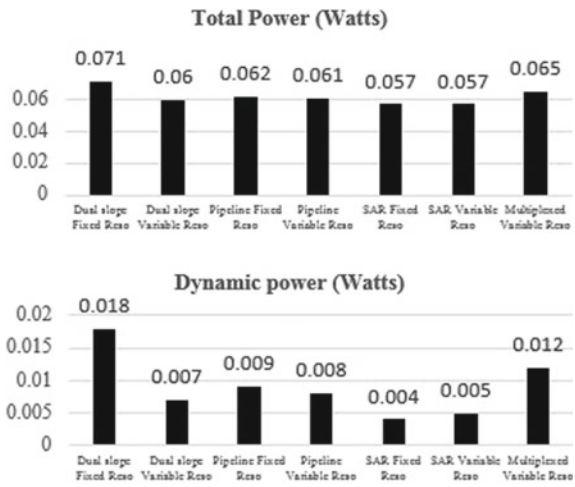

Fig. 16 Power analysis

multiplexed architecture is 12 mW and is more than other architectures measured at 96 MHz operating frequency, including delay components caused due to clock, combinational logic as well as path delays. Area on chip is also greater than other individual architectures. The design provides functional plurality on the single chip for three different ADC architectures at the cost of utilization of the device.

Incorporating this architecture in a microcontroller or SoC, would exploit the benefits of all three architectures with the trade-off in area and power consumption so as to get suitability to diverse applications of three different architectures.

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Spontaneous Detection of Potholes and Humps

Swati K. Mohod, Anjula Wararkar, Swaranjali Bokade, Rupali Lende, Rahul Lichade, Yash Mahure, and Sagar Fartode

Abstract Roads are the major means of transportation and it supports the nation's economy only if they are well maintained. It is necessary to identify holes and potholes so the accidents can be avoided and the damage caused to the vehicle is less. It also contributes in saving fuel. Here is a simple and effective solution regarding the problem of accidents by detection of potholes and humps and help drivers. Detection of potholes will be done by image processing technique and humps would be detected by ultrasonic sensor. Raspberry Pi is the controlling device. Wi-Fi will be used to acquire geographical position of potholes and will be send to the authority to take appropriate measures.

Keywords Raspberry Pi · Wi-Fi · Ultrasonic sensor · GPS receiver · GSM SIM900 · Camera

1 Introduction

Roads connect numerous cities in India and villages with the cities. They're a crucial mode of transport in India. Our nation incorporates a network of over 5,897,671 km of roads. This is the second largest road network within the world. India has close to 4.87 km of roads per 1000 people.

India's road network carries over 65% of its freight and regarding 85% of rider traffic. It contributed 4.7% towards India's domestic product. In step with ministry of Road Transport and Highways as of March 2019 India had regarding 142,216 km of national highways and expressways and another 176,166 km of state highways. Major comes being enforced beneath the National Highways Development Project a government initiative. Nevertheless, on the other hand, it's sealed the manner increasing range of RTA (road traffic accident). In step with WHO, close to 1.35 million individuals die every year as a results of road traffic crashes. Road traffic crashes price most countries 3% of their Gross Domestic Product. Over half of road traffic deaths are among vulnerable roads were: pedestrians, cyclists and motor cyclists. Over

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Fig. 1 Road accidents due to potholes

93% of the world's fatalities on the roads occur in low and middle incomes countries, although these countries have close to 60% of the world's vehicle. Road traffic injuries are the leading explanation for death for youngsters and young adults aged 5–29 years. The safe system approach to road safety aims to make sure a secure transport system for all road users like approach takes under consideration people's vulnerability to serious injuries in road traffic crashes and acknowledges that the system ought to be designed to be forgiving of human error.

The cornerstones of this approach are safe roads and road sides, safe speed, safe vehicles and safe road users, all of that should be self-addressed so as to eliminate the look of roads is one in every of the foremost vital facet which may have a substantial impact on their safety. Ideally, roads ought to be designed keeping in mind the security of all road users. This might mean ensuring that there are adequate facilities for pedestrians, cyclists and motor cyclists [1]. The road accident due to potholes is shown in Fig. 1.

2 Preparation of the Paper

2.1 Potholes Detection

Wi-Fi is used for tracking location of the vehicle. The camera placed in front of the vehicle continuously capture the images of the road through the open source computer vision in a Red, Green and Blue model (i.e. RGB form). It is difficult to visualize the RGB form of the image, therefore the image is converted into Hue Saturated Vision (HSV) form by the image processing technique. When the captured image matches with the conditions of the program, a GPS module compatible with Raspberry Pi is used to obtain the longitudinal and latitudinal co-ordinates. The information will be provided to the NMC with the captured image. As soon as the potholes is detected, the driver is alerted via speaker acting as an alert system. Information in the form of location and the image of Potholes is saved in micro-SD card for further references.

The image is shown to the driver through LCD display. This process is repeated at every contact of the pothole [2].

2.2 Hump Detection

Ultrasonic sensor plays a key role for continuously measuring the distance between the vehicle and the road. The distance obtained is further compared with the set value of threshold. Each time, when the distance of a vehicle and the hump is smaller than the set threshold then it eventually alerts the driver by speaker as well as by displaying on the LCD screen. This process is carried out, every time the detection is done [3].

The Raspberry Pi is additionally a series of little single-board computers developed at intervals the UK by the Raspberry Pi Foundation. The Raspberry Pi is presently wide used due to its low value and high quality. It doesn't embrace peripherals or cases. Several generations of Raspberry Pi's unit of measurement free. All models feature a Broadcom system on a chip (SoC) with Associate in Nursing integrated ARM-compatible central methodology unit (CPU) and on-chip graphics methodology unit (GPU). We use Raspberry Pi a strive of, which will be a major upgrade to the present Raspberry Pi a strive of boasts of a Broadcom 900 MHz quad-core ARM Cortex-A7 processor,1 GB of RAM thus transportation the utmost amount as six-fold more performance to the present Raspberry Pi models.

The SIM900 is additionally an entire Quad-band GSM/GPRS answer throughout a SMT module which may be embedded at intervals the patron applications that have Associate in Nursing industry-standard interface; the SIM900 delivers GSM/GPRS 850/900/1800/1900 MHz performance for voice, SMS, Data, and Fax throughout a tiny low kind issue and with low power consumption. With a tiny low configuration of 24 mm × 24 mm × three metric quantities, SIM900 will match the majority the house wishes in your M2M application, considerably for slender and compact [4].

Ultrasonic sensors deal with the ultrasonic waves to measure the distance between the vehicle and the object. Ultrasonic waves whose frequencies are beyond the normal hearing limit that is above 20 kHz. Sensors consist of two transducers, one for transmitter and another for receiver. According to the principle, Transmitter emits frequency at about 40 kHz. While travelling through the air and when blocked by an object, waves get reflected and get bounced back to the sensors. The reflected waves are absorbed by the receiver at the sensor end. Four pins present on the sensor; each have specific operation. First pin is Vcc pin used to power on ultrasonic sensor. Pin is usually given with voltage of 5 V and current consume is less than 15 mA. Powered easily with the on-board power supply on Raspberry Pi. Second pin is triggered pin Input to the sensor. Provide a short 10 μs pulse to this pin to start ranging. Then, the Module emits ultrasonic waves at a frequency of 40,000 Hz. The Third pin is the Echo pin. The Echo pin is low when the waves are reflected by the object and are absorbed by the receiver. The Echo pin is High when the time taken by ultrasonic wave to travel from transmitter to the object and again from object to the receiver.

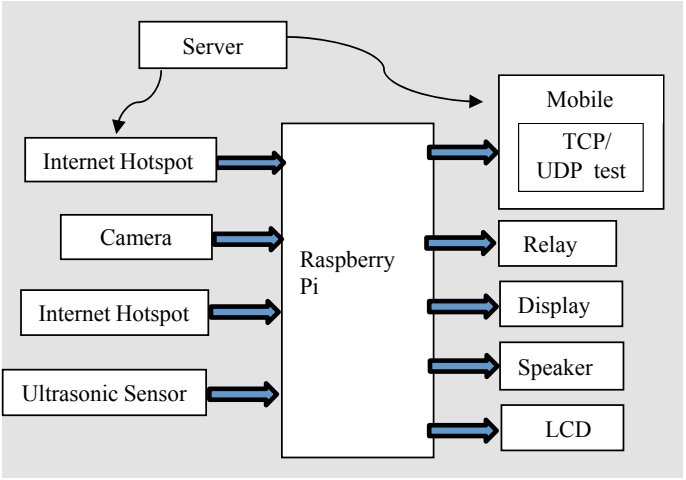

Fig. 2 Block diagram of proposed work

The Fourth pin is used to connect to the Raspberry Pi ground. Distance is calculated by $d = S * T/2$ where $S = 0.034 * 10^2$ cm/s. Range of the sensor is from 2 to 400 cm [3] (Fig. 2).

The waves present in the sound oscillate every time through a medium of air. The ultrasonic sensor is generally inaudible to the driver and it is accurate about measuring the distance between the vehicle and the humps. The distance is proposed according to the code written. The high-frequency ultrasonic sound emitted by the transmitter, bounces off as soon as it detects the variation on the road that are humps.

The ultrasonic noise reflected from the hump is received by the receiver end of the sensor. Then, the control circuit deals with the processing of signals which are returned, for finding the time difference between the signal transmitted and received. With the help of speed distance formula, the distance will be calculated which alerts the driver through the speaker when the distance loaded in the program matches with the calculated distance [3].

The Raspberry Pi sends an input signal to TRIG which triggers to send an ultrasonic signal through the sensor. The model is powered with Vcc terminal and ground using GND. 5 V signal on the Echo pin is send when the time is measured between the trigger and returned pulse. The python scripts proposed therefore measures the transmitted and received pulse duration and then calculate distance from that. Raspberry Pi has an input pin which operates at 3.3 V.

For Navigation systems, GPS Module plays the important role. An advanced real-time navigation system developed when Raspberry Pi interfaced with a GPS. The four pins present at the GPS Module are Vcc, Ground, RX and TX. The input power required is about 5 V voltage and 100 mA current. The TX pin of GPS module connected to the RX pin of Raspberry Pi. The proper grounding of the GND pin of the GPS and Raspberry Pi. Loading the program in to Raspberry Pi opened in the

Python editor to receive the serial data. Note—GPS Module must be at least near to the window for perfect signal integrity [4].

Now a day's we've got an inclination to check plenty of advanced cameras that are used to capture motion conjointly as footage throughout the time of its invention footage may well be taken only throughout a space and the instrument have to be compelled to be unbroken throughout a dark chamber or box and so the realm have to be compelled to perform as the camera was earlier referred to as "camera-obscure" that meant "dark chamber" but this instrumentality was really Brobdingnagan and can be transferable only as a tent work the sunshine was passed onto it through a lens. Camera is employed to capture all the photographs of a potholes and humps. working of camera is endlessly keep capturing the photographs of a potholes and humps. As the Camera is also able to capture images efficiently at night on the opposite hand it'll show real moment on the screen at the same time.

For an extended distance potholes and humps detection, Raspberry Pi Camera Module is employed, it is connected at the highest of the front mirror, that is lighter to driver for best driving. In Image Processing the image captured by the camera as soon as the pothole is detected present in the RGB (Red Green Blue) form, which is not possible for the driver to identify the image properly. Therefore, the image processing technique is used to convert the RGB form of the image into HSV (Hue Saturated Vision) model. HSV form helps the driver to identify the image captured of the pothole perfectly. The image is used for further reference and the most important thing that it will be sent to the higher authorities like NMC with the coordinates of longitude and latitude. It helps to take certain actions on the road conditions for improvement [2].

Major challenges are faced in the road transportation because of poor quality of roads, low maintenance, potholes and humps. Due to low maintenance and lack of information regarding damaged road, many accidents take place.

Potholes are formed due to heavy rains and dense movement of vehicles on the poorly constructed roads. Pothole formation has given rise to an accident and loss of human life.

Indian speed breakers are constructed in order to control the speed of a vehicle but sometimes due to heavy rains or various factors, drivers are unable to identify humps on the road and vehicle gets unbalanced. The vehicle can also get stuck or fall inside the potholes which are unable to identify when filled with water during monsoon.

This is the major reason for accidents. Due to the low maintenance and incorrect constructions, accidents may occur. So, all information regarding unwanted potholes and humps should be provided to the NMC for the improvement of road condition [1].

The Intelligent data gathering system fitted in any vehicle for the real-time detection of potholes and humps to alert the driver from road accidents and to inform about the road conditions to the higher authorities known as municipal officials through Email along with the captured image for the improvement of road which eventually helps for the economic development as well.

The program to perform the detection written in python language that will be loaded to Raspberry Pi which is a series of small single board computers through USB port [2].

2.3 Program Code

```
                    private void cmdConnect_Click(object
sender, EventArgs e)
        {
            try
            {
                listLog.Items.Clear();

                string szPort = txtPort.Text;
                int alPort = Convert.ToInt16(szPort, 10);

                createTerminal(alPort);

                cmdConnect.Enabled = false;
                cmdClose.Enabled = true;
            }
            catch (Exception se)
            {
                MessageBox.Show(se.Message);
            }

 }
                private void createTerminal(int alPort)
        {
            m_ServerTerminal = new ServerTerminal();

            m_ServerTerminal.MessageRecived += new
TCPTerminal_MessageRecivedDel(m_Terminal_MessageRecived);
            m_ServerTerminal.ClientConnect += new
```

```
TCPTerminal_ConnectDel(m_Terminal_ClientConnected);
            m_ServerTerminal.ClientDisconnect += new
TCPTerminal_DisconnectDel(m_Terminal_ClientDisConnected);

            m_ServerTerminal.StartListen(alPort);
  }
          public void StartListen(int port)
        {
            IPEndPoint ipLocal = new IPEndPoint(IPAddress.Any,
port);

            m_socket = new Socket(AddressFamily.InterNetwork,
                SocketType.Stream, ProtocolType.Tcp);

            //bind to local IP Address...
            //if ip address is allready being used write to log
            try
            {
                m_socket.Bind(ipLocal);
            }
            catch(Exception ex)
            {
                Debug.Fail(ex.ToString(),
                    string.Format("Can't connect to port {0}!",
port));

                return;
            }
            //start listening...
            m_socket.Listen(4);
            // create the call back for any client
connections...
            m_socket.BeginAccept(new
AsyncCallback(OnClientConnection), null);

  }
     private void RaiseMessageRecived(byte[] bytes)
        {
            if (MessageRecived != null)
            {
                MessageRecived(m_socWorker, bytes);
            }
```

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A Low-Power Positive Feedback Operational Amplifier Using Carbon Nanotube Field Effect Transistor

Varsha Bendre, A. K. Kureshi, and Varsha Harpale

Abstract The operational amplifier (op amp) design in very deep submicron technology endure the barriers like exponential increase in leakage current, process variations, quantum–mechanical tunnelling, and lithographic limitations. This results in low gain stages and decreased impedance thereby degrading the performance of op amp. In order to provide improvements in electrostatics over complementary metal oxide semiconductor (CMOS) and to sustain Moore's law in near future, various advanced and beyond CMOS devices are evolved over the period such as ultra-thin body single or multiple-gate field effect transistors (MG-FETs), FinFET, dynamic threshold MOSFET, silicon on insulator (SOI) FETs, strained silicon and, Carbon Nanotube Field Effect Transistors (CNFET). CNFET is one of these embryonic technologies evolved through the contemporary innovations which provides very high throughput, due to near ballistic transport of charge carriers and large mean free path. Very low leakage current and high output resistance of CNFET makes further miniaturization of transistors possible sustaining Moore's law in future. Therefore, CNFETs have been reconnoitred as the stimulating aspirant for the future generations of integrated circuit (IC) devices. In this paper, Positive Feedback Compensation (PFC) technique is proposed for a LVLP three-stage amplifier. The proposed CNFET based three-stage op amp is designed and simulated at 32 nm technology node using HSPICE software. The proposed op amp is capable of providing gain of 65.8 dB at 0.9 V input supply voltage using 1400 carbon nanotubes. Moreover the op amp is stable with 46° phase margin and capable of operating at wide frequency range with unity gain frequency to be 778 MHz. The power consumed by the proposed op amp is just 36 μW. Hence, CNFET provides low power solution for op amp designed at very deep submicron technology node.

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Keywords Carbon nanotube · Positive feedback · Operational amplifier · Low power · Stability · PSRR · Phase margin

1 Introduction

The rapid increase in the circuit functionality and performance has only been possible due to intense upsurge in the realizable integration densities. The resultant enduring shrinkage of device structures has resulted in more and more nonlinear physical phenomena. With continuous downscaling and higher integrated density it is difficult to get expected performance of the analog circuit [1]. Hence a main aim of analog circuit is to satisfy circuit specifications through suitable circuit architectures with the required performance.

Operational amplifiers (op amps) are indispensable and widely used block in many analog integrated circuits. The general architectural block diagrams of an op amp have three stages: differential transconductance stage to provide differential to single ended conversion, additional gain stage to contribute the overall gain along with differential input stage and output buffer stage which is optional and used only if Op-Amps have to drive low resistive load [2]. In addition to these three stages, Op-Amps also needs suitable biasing circuitry to drive input and second gain stage [3]. There are distinctive structures of operational amplifiers (op amps) yet just a portion of the design is suitable for low power application [4]. One of the main differing techniques in variety of op amp architectures is the implementation of new compensation techniques. Different architectures of op amp are proposed in literature with different compensation techniques using conventional CMOS technology. Majorly negative feedback compensation is used in numerous architectures of op amp. Normally it is said that positive frequency compensation (PFC) results into oscillation and hence need proper biasing. The PFC is especially suitable for driving large capacitance loads. It improves frequency response, slew rate (SR), and settling time. Small compensation capacitors make it appropriate for integration in commercial CMOS processes. Hence in this paper three stage operational amplifier is implemented using PFC technique [5].

Shrinking the conventional Metal Oxide Semiconductor Field Effect Transistors (MOSFETs) into very deep submicron (VDSM) technology node faces severe barriers. This includes exponential increase in leakage current, process variations, quantum–mechanical tunneling of carriers through thin gate oxide and lithographic limitations due to the fundamental physics that constrains the conventional MOSFETs [6]. The associated drawbacks in the case of amplifiers are various short channel effects which results in low gain stages and decreased impedance. Hence there is a substantial degradation in the performance of op amp at VDSM processes. So rigorous exploration is necessary in order to propose different circuit design methods using new upcoming devices like ultra-thin body single or multiple-gate FETs, FinFET, dynamic threshold MOSFET, silicon on insulator SOI FETs, strained silicon and carbon nanotube field effect transistors (CNFET) [7]. This will provide

improvements in electrostatics over CMOS and will help to sustain Moore's law in future event at very deep submicron region.

Amongst various emerging beyond CMOS technologies, Carbon nanotube (CNT) is one of the embryonic technologies evolved through the contemporary innovations. CNT based transistors have very high throughput due to near ballistic transport of charge carriers and large mean free path. Hence CNFET's are gaining ample attention in different high speed portable applications [8]. Therefore, in this paper MOSFET like N-CNFETs and P-CNFETs are used for design and implementation.

2 Related Work

In [8], Iijima introduced multi-walled CNT technology for the first time, which is used in arc discharge electrodes. Tans et al. and Avouris P et al. in [9, 10] proposed first transistor using single walled carbon nanotube and presented how nanotubes can be used as a channel for transistor. The phenomenon of the ballistic transport with limited carrier phonon interaction because of larger mean free paths of acoustic phonons is used in this case. Uday Kumar, Gowri Sankar et al. [11] proposed CNFET based arithmetic circuit for low power applications. In this paper, various arithmetic circuits such as summer, inverter, differentiator, and integrator are designed for low power and low voltage performance using CNFET. Fatema et al. [15] presented performance of two CNT-OPAMP using 8T and 9T OP AMP model. In this paper, single walled CNFETS are used to obtain the gain, output resistance, bandwidth, power dissipation and phase margin.

Shobha et al. [12] proposed simulation of CNTFET for prostate cancer detection. In this paper, prostate specific antigen (PSA) has aided the prediction of prostate cancer. More time is required to analysis the electrical and mechanical property of the CNT. According to the performance, MOSFET and CNFET have same functionality. But, MOSFET consume more power and more voltage than CNFET. Ren et al. [13] presented a robust low power CNT sensor circuit in 180 nm CMOS technology. This sensor interface circuit (SIC) achieves the measurements of 2.5 kΩ to 25 MΩ resistance and 1.4% of accuracy. The harmonic distortion is occurred in SIC model to design the CNT model for low power applications. Biswas et al. [14] proposed CNTFET based low harmonic distortion state differential amplifier for Nano-electronics. In this model Fast Fourier Transform also analyzed to predict the performance of the low voltage applications. But, this differential amplifier has more complexity to design the CNT model for low power applications. It is further observed that though various digital circuits are implemented using CNFET, only basic two stage op amp topology is implemented for inverting amplifier so far. Hence designing of an analog circuit, more specifically, op amp is still unexplored and therefore there is need to explore CNFET technology for designing op amps.

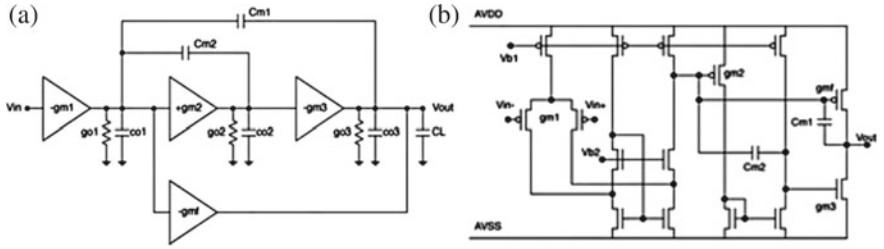

Fig. 1 **a** Block diagram of three stage amplifier with PFC [7]. **b** Schematic of three stage amplifier with PFC [7]

3 Methodology

All the modern widely used computer chips are based on CMOS logic. Even though CMOS circuits are working aggressively in semiconductor industry, some major challenges have been faced at the nano-scale dimension such as more power consumption and less gain. Hence CNFETs are used in this work instead of Si-MOSFETs.

3.1 Working Principle

The most popular compensation is the Miller compensation. In this method, compensation capacitor needs to be added in each stage and each new capacitor reduces the bandwidth by a factor of 2. This creates an overhead of the power requirements reducing the slew rate. Also the capacitance at the output node puts limitations on the bandwidth. Hence, PFC with feed forward transconductance is proposed as shown in Fig. 1. Figure 1a shows the block diagram of three stage operational amplifier with PFC. The frequency compensation principle is described in the subsequent section and its circuit diagram is shown in Fig. 1b.

The feed forward transconductance g_{mf} bypasses all but the first stage at high frequencies to provide a direct path to the output. Consequently, this boosts the bandwidth of the PFC amplifier. This block is implemented using a single MOS transistor (g_{mf} in Fig. 2), driven by the output of the first stage and connected to the output node. By using this approach to implement g_{mf}, it is ensured that there is no increase in power consumption and silicon area, when comparing it to the NMC counterpart [13].

A positive feedback around g_{m2} allows effective control of the damping ratio of the complex poles, and capacitor C_{m2} [14] fulfills this condition. This capacitor is significantly smaller than Cm1, and thus, does not limit the Slew Rate (SR) of the first stage. As an extra benefit, a left half plane (LHP) zero is created which helps in improving the Phase Margin (PM). The major significance of this kind of configuration is:

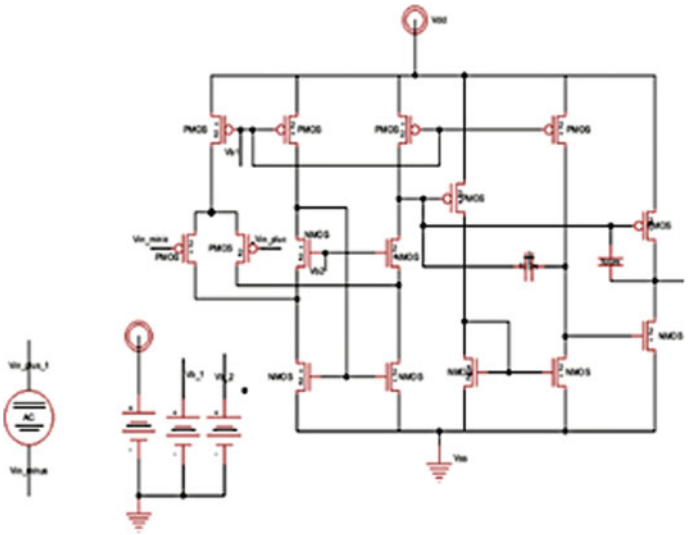

Fig. 2 Three stage PFC amplifier using CNFET

The Positive Feedback Compensation (PFC) bandwidth is implemented by using feed forward transconductance, g_{mf} bypass at first stage to provide high frequency output. This is implemented using MOSFET transistor by connecting to the first stage of output node. This PFC circuit consumes less power and small area than NMC circuit [13]. Positive feedback is allowed by damping ration controlling with complex poles and fulfills capacitor, C_{m2} this capacitor is lesser than C_{m1} without SR of the first stage. Especially, PM is improving it helps to create in LHP zero [13].

4 Experimentation and Simulation

The experimental set up of the proposed three stage op amp circuit is shown in Fig. 2. Initially, input 375 uV is given to the differential amplifier circuit. This output is combined using XCNT_6 and XCNT_7 transistors. This output is connected to offset control circuit such as XCNT_8 and XCNT_9. In this circuit, helps to maintain offset voltage at 210 mV, which output is connected to gain amplifier circuit XCNT_10 and XCNT_11. Offset control and amplitude of the signal is very important to increase the overall gain. So the amplifier output signal is again connected to next stage offset control XCNT_12 and XCNT_13. Finally, last stage gain amplifier XCNT_14 and XCNT_15 circuit deliver the output voltage at 8.75 V.

The proposed method implemented in HSPICE software and wave form simulated in SPICE Explorer b2008.09. The entire work is done by using I_7 system with 8 GB RAM. Similarly, the determination of op amp parameters such as OS, SR, CMRR, Av0, UGBW, PM, PSRR, and power consumption using spice explorer wave forms.

The simulation results and its comparison with existing work are summarized in Table 1. The corresponding input–output waveforms are shown in Fig. 3. From this result, it is clear that if the input voltage of 375 uV is given to the differential amplifier and output voltage is 0.75 V is delivered from last stage amplifier, which means the gain of the three stage amplifier with PFC is 65.8 dB.

Unity gain frequency is calculated, when the magnitude graph is touched zero and it is 778 MHz. Slew rate of the op amp is obtained from voltage versus time

Table 1 PFC amplifier performance summary and comparison with related work

Parameter	Existing-I [16]	Existing-II [7]	Proposed
Device	CMOS-180 nm	CMOS-350 nm	CNFET-32 nm
DC gain (dB)	94	100	**65.8**
−3 dB bandwidth	–	–	545 kHz
Unity gain bandwidth (MHz)	549	2.7	**778**
Slew rate (V/us)	200	1	0.61
Phase margin (°)	68	52	**46**
PSRR (dB)	54.35	–	3
Output swing (OS) (V)	1.1	–	0.75
Power consumption (W)	2.73 m	275 μ	**36 μ**

Bold values shows improvement in the performance parameters with reference to previous work and also specifies that the values are as expected with reference to standard required values

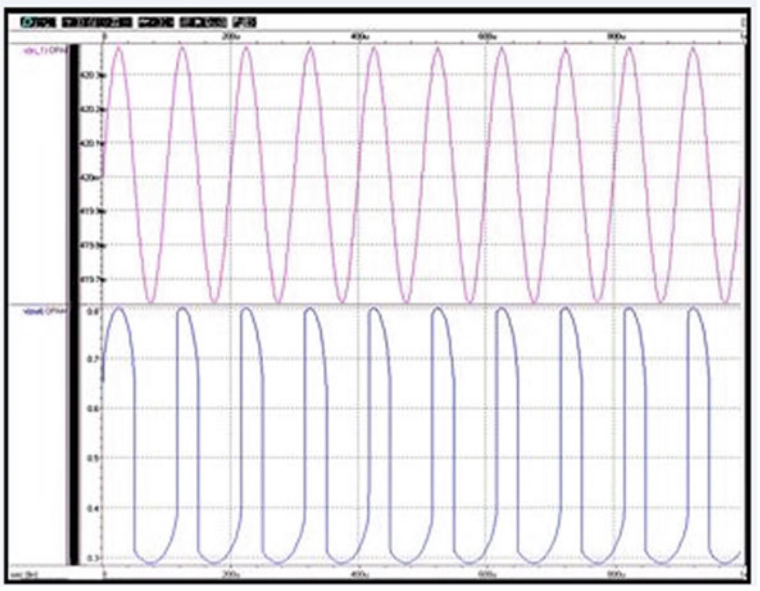

Fig. 3 Input–output waveform of PFC amplifier

characteristics. In this case, linear voltage and linear time obtained are 178 mV and 290 ns respectively. The ratio of linear voltage and linear time is mentioned as slew rate, which when calculated comes as 0.61 V/us. The phase margin of the op amp is calculated with the help of magnitude and phase plot. Magnitude plot 0 dB is touched phase angle graph at 134°. According to phase margin equation, 134° are subtracted from 180°, which give phase margin of 46°. Form this result; it is clear that all the performance parameters are improved in proposed method using CNFET than existing methods which are implemented using CMOS.

5 Conclusion

Positive feedback frequency compensation three stage operational amplifier is proposed in this paper. In this work, each and every block from the beginning of differential amplifier to at the end of amplifying circuit has been simulated. All important parameters of operational amplifier such as unity gain bandwidth (UGB), Slew Rate (SR), DC gain (Av0), Phase Margin (PM), Power Supply Rejection Ratio (PSRR), Output Swing (OS), Common Mode Rejection Ratio (CMRR) and power consumption is calculated. The simulation is carried out at 32 nm CNFET technology using HSPICE.

The proposed op amp is capable of providing gain of 65.8 dB at 0.9 V input supply voltage using 1400 carbon nanotubes. Moreover the op amp is stable with 46° phase margin and capable of operating at wide frequency range with unity gain frequency to be 778 MHz. The power consumed by the proposed op amp is just 36 μW. The comparison with existing work using CMOS at 180 nm technology shows that there is significant reduction in power consumption while maintaining suitable stability and gain. Hence, CNFET provides low power solution for op amp designed at very deep submicron technology node.

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End-to-End Supporting System for IoT Applications: Survey

Sonali P. Lohbare, Swati Dixit, and Shubhada Deshpande

Abstract Impact of digital technology has brought tremendous change in human life. IoT is a collection of embedded systems and communication technology that works together to serve a meaningful purpose. The work here presents a comprehensive survey of end-to-end supporting technologies for IoT applications and highlights some of them, like Gateways, Operating Systems, Communication Protocols, Middleware, Cloud-based structure for IoT. Software technology has facilitated global IoT with EPC global architecture, cloud middleware interfaces for high-level services provision for web-based application services platforms as well as Machine-to-Machine services, for the integration of physical devices. Most of the existing cloud-based structures support interoperability However, the difficulty of applications requirements, the heterogeneity of network architectures and communication technologies impose many challenges in developing IoT applications. To convey the challenges, including self-organizations, data transmission, security and privacy protection, data integration and processing in large-scale IoT applications is a commanding task. The proposed work provides a short survey on varied technologies like communication protocols, middleware, fog and cloud computing which come up together to enable the IoT system of real-world applications.

Keywords Operating system (OS) · Communication protocols · Middleware · Cloud

1 Introduction

IoT has become an eminent advancement of technology. Billions of devices are connected to one another with different applications in every domain [1]. IoT devices are nothing but a compilation of sensors, actuators, controllers and gateways connected through various communication protocols [2]. The sensors gather all the information and pass it to the gateways. Actuators receive the information

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from the gateways. Gateways are data managers which format, filter and maintain the data flow between sensors and communicators.

The operating system acts as a bridge between applications and devices as resource managers for complex systems. Several open-source alternative forms are available for the IoT systems. Comparative analysis of open source low-end and high-end IoT operating systems with different characteristics [3] has been discussed. Controllers convert the data into meaningful information and communicate with the middleware through the gateways, share information and coordinate decision in various different application domains such as Smart City, Healthcare, Transport, Smart Agriculture, Smart Supply Chain, Smart Grid, Target Tracking Smart Environment Monitoring, and Smart Surveillance. Smart surveillance basically deals with the area monitoring and object tracking in open and closed environments using wireless sensor technology [4]. IoT communication protocols support communication with a Machine to Machine (M2M) [5] and IoT networks. Short-range communication protocols and long-range communication protocols are used for IoT.

Middleware is software that deals with different roles like analyzing, data aggregation, and generation of the statistical report, graphical representation of data, abstraction of sensor data and syntax for interfacing the protocol with a set of diverse devices. Middleware maintains the heterogeneous interoperability of IoT devices. It provides privacy and security to the database. Middleware facilitates the heterogeneous devices to interface with local and global applications. Application Programming Interface (API) provides the facility of context awareness and self-adaptive services [6]. Different service platforms communicate with users directly to share the information under the flexible mode. Open source middleware provide solution to user can view the complete IoT Application.

Different service infrastructure platforms are provided under the cloud for different IoT applications. Advantages of cloud include accessibility, flexibility, and big data capacity when traditional online storage of data is used in IoT applications [7].

In the following sections, the work is organized in the following manner. Section 2 describes IoT devices. Section 3 discusses the Operating System (OS) types, including Gateways in lower-level support in the IoT system, the programming languages, communication protocols, simulation tools, and interface devices. Section 4 discusses Middleware, cloud based infrastructure platforms, the application protocols to discover service resources and cloud integration options that can enable interaction between the devices and end-users. Section 5 includes IoT Platform challenges and Sect. 6 puts forward the conclusion.

2 Related Work

In this survey, the priority concerns for IoT systems in terms of communication devices, gateways, edge, fog and cloud computing are addressed. IoT has been one of the real time data analysis systems with mobility and ability to deliver

services anytime anywhere. In the design of large scale infrastructure of IoT, the key factors considered are availability of resources, maintainability, scalability and storage capacity. Considering these main issues while deciding the computing model in different areas of user needs, the system design involves different technologies, Operating Systems (OS), embedded systems. The communication protocols play an important role in the IoT system.

Based on application, the basic architecture consists of three tiers, first tier is Perception, Network is a second tier and third tier is Application. Sensing and actuating comes under the Perception layer. Network layer is used for distributing and preprocessing the gathered data. Processing and analysis of information flow, forwarding data to applications, heterogeneous services and providing feedback to control applications all comes under the Application layer [8]. Two more tiers can be added to the basic IoT architecture, Middleware and Transport, as they have an important role to play for heterogeneous applications. The middleware platforms act as a software bridge between the things and applications, and provide an Application Programming Interface (API) for computing. Communication, data management, privacy and security comes under Transport [9]. Middleware deals with challenges like interoperability, device discovery, management and analysis of big data, and cloud services. For applications in terms of end user application, web application that allows the data exchange for different applications.

2.1 Devices

In IoT, the first task is to collect data from the physical environment using smart devices. Active mode as a Low end IoT devices with memory, power and computation capability are closer to physical environments like sensors, actuators, open mote. Middle end devices are microcontrollers, which have more functionality but computational capability is not enough to handle very complex requirements. These devices have better peripheral interfaces with multiple communication technologies installed on them as Arduino, ESP8266. Passive mode is high end IoT devices are single board computers with CPU, RAM, flash memory and an operating system is supported [10]. Like Raspberry Pi devices support communication protocols and provide a graphical user interface along with multimedia and data analysis. Due to the highly intelligent devices used as complex gateways and controllers. Like LINUX and UNIX operating systems supported to high end devices with running technologies as artificial Intelligence, Deep learning, NLP, Machine learning [11].

3 Operating System

IoT-OS provides the programming Interface between IoT devices and manages operation time. Designing an operating system is based on Kernel programming model

and system architecture. Development model is defined with multithreading, event driven memory design, and concurrency. Memory management requirement is based on flexibility requirements. Internet servers need to be robust to conserve battery life and reduce attacks. Some of the examples are Contiki Sec, Lits OS, and RTOS.

3.1 Gateways

IoT Gateway is an intermediary between numerous sensing networks and high-end IoT devices like cloud platforms through the internet. Gateway acts as a bridge between different layers of IoT architecture, manages terminal nodes and itself. The data collected from devices is filtered, converted to different formats and processed. Gateways are capable of overcoming the gap between sensor nodes and processors. Also when the power fails, the gateway saves system status to permanent memory and puts the system into inactive mode. It also can reboot, troubleshoot and communicate with different support systems. IoT gateway works in three modes: In fully automated means the devices have the ability to self-configure with several communication protocols, Semi-Automated mode means plug and play mode. Passive mode is able to add and or remove the device any time. It can optimize network operation and handle each node or sensor. They are neither customizable nor flexible in nature [12].

3.2 IoT Communication and Protocol

Wireless communication Standard techniques related to the Internet of Things are broadly two types: short-range communication and long-range communication (Table 1).

Table 1 Short range communication [13]

Parameters	Bluetooth	ZigBee	Z-wave	Wi Fi
Topology	Star	Mesh	Mesh	Star
Data rates	24 Mb/s	250 kb/s	9.6–100 kb/s	2 Mbps, 54 Mb/s
Distance coverage range	8–50 m	30–50 m	100 m	20–100 m
Frequency-band	2.4 GHz	915 MHz	800–900 MHz	2.4 and 5 GHz
Power-efficiency	Higher	Higher	Higher	Lower
Application	Wireless connectivity	Automation industries	Light commercial	WLAN connectivity broadband, Internet

Table 2 Long-range communications [14]

Parameters	LoRaWAN	SigFox	NB-IoT	6LoWPAN
Modulation type	CSS-type	BPSK-type	QPSK-type	DSSS-type
Frequencies of communication	Unlicensed ISM bands [433 MHz-Asia 868 MHz-Europe 915 MHz-N. America]	Unlicensed ISM bands [433 MHz-Asia 868 MHz-Europe 915 MHz-N. America]	Licensed LTE frequency bands	2.4 GHz-word wide 868–868.6 MHz-Europe 902–929 MHz-N. America
Bandwidth	250; 125 kHz	100 Hz	200 kHz	5 MHz
Data rate	50 kbps	600 bps	200 kbps	250 kbps
Transmission power	14 dBm (UL) 14–27 dBm (DL)	14 dBm (UL) 27 dBm (DL)	23 dBm (UL) 37 dBm (DL)	23 dBm
Ranges	Urban 4–5 km Rural 15–20 km	Urban 8–10 km Rural 35–40 km	Urban 1 km Rural 10 km	10–100 m
Authentication and encryption	Yes (AES 128 byte)	Not supported	Yes (LET encryption)	Yes (AES 128 byte)
Localization	Yes (TDOA)	Yes (RSSI)	No (under specification)	Yes
Standardization	LoRa-alliance	ETST	3GPP	IETF

Short-range communication is used between smart sensor nodes and center nodes like gateway/controller. It is cover a very few distance between them where data processing take place.

Long-range communication is generally covering the distance up to several kilometers. It supports wide area networks like base station and central node.

In IoT, smart devices are communicated at local and global networks. IoT applications require mobility management protocol involving intra devices and inter devices communication. To enable proper communication some of the important criteria should be followed (Table 2).

4 IoT Middleware

Middleware is nothing but an Application Programming Interface (API) for computing, communicating heterogeneous devices to manage data, security and privacy. Middleware is focused on application requirements, flexibility, and Interoperability. The middleware is categorized into three types based on flexible, adaptive and usability nature [6]. Type of Middleware shown in Fig. 1.

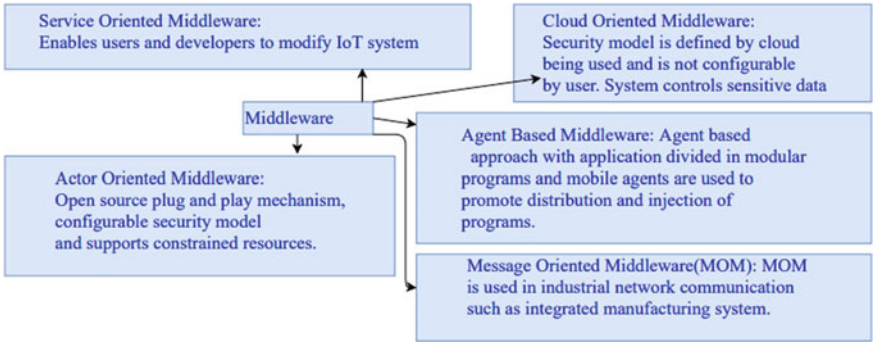

Fig. 1 Types of IoT middleware [15]

4.1 Cloud

There is an increased demand for storage resources with the ability of processing and virtualization. Data analysis is performed on the public or private cloud. Cloud architecture is based on IoT platforms and interacts with three types of cloud computing models, IaaS, PaaS, and SaaS. They provide technological solutions to networking, integrating, and interacting things with the cloud. The key advantages of the cloud are high performance, location independence, scalability, flexibility, privacy security, and easy maintenance. It uses centralized storage analysis and networking on public, private, hybrid, community data. Different cloud platforms are Amazon, Yahoo, Google, and Microsoft Open IoT. The Cloud Things service platform allows sharing of device and data information resources of different application providers under a flexible usage model in the cloud environment [16].

- Infrastructure as a Service (IaaS): IaaS offers unique device management. Data collection, processing capabilities, and transmission are done directly through the use of virtual machines.
- Platform as a Service (PaaS): Users can develop, modify, and maintain the application with PaaS. Web Service API provides complete development and deployment capabilities to developers.
- Software as a Service (SaaS): SaaS supports service subscription management, things connection, community coordination, data intelligence, and composition. Users can remotely access different applications using a web browser in real-time.

Central storage issues are security, privacy, and confidentiality. Social networking, Email, file sharing increase data load on cloud storage regularly. Standard encryption algorithms techniques based on attributes and identity used. Symmetric encryption size of 56–64 bit is Data Encryption Standard (DES). Triple Data Encryption Standard (TDES) increases key size from 112 to 168 bit. 128–256 bit encryption is used as Advanced Encryption Standard (AES). It is faster and more secure than others [17, 18].

4.2 Fog Computing

Decentralized computing architecture, it helps to process and store data locally. It reduces data transmission overheads, improves performance, and reduces latency time. Fog node device provides real-time access control, better scalability, security, reliability, location-aware services and interactive optimization services supporting the IoT applications.

4.3 Edge Computing

Edge device is an edge server that is located to closer to IoT devices. As edge devices are located nearer to the node, latency decreases when compared to cloud computing models. The edge device sends the required encrypted data to the cloud server.

5 IoT Application Protocols

IoT nodes have the capability to transfer the data from one domain to another domain. IoT application protocols are helpful to communicate with devices from remote locations. Broker-based and Bus-based are the two dominant architectures. In the broker-based architecture, the issue of the information, like filter, storages and forwards. Publisher is controlled by the subscribers. Depending on their objective, publisher and subscriber switch between clients. Some of the examples of broker-based protocols are AMPQ, CoAP, and MQTT. The Bus-based architecture is a decentralized base service that is directly delivered to the subscribers (Table 3).

Table 3 IoT application layer protocols [19]

Specifications	Parameters	AMPQ	CoAP	MQTT	XM PP	DSS	HTTP
Architecture	Broker base	Yes	Yes	Yes	No	No	No
	Bus base	No	No	No	Yes	Yes	Yes
Transport layer	TCP	Yes	No	Yes	Yes	Yes	Yes
	UDP	No	Yes	No	No	Yes	No
Data exchange	Request/response	No	Yes	No	Yes	No	Yes
	Publisher/subscriber	Yes	Yes	Yes	Yes	Yes	No
Security	TTL/SSL	Yes	Yes	No	Yes	No	Yes
	DTLS	No	No	Yes	No	No	No
QoS	Supported	Yes	Yes	Yes	No	Yes	No

5.1 Applications

Applications are built at the top of the IoT architecture to provide the services in real time such as Smart City, Healthcare, Transport, Smart Agriculture, Smart Supply Chain, Smart Grid, Target Tracking, Smart Environment Monitoring, and Smart Surveillance.

Smart devices are to be connected globally through the IoT. Some of the challenges make the framework of IoT vulnerable in terms of Scalability, Interoperability Security and Privacy, Reliability, Storage, Energy Efficiency [19].

5.2 Challenges

Interoperability, Energy Efficiency Reliability, Storage, Scalability, Privacy and Security are overcome with suitable communication protocol and cloud computing.

6 Conclusion

Real-time machine-to-machine communication within the IoT applications is an everyday necessity. However, the selection of IoT devices, Gateways, Communication protocols, Middleware, and Cloud platforms, is a challenging task for a universally adopted IoT system. For designing IoT applications it is essential to recognize the systems assets and liabilities. Best combination of emerging technology of the IoT system is a necessity and can be designed with the help of application protocols. The work presented discusses the IoT systems supported with different microcontrollers, gateways, operating systems, communication protocols, cloud platforms, application protocols, and IoT applications.

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Cryptography Based Security Solutions for IoT Devices

Sanjay Kumar Gupta and Sandeep Vanjale

Abstract Internet of Things (IoT) devices are simple rudimentary devices always connected to the internet. They are prone to the attacks from the internet. Recent studies in the field of IoT security is concentrated on a particular hardware, homogeneous setup, AI, SDN etc. However, as it can be seen in practical applications, the IoT devices are accessed and controlled through application layer; as the protocols operating in this layer are less complex and have good user interface. In this paper an effort is made to design a framework operating in application layer to implement security in an IoT setup, which can be further replicated on generic access device. This setup is then evaluated against the existing techniques for efficiency comparison.

Keywords IoT devices · Security framework · Application layer

1 Introduction

Internet of Things is a computing trend where the rudimentary devices are controlled through computerized system over the network and internet is preferred to manage the IoT Devices. Network is composed of layers and a set of protocols [1]. While using IoT appliances, it is important to maintain the Quality of Service and also security of the system. Breakthrough in IoT security may cause serious issues in its working environment [2]. There are some flaws in the IoT communication like insecurity of communication, security methods and protocols used [3]. Further as more and more customized services are available to end users, the security and privacy issues are becoming cause of concern for the system designers.

Information is exchanged between Application Layers by means of HTTP/HTTPS [4]. Also, most of the IoT application are accessed through HTTP protocol based front ends. Hence, for secured IoT communication, robust HTTP/HTTPS is desired [5, 6]. Application layer provides a low complexity, high level control, highly critical

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access control and security against malwares and programmable user interface in the rudimentary systems. Hence, it is desired to develop a solution for IoT setups that would run in the application layer and provide the much-needed security to the setup. In this paper, a cryptography-based security solution is proposed for an IoT setup. This solution operates in the highest layer viz. the application layer to filter out malicious attempts by the cyber attacker to get access to the IoT setup.

This paper is organized in 5 sections. Section 1 provides an introduction of application layer-based security. Section 2 provides the working details of the proposed security system. Section 3 provides performance analysis of the setup. Section 4 compares the working of the system with the latest state-of-the-art system and Sect. 5 draws the conclusion.

2 Application Layer Based Security Solutions for IoT Setups

The proposed system is referred as "Multilevel Cryptographic Hash function-based Security framework for Internet of Things". It provides enhanced security to access the IoT devices against DDoS attacks. It is generic in nature and can be used in any IoT device access structure. In this System, two types of users viz. Admin user and IoT user are created with respect to the type of framework. Admin user is able to access Framework I and Framework II. IoT user is able to access Framework III. Frameworks are developed in a such way that those can be accessed through cryptographic uniform resource locators only. Cryptographic URLs are developed by using hash function. However, for simplicity SHA 256 has function is considered. Based on those secret keys only, user can access the respective frameworks. Respective users of this System are provided with the secrete keys to access the respective framework.

Figure 1 provides the basic block diagram of the proposed system and Fig. 2 provides the proposed secure communication system using the framework structure.

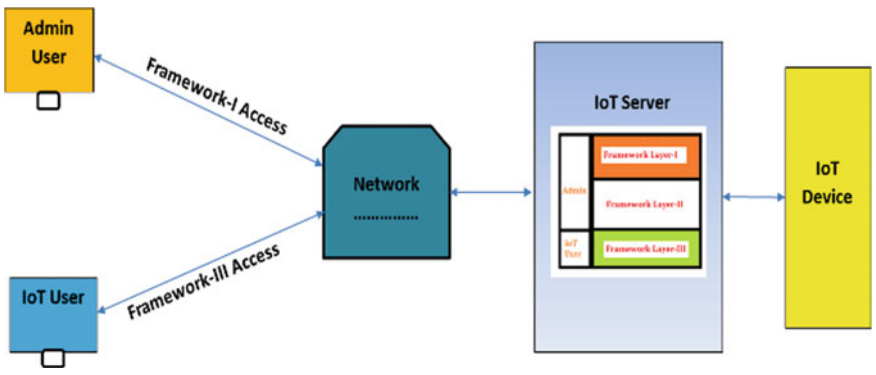

Fig. 1 Block diagram of proposed system

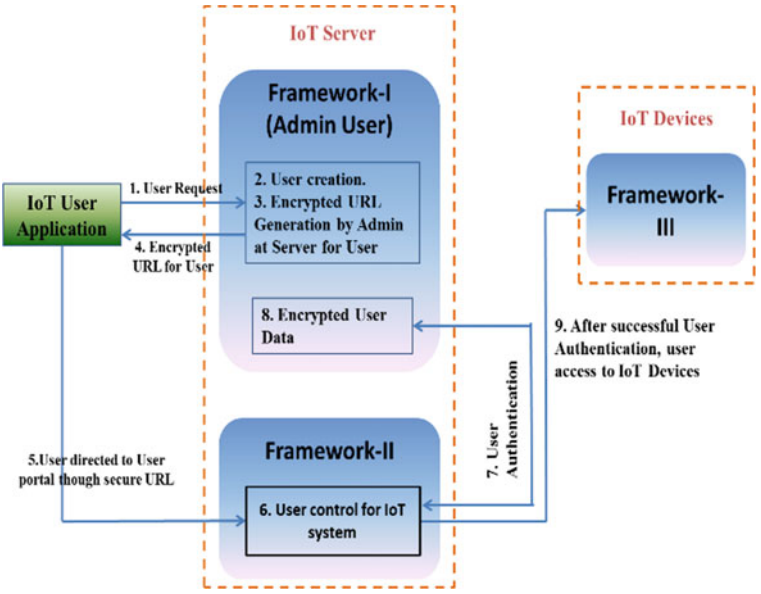

Fig. 2 Proposed secure communication framework

The setup is created using raspberry Pi computer boards, Wi-fi Router, laptop and servers. Standard user interfaces are created for users to access the IoT device. The setup can be further replicated on general access devices like smart phones, PCs, laptops etc. Table 1 provides the details of the keys used in the proposed system.

Salient Features of the Proposed System

- The system security feature is operating using Layer-7 of the OSI model by employing unique URL thereby providing state-of-the-art mechanism for the security, which can be implemented in any setup seamlessly.
- The proposed system is a robust mechanism for mitigation of DDoS attack on IoT setup as it employs low complexity solution for the mitigation taking into account the limited processing capabilities of the IoT setup. It uses one framework at a time thereby limiting the processing and memory requirements of the system.
- Low complexity SHA 256 algorithm is used for encryption thereby, offering a light weight security approach.

Table 1 Details of the keys used in the proposed system

User	Framework	Access parameters	Keys	Target	Server status	Cryptographic function used
IoT user	Framework-III	Secret key based URL	URL-secret key-II	Access the framework-III with IoT device access	–	SHA-256
		User credentials	Secret key-I/secret key-II	IoT device operations	Updating the IoT device status (ON/OFF)	
Admin user	Framework-II	System generated cryptographic URL	–	Access the server database (flask)	Update the secret key-III and secret key-IV	
		User credentials	A-secret key-III	Update the secret key-I and secret key-II	Updating the secret key-I and secret key-II	
	Framework-I	Secret key based URL	URL-secret key-I	Access the framework-I	–	
		User credentials	A-secret key-I and A-secret key-II	Access the system generated cryptographic URL	Updating the server with newly formed system generated cryptographic URL	

3 Performance Analysis of the System

The Performance analysis of the system is presented in this section. The parameters for evaluation analysis are CPU utilization, Execution Time and Thermal Readings. Figure 3 shows the performance of the CPU on idle condition and under DDoS attack.

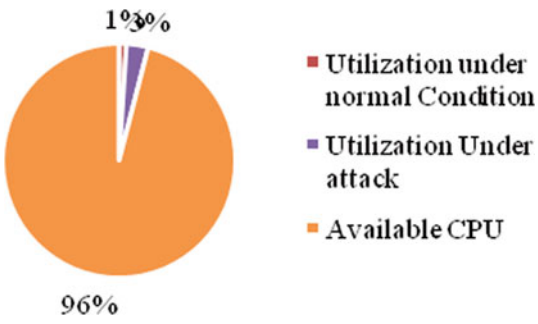

Fig. 3 CPU utilization during DDoS attack

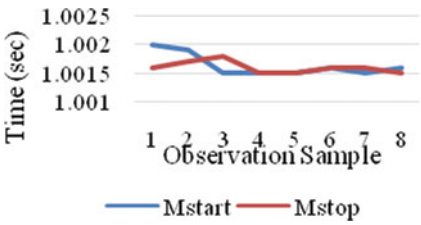

Fig. 4 Execution time analysis

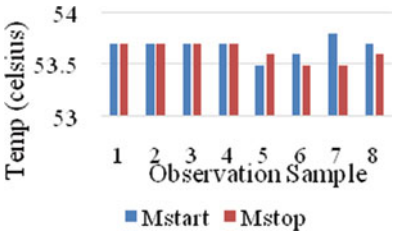

Fig. 5 Thermal analysis

The above analysis indicates that the desired action is completed by the setup with minimal CPU utilization and also shows a state of art performance on the event of a DDoS attack. Figure 4 details the execution time analysis of the setup. It shows total time of execution from providing the instruction by the user to performance of the activity concerned. The entire duration of the execution is <1.1 s, which includes the physical start and stop of the motor connected. This shows the efficiency of the system to perform the assigned task in real-time.

Figure 5 details the thermal readings of the setup. It indicates that the desired activity is completed without any major increase in the system temperatures. This indicates that the activity is performed in relatively good efficiency and in real time manner. From the analysis of the system as detailed above, it can be stated that the proposed system is highly efficient in performing the assigned task in real-time and has capability to integrate more such activities to have a complex functionality. Further the system is demonstrating promising results in detecting and mitigating the DDoS attacks in the system.

4 Performance Comparison with Latest Solutions

As per the research on mitigation techniques for the TCP SYN attacks, the best defense against such attacks is TCP Intercept approach [7]. In this approach, the gateway intercepts the incoming TCP connections and acts as a server to the client and only on completion of three-way handshake, the server is allowed the actual connection. This approach eliminates the malicious traffic both spoofed IP address and that coming from TCP SYN attack [8].

The QoS Parameters for a security solution should include CPU utilization, round trip time (RTT) and attack detection time [9]. CPU utilization is the measure of the complexity level of the system/algorithm [10]. As IoT devices have limited processing power, this parameter is of great importance in deciding the acceptability of the solution in IoT domain. RTT is the duration when a browser sends a request to the server and receives a response from a server. It is a key performance metric for web and its higher value may hamper the further growth of the system. In security solutions, "Detection Time" is the time elapsed in detecting an attack in the system. This time cost analysis is deciding factor in determining the magnitude of damage an attacker can cause to a system. Hence, this metrics is of prime importance in deciding the effectiveness of security algorithm in an IoT setup. The proposed system is subjected to a simulated DDoS attack and the results observed are presented in Figs. 6, 7, 8 and 9.

The performance of the system is benchmarked against the existing DDoS mitigation technique viz. layer-3 based TCP intercept technique and presented in Table 2.

It can be seen the system provides an improvement of 7% in CPU performance and about 2 s in round trip time thereby reducing the resource drain significantly in the event of a DDoS attack.

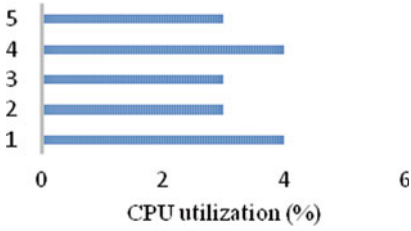

Fig. 6 CPU performance (with attack)

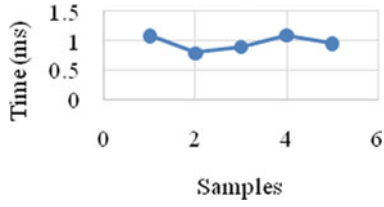

Fig. 7 RTT (w/o TCP SYN attack)

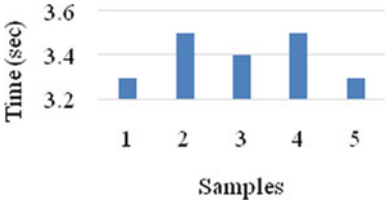

Fig. 8 RTT with TCP SYN attack

Fig. 9 Detection time

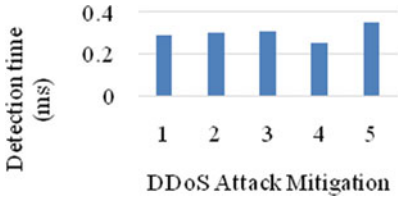

Table 2 Benchmarking with existing system

S. No.	Parameter	Existing system [8]	Proposed system
1	RTT without an attack (ms)	1.92	0.96
2	RTT during TCP SYN attack (ms)	5252.52	3442.52
3	CPU utilization without attack (%)	1	1
4	CPU utilization during attack (%)	10	3

5 Conclusions

The proposed security solution for IoT devices is implemented on Layer-7 for providing highly efficient and robust security solution. It is generic in nature and can be easily implemented in any access devices used in real-world IoT setup. The system further shows promising results in DDoS attack mitigation. On evaluating the system performance with that of the state-of-the-art Layer-3 solution, it is seen that the proposed system provides efficient resource utilization.

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Performance Evaluation of Radio Channel Models for mmWave

Amol D. Bhoi and Vaibhav Hendre

Abstract New media transmission frameworks are continually being created to address persistently expanding remote correspondence needs. The cutting edge organizations and gadgets are wanted to be accessible, in no time by 2021. Because of huge measure of accessible range millimeter wave (mmWave) correspondence is quite possibly the most encouraging advancements in cutting edge portable organizations. Regardless of the hypothetical capability of a high information rate, there are different specialized difficulties with utilizing mmWave. An important feature of mmWave is utilization of frequencies, propagation and channel modelling. The objective of this paper is to define the channel models for the indoor and outdoor scenario for the next generation systems using mmWave frequency. New requirements are identified and addressed for the channel modelling. Furthermore, the simulations of the widely suggested models Saleh-Valenzuela (SV), Wide-Sense Stationary Uncorrelated Scattering (WSSUS), Log-Distance Path Loss or Log-typical shadowing may give over-hopeful multi-client MIMO (MU-MIMO) execution in an indoor and open air climate at 30 GHz is done. The results in this paper give the choice of channel model for suitable environment in terms of estimated Frame Error Rate versus Signal to-Noise ratio parameter.

Keywords mmWave · Channel model · Indoor · Outdoor · MIMO

1 Introduction

Any communication requires a channel to convey the message. In radio communication, the channel is composed of the propagation channel and of transmitting and receiving antennas. The antennas at the both ends and propagation channel establish the radio channel. For creating remote frameworks and gadgets, the engendering channel is commonly the segment of the framework that can't be stays static. To get quicker and solid connection it is essential to plan reasonable transmitters, beneficiaries, receiving wires, calculations, and conventions [1–3]. The proliferation channel

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must be taken for what it's worth, and different parts must be planned considering the conditions and requirements set by the channel. Hence the plan of proliferation and radio direct models are vital in exploration and framework plan [1, 4, 5]. For the cutting edge remote correspondence framework, mmWave correspondence is perhaps the most testing innovation. Millimeter-wave (mmWave) recurrence groups between 30 and 300 GHz give plentiful unlicensed range and are promising to convey multi-gigabit-per second information rates for the improvement of the cutting edge remote correspondence frameworks [1, 2]. 28 and 38 GHz (26.5–40 GHz) are potential frequency bands for 5G cellular systems due to negligible atmospheric absorption and can be used for both mobility and backhaul between small cells [6]. The proliferation channel qualities across all mmWave frequencies is fundamental know to decide the reasonable transporter recurrence groups and to lead precise and dependable new framework design [3, 6, 7]. The more modest items and the articles that are extremely near one another may turn out to be very significant supporters of the spread properties of mmWave channels. The wide sense fixed (WSS) supposition that is generally viewed as because of stationarity of a channel which assumes an essential part in channel demonstrating and information examination of channel estimations. Exploration's accounted for that the spatial stationarity is extremely delicate to the transmission capacity of the mmWave channel. Consequently, the investigation in spatial stationarity could be basic too [5, 7, 8]. The beamforming innovation which depends on enormous receiving wire clusters to repay the high weakening. mmWave correspondence utilizes beamforming innovation for better execution. The fleeting and spatial non-stationarities were accounted for and displayed by scientists about multi-input and multi-output (Massive MIMO) [2, 8]. Bigger receiving wire geographies, with tens or many firmly pressed components, and enormous exhibits with conceivably actual elements of several meters, might be utilized [2, 4]. The highlights of the cutting edge framework set new channel displaying necessities for reproduced assessments of the framework. The purpose of any modelling is to reflect physical reality with an appropriate level of detail, balancing accuracy and complexity. The paper explains a selection of good model correctly renders the aspects of the radio channel relevant to the system to be evaluated. Normally a general all-purpose model would be too complex. Therefore, channel models are commonly developed for certain purposes, considering the use of the model as a design criterion. The rest of the paper is prepared as follows. Section 2 describes the different widely used channel models for indoor and outdoor environment for mmWave. Section 3 the simulation results of the channel models are presented and compares result of channel models across mm-wave frequency bands. Finally, Sect. 4 provides some concluding remarks.

2 Paper Channel Models

The first step in developing any channel model is to study the purpose—the coming use of the model. The key drivers for channel models were formulated as: large

antenna arrays, new frequency bands, and new deployment scenarios of transceivers. The most obvious new requirement is the support for mm-wave frequencies motivated by the considered spectrum allocations for next generation systems that will be confirmed in the World Radio Communication Conference in 2019 [1, 4]. The next generation channel model has to support the reconstruction of consistent multi-dimensional radio channel conditions at approximately 0.5–100 GHz, including not only path loss, but also fast fading related characteristics. For spatial consistency and mobility all channel attributes should differ sensibly and consistently on the grounds that either or the two closures of the radio connection are moving [5, 9, 10]. The highlight be considered is that, at mm-wave frequencies the channel might be exceptionally unique even with a movement over little distances. For instance, the way blockage impact from shadowing impediments is extreme and is viewed as vital for model [8] contrasted with sub 6 GHz frameworks. Next, that antenna arrays at mm-wave have a large aperture and the used bandwidths will be large, the transceivers have a high resolution in both the angular and delay domains. It is also known that scattering caused by rough materials and small objects versus larger smooth surfaces, results in substantially different propagation.

2.1 Wide-Sense Stationary Uncorrelated Scattering (WSSUS)

Wide-sense stationary and uncorrelated scattering (WSSUS) doubts are oftentimes applied for the quantifiable portrayal of far off correspondence channels. In this channel ideally, the drive reaction of the network is seen as Wide Sense Stationary (WSS) [11]. Given the far off direct inspiration response in the depiction of $h(r, t, \tau)$, by then those doubts limit the far off channel to be fixed or semi fixed in a particular extent of room (r), time (t), and delay (τ). The Wide-Sense Stationary Uncorrelated Scattering channel model unites the pieces of Wide-Sense Stationary and US channel model. In WSS channel drive reaction is autonomous of time t, that is the autocorrelation function $R_{hh}(t, \tau)$ is independent of time instant t and it depends on the difference between the time instants $\Delta t = (t_2 - t_1)$ where $t_1 = t$ and $t_2 = t + \Delta t$ and is expressed as

$$R_{hh}(\Delta t; \tau_1, \tau_2) = E[h(t, \tau_1)h^*(t + \Delta t, \tau_2)] \tag{1}$$

whereas for US channel model the autocorrelation function can be expressed

$$R_{hh}(t_1, t_2; \tau_1, \tau_2) = R_{hh}(t_1, t_2; \tau_1)\delta(\tau_1 - \tau_2) \tag{2}$$

The WSSUS channel drive response is self-ruling of time t, that is the autocorrelation work $R_{hh}(t, \tau)$ is autonomous of time moment t also it relies upon the distinction between the time. $R_{hh}(\Delta t, \tau)$ is obtained by combing the autocorrelation function of WSS and UC and express as

$$R_{hh}(\Delta t, \tau) = E[h(t, \tau)h^*(t + \Delta t, \tau)] \tag{3}$$

The frequency domain representation of the channel is represented by taking the Fourier Transform (FT) with deference one or the two factors for example distinction as expected (Δt) and the engendering delay (τ). FT of Δt gives more understanding to divert properties regarding proliferation delay τ and the Doppler Frequency f_D. The scattering function is the autocorrelation function on the variable (Δt) and is given by

$$S(f_D, \tau) = \int_{-\infty}^{\infty} R_{hh}(\Delta t, \tau)e^{-j2\pi f_D}\, d\Delta t \tag{4}$$

The dispersing capacity gives the normal yield force of the channel as an element of Doppler Frequency (f) and the propagation delay (τ). Power Delay Profile p(τ) gives the signal intensity received over a multipath channel as a function of propagation delays and is given as

$$p(\tau) = R_{hh}(0, \tau) = E\left[|h(t, \tau)|^2\right] \tag{5}$$

Power Delay Profile can likewise be acquired from dissipating capacity, by coordinating it over the whole recurrence range

$$p(\tau) = \int_{-\infty}^{\infty} S(f_D, \tau)\, df_D \tag{6}$$

Likewise, the Doppler Power Spectrum can be acquired by incorporating the dispersing capacity over the whole scope of engendering delays.

$$S(f_D) = \int_{-\infty}^{\infty} S(f_D, \tau)\, d\tau \tag{7}$$

2.2 *Saleh and Valenzuela (SV) Channel Model*

The SV model express that the got signal in a static wideband remote correspondence framework. It very well may be communicated as the amount of undistorted reproductions of the Multi-Path Components (MPCs) of the sent sign [12 –15]. The MPCs are deferred, lessened and moved in stage. The proliferation channel can be portrayed by a direct time-invariant filter with a complex baseband identical motivation reaction that can be communicated as

$$h(\tau) = \sum_{k=0}^{\infty} \beta_k e^{(j\phi_k)\delta(\tau-\tau_k)} \tag{8}$$

where are the random amplitude, phase and propagation delay of the kth multipath component is the Dirac delta function. The number of multipath components N arrived in delay interval of T is Poisson-distributed with and is given by [15],

$$\mathrm{P}[N = n] = \frac{(\lambda T)^n e^{(-\lambda T)}}{n!}, \quad n = 0, 1, 2, \ldots \tag{9}$$

where is the mean arrival rate. The differences between the arrival delays of successive MPCs are exponentially distributed and mutually independent which is given by

$$\tau_k = \tau_0 + \sum_{m=1}^{k} \Delta\tau_m \tag{10}$$

where is arrival delay of the first component and the interarrival delays have probability density

$$p_{\Delta\tau_k}(\tau) = \lambda e^{(-\lambda\tau)}, \quad \lambda > 0 \tag{11}$$

It is observed that the multi-point components have the tendency to arrive in clusters. For that reason, Saleh and Valenzuela introduced an alternative model for indoor environments, based on a doubly stochastic Poisson process, in which the multi-point components arrive in clusters. Hence impulse response in (12) is replaced by

$$h(\tau) = \sum_{l=0}^{\infty} \sum_{k=0}^{\infty} \beta_{k,l} e^{(j\phi_{k,l})\delta(\tau-T_l-\tau_{k,l})} \tag{12}$$

where $\beta_{k,l}$ *and* $\phi_{k,l}$ are the random amplitude and phase of the kth multipath component in the lth cluster, respectively, T_l is the random arrival delay of the lth cluster.

2.3 Log-Distance Path Loss with Log-Normal Shadowing

Many propagation studies performed at mmWave bands considers the applications as view, highlight point, or indoor situations. mmWave frequencies go through more noteworthy free space constriction in the principal meter of engendering from Tx receiving wire. The mmWave also undergo penetration loss, foliage attention, oxygen absorption and rain attenuation [4, 9].

$$[P_L(d)]\,\mathrm{dB} = [P_L(d_0)]\,\mathrm{dB} + 10n\log\left(\frac{d}{d_0}\right) + \chi \quad for\ d \geq d_0 \tag{13}$$

where d distance in meter, n Path Loss exponent, χ Gaussian distributed random variable with std. deviation σ in dB, PL(d_0) reference path loss (Close-In (CI) reference distance). In both LOS and NLOS scenario the CI free space reference distance model and floating intercept model may be used to characterize mmWave channels. But it is reported that the use of [14] with $d_0 = 1$ m for mmWave path loss channel modeling, because of the simpler form, the physical basis, and reasonable accuracy across many environments, scenarios, and frequency bands [4].

$$\left[P_L^{CI}(f,d)\right]\mathrm{dB} = 10n\log\left(\frac{d}{1\,\mathrm{m}}\right) + 32.4\,\mathrm{dB} + 10n\log\left(\frac{f}{1\,\mathrm{GHz}}\right) + \chi_\sigma^{CI} \tag{14}$$

where 32.4 dB is a free space path loss at 1 m and at 1 GHz.

3 Simulation and Results

The above four channel models are simulated for indoor and outdoor environment. For indoor and outdoor environment, the probability of noise is assumed to be 10% and 30% respectively. The operating frequency is set to be 30 GHz. At the transmitter 1000 symbols are inputted. The input data symbols are encoded with Cyclic Redundancy Code (CRC) and Low-Density Parity-Check (LDPC) with OFDM. The channel performance is evaluated for 16-QAM OFDM with and without CRC.

The channel performance is evaluated without CRC and with CRC for indoor and outdoor environment four models. From Fig. 1 it is clear that for indoor scenario it is clear that without CRC the FER is more than with CRC. It is also observed that the without CRC Saleh and Valenzuela (SV) Channel Model gives better performance that the other models.

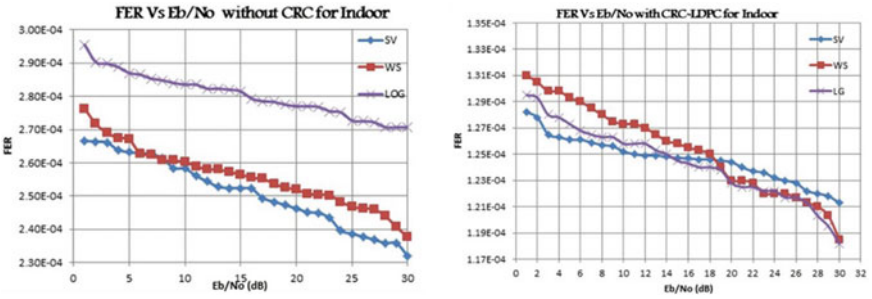

Fig. 1 FER versus Eb/No with CRC for indoor

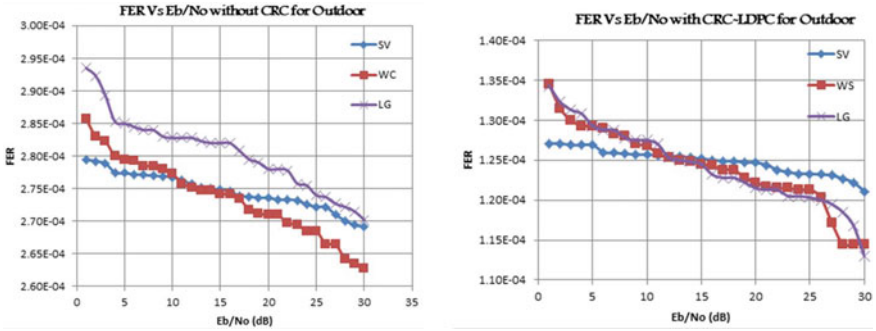

Fig. 2 FER versus Eb/No without CRC for indoor

For outdoor scenario Wide-sense stationary and uncorrelated scattering (WSSUS) channel performance considerably good than SV, and Log-normal model as shown in Fig. 2. It is also clear from Fig. 2 that the WSSUS model gives better performance as compared to the other models.

4 Conclusion

The channel models for mmWave frequency are proposed in this paper. The performance of Log-Normal, SV, GBSCEM and WSSUs models for indoor scenario is simulated at 30 GHz with CRC and LDPC. It is observed that with SV model with CRC is preferable for indoor environment. The outdoor scenario appears to be more realistic with WSSUS. The presented work provides a realistic and simple simulation model for the performance evaluation at mmWave.

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A Critical Survey on Machine Learning Paradigms to Forecast Software Defects by Using Testing Parameters

Y. Prasanth, T. Satya Sai Vinuthna, P. Komali, K. Kavya, and N. Aneera

Abstract This project detection of malicious software commonly known as malware that gets into the system without user consent to steal private and confidential data of the user that includes bank details and password. The analyzing behavior, functionality, and impact of malware samples on a user system are denied as malware analysis. Methods that are used to analyze the behavior of malware is static or dynamic. Static examination is the underlying and amazing wonder to break down the malware without running it. While in powerful examination, the paired records are executed in the controlled climate and the running conduct is caught. Utilizing these methods, special examples are removed to distinguish malware effectively. In addition, extricated highlights from the dataset are utilized in malware discovery. At last, all the features which are extracted are given to the classier which is machine learning findings like Random Forest, XGboost, and KNN, etc. It aims to calculate and predict the accuracy in a new way where malware is found.

Keywords Classifier · Machine learning · Filter based · Extraction · KNN · Random forest

1 Introduction

With the growth of the internet and the popularity of computers, today's computers face significant security challenges, the primary cause of which is the exponential growth of malicious code [1, 2]. Malicious code is computer code that is written with the intent of posing a security risk to a computer or network. Malicious sharing applications, adware Trojans, and viruses are commonly contained in it [3, 4].

On the PC side, there were 14,098,000 malicious programmes intercepted, with an average of 779,000 new malicious programmes intercepted every day [5]. On the PC side, there were 14,098,000 malicious programmes, with an average of 779,000 new

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malicious programmes intercepted every day [6–8]. McAfee Laboratories uncovered the most new malware in history in the fourth quarter of 2017, with a total of 63.4 million new samples. McAfee Laboratories currently reports an average of eight new malware samples per second, up from four new samples per second previously [9–11].

Malware not only causes users to lose money, but it also places a lot of strain on malicious software anti-killing technologies due to rapid changes [12, 13]. The current technological demand makes it difficult to detect malware until it infects the host. Since most malware cannot talk, detecting malware-infected hosts in network traffic will compensate for this shortcoming with externally hosted command and control (C&C) servers infecting the device [14]. The command and control server (C&C server) is the command and control centre for malware. It is also where malware collects data. The managed host sends a link request to the C&C server after being infected by malware. The external traffic created by the link is malicious.

We can currently classify malware in two ways. The first is to use blacklists to filter malicious domain names, and the second is to use rules to balance malicious external traffic. Both of these options have several disadvantages [15]. The blacklist-based filtering scheme can only detect malicious external traffic when it links to a known malicious website, and it doesn't take into account domain name changes [16]. The security practitioner must evaluate each sample one by one, which takes a lot of time and makes it difficult to detect the variant's malicious external link traffic based on the feature selection theme.

2 Theoretical Analysis

As part of the technique to detect the malware we have used algorithms like Random Forest, KNN, XGboost, etc. We can also use the feature extraction technique to extract the features from the data set.

To detect the malware in the system the pre-processed data set is given to the classifier to each of the algorithms. Based on the accuracy the features are extracted on the ranking of the attributes for the algorithms. The features which are extracted are then given to the feature selection tool.

Here we have developed a new approach to detect the malware. By classifier training, the original data set classified by using some algorithms in machine learning and gives the malware percent.

2.1 Classification Algorithms

Characterization calculations in AI utilize input preparing information to foresee the probability that ensuing information will can be categorized as one of the fore-ordained classes. Perhaps the most well-known employments of arrangement is separating messages into "spam" or "non-spam."

So, an order is a type of "design acknowledgment," with grouping calculations applied to the preparation information to locate a similar example (comparative words or slants, number successions, and so forth) in future arrangements of information.

The issue in perceiving the malware can be seen as a worm grouping issue. To identify the malware here we have utilized a portion of the techniques like KNN, Decision Tree, and XGboost. These calculations go about as a classifier and suspicion of exactness.

K-Nearest Neighbor (KNN)

K-Nearest Neighbor depends on the Supervised Learning procedure and perceived as the least complex based AI calculation.

K-NN expects the up to minute information of equities and right now present information and store into the class that is well on the way to the accessible classifications.

K-NN calculation stores all the information which is accessible and accepted dependent on uniformity it classifies. This implies when new information is seen then it very well may be handily partitioned into a decent suite classification by utilizing K-NN calculation.

K-NN calculation can be utilized to arrange however generally it is utilized for the Classification issues.

K-NN is a non-parametric calculation, which implies it doesn't expect on present information.

KNN calculation doesn't gain from preparing set quickly rather it stores the dataset, it follows up on the dataset so it is named an apathetic sprinter calculation.

Random Forest

Random Forest is in a two-step process,

1. Combination of N decision tree
2. Prediction of each tree

Step 1: First select the arbitrary K points (data) among the preparation set.

Step 2: Build the choice trees associated with the recognized information focuses which are subsets.

Step 3: Finally pick the number N for choice trees that you like to build.

Step 4: Repeat Steps 1 and 2.

Step 5: For new information focuses, discover the forecasts of every choice tree, and allocate the new information focuses to the class that successes the greater part casts a ballot.

XG Boost

XG Boost has recently diminishing applied machine learning and Kaggle competitions for structured or tabular data.

eXtreme Gradient Boosting is called as XGBoost.

The speed and performance of the gradient boosted decision trees are the main implementation of the XGBoost.

Reasons for using XGBoost:

Speed of the Execution.
Performance of the obtained model.

It's a new algorithm and having accuracy as same as a random forest so we compared the accuracy of both the algorithms; so we use XG BOOST but it resulted in low accuracy compared to others.

3 Methodology

To detect the undetermined malware using techniques in machine learning, a flow chart of our approach is shown below. It includes preprocessing of the dataset, promising feature selection, training of the classifier, and detection of advanced malware as shown in Fig. 1.

3.1 Accuracy Prediction

The ratio of classification accuracy is the number of predictions that are accurate to the total quantity of samples. It works well if they are an equal quantity of samples. Here in our project, the accuracy is predicted using the classifier. The confusion matrix gives us the matrix as the output it tells the overall performance of the model.

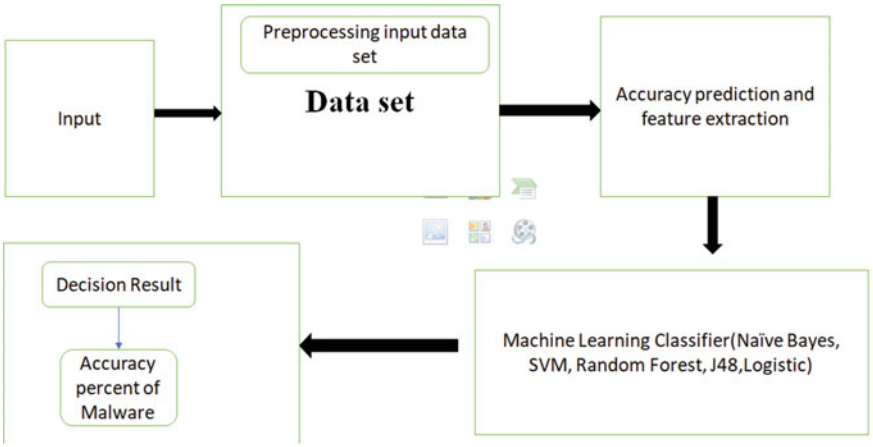


Fig. 1 Architecture of malicious software detection

True Positives: Assumption YES output YES.
True Negatives: Assumption NO output NO.
False Positives: Assumption YES output NO.
False Negatives: Assumption NO output YES.

Positive True Rate—Sensitivity

It is defined as True Positive Rate determines the number of positive data points that are correctly identified as true, as per the data point which is given as input.

Negative True Rate—Specificity

It is defined as False Positive Rate determines the number of false data points that are identified as false, as per the point of data which are given as input.

3.2 Features Extraction

The main aim of feature extraction is to reduce the number of resources in the input data set. But here the ultimate downside is with the examination of complicated information from the participation of amount of variables. A large amount and the memory is required for analyzing the greater number of variables and can cause a classifier algorithm for training samples and an indication of poor to the new samples. It is used for developing methods of the variables with still saying that the data is sufficiently inaccurate. The key for effective model construction is done by optimized feature extraction.

4 Experimental Investigation

After selecting input data we have to use a certain method to calculate the accuracy value. There are various methods like using the KNN model, SVM model, Decision tree, and boost. In our project, we have used the concept of term extracting features to predict the accuracy of the level of the malware which is present in the software.

4.1 Preprocessing

Every real-time data contains noise such as unwanted words or unwanted attributes or unwanted spaces. As this din might affect our result we have to preprocess the data to remove this noise. These attributes also increase processing time to remove these unwanted attributes we use classifier remove.

Capturing the Run Time Behavior

The run-time activities describe the behavior file that is executing.

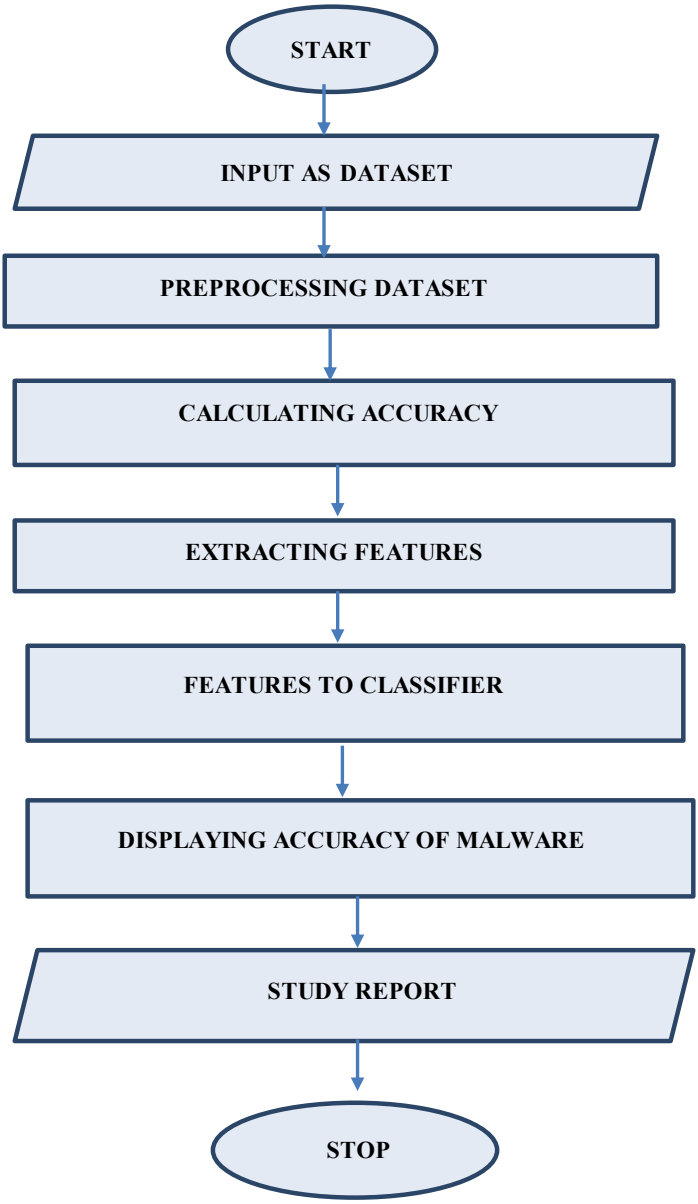
Feature Extraction

Feature Extraction module selects run time features from pre-processing data sets. Feature extraction is a common term for various ways of building combinations of the attributes to get around these with sufficient accuracy while describing the data.

Classifier Training

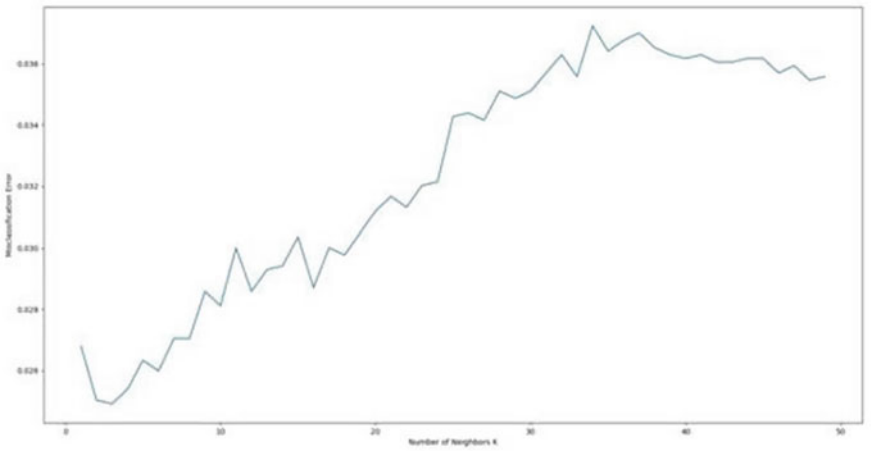
To assess the proposed technique, the original data set is classified by using machine learning algorithms and gives the classification of malware files and benign files.

4.2 Flow Chart



4.3 Table: Accuracy

Algorithms	Accuracy (%)	Extracted features accuracy (%)
Random forest	97	98.2
Naïve Bayes	96.3	96.7
Support vector machine	97.2	97.8
Decision tree	92.6	94.2
J48	98.1	98.4
XGBoost	97.3	97.9
Logistic	87.4	89.5



5 Experimental Results

In our project, we have used two different algorithms to calculate the comparative report.

KNN Algorithm

Sensitivity: 97.3%

Specificity: 95.3%.

Random Forest

Sensitivity: 99.2%

Specificity: 96.09%.

From the above results, we can observe there is quite some difference between the outputs of two models for the same input applications. This is mainly because our second model works well if we want to calculate malware of the software. That is it only focuses on malware recognition. Whereas our first model works well if we want to calculate the same worm/virus but not efficient. After extracting features the accuracy has improved and hence we want to prove that the algorithms we used can tell the percent of malware. So, we get accurate results with second as it also considers context. The difference between the results of two models for the same input is because of the different functions of these models. Hence it is preferred to use the second model over the first model.

6 Summary

A sort of similarity analysis is also conducted using various methodologies and found how malware is detected by this. Usually, the first step is to process the data set that is given as input which is used to recognize the malware in the further process; and the prediction we found in the further step leads to analysis and prediction of each algorithm on the data set.

Though the predicted accuracy is not sufficient and on the further step features are extracted based on the variable ranking. The classifier technique to classify the malware.

7 Conclusion

This project mainly focuses on detecting malicious software using machine learning techniques. We have used different models to find the similarity and we have also used some filter based technique to achieve our goal. Based on the results talked-over in Chapter "Comparative Study on Online Teaching Learning Tools" we can conclude that the second model is more accurate or precise compared to the first model.

Some applications of this project are the identification of plagiarism in software, it can be used during searching for certain applications, it can be used during the testing phase of software to decrease the testing size, and so on.

8 Recommendations

As we have done two models in which one is effective in detecting the malware and the second model is least as compared to the first one. The second model also detects

the malware to some extent. But as an advancement of this project, the model that we recommend is a random forest.

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A Novel Descriptive Approach: Local Tetra Patterns (LTrPs) for Face Recognition

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Abstract Face recognition plays a significant research attention in the recent years on computer vision with emerging security needs in automated video surveillance. Face recognition is plays major role in day-to-day life such as accessing mobile phone through face identification, crime investigation, and victim identification in the crowded area. Due to need in security increases derivative pattern based approach improve the recognition accuracy which leads to the LTrP with four directions. In this work, we propose local tetra pattern (LTrPs) based derivative approach for representing descriptive patterns of facial images. Local Binary Patterns (LBPs), Local Derivative Patterns (LDPs) and, Local Ternary Patterns (LTPs) which encoding association between the neighboring pixels, and referenced pixel values by generating gray level pixel value difference. Proposed approach encode association between pixel, and referenced pixel value. Neighboring pixel value directions are computed through first order derivative of horizontal directions. Nth-order tetra pattern is computed through (n − 1)th-order vertical, and horizontal derivatives for accurate facial image analysis through Gabor transform. To estimate the proposed system performance experiment conducted with JAFFE and ORL dataset. As a result, LTrP achieves the better recognition accuracy among the other patterns such as LBP, LTP and LDP.

Keywords Local tetra patterns (LTrPs) · Pattern recognition · Facial image recognition · Gabor transform (GT)

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1 Introduction

Face recognition [1] in automated video surveillance leads to variety applications such as facial image analysis, biomedical data analysis, and crime investigation etc. Face recognition techniques are broadly categorized into geometric template matching through features. Geometric based matching segmenting [2] facial features as mouth, nose, and eyes also some illustrative information such as widths, heights. Template based matching technique [3] recognize the face through non-segmentation. Face is represented as 2D array and compared as high dimensional data. Furthermore, euclidean distance is calculated and Principal Component Analysis (PCA) is to reduce the dimensionality [4, 5], and to resolve issues in the face detection. Face recognition [6] contains three phases such as face detection, feature extraction, and its recognition. First phase is to localize the face, and removes the other irrelevant details from an image. In phase two, feature extractor transforms the image pixels into vector representation [7], and face recognizer is the final phase to recognize the face. An extensive review on face recognition is presented in [8–10]. In recent years, face recognition is mainly used in most of the automated surveillance such as public safety, health care [11] biometrics verification [12], alleged terrorists, smart phones [13] and defense. Jahnavi et al. [14] analyzed both human emotional behaviors and recognition. In [15] used the face recognition for securing the cloud data with deep learning. Local binary pattern [16] descriptors are extracted and applied on the face recognition for facial picture recognition. LTrP based method is applied for face recognition system is to increase the accuracy and protect personal data when smart phone is accessing through face. This technology employed for huge range of real time cases such as crime investigation, victim identification in the crowded area, and for convenient air traveling. Organization of the proposed system as follows. Section 2 discusses various descriptive patterns applied on face recognition in the recent work. In Sect. 3 describe LTrP based proposed method in detail. Section 4 discusses experiment evaluation of the proposed work with JAFFE and ORL datasets and compared with existing approaches. Section 5 discusses conclusion, and future extension of the proposed method.

2 Related Works

Different existing approaches applied on face recognition in videos such as hand craft features (HOG, Harris 3D, HOF, OF etc.) to generate spatio-temporal features around region of interest, and then SVM using for classification. This section, we review the related work on descriptive patterns such as LBP, LTP, LDP but not hand craft based approaches. Table 1 summarizes the different descriptive patterns with features, and datasets.

Table 1 LBP, LTP, and LDP in the recent work

Author and Refs.	Patterns	Features	Dataset
Zhang et al. [7]	LBP	Gabor binary pattern with histogram sequence	FERET
Gritti et al. [2]	LBP	Local features with face registration errors	FERET
Ahonen et al. [6]	LBP	Texture features	FERET
Murala et al. [18]	LTP	Encoding with reference and surrounding pixels	Corel 1000, MIT, Brodatz
Zhang et al. [20]	LDP	Directional pattern features	FRGC, CAS-PEAL, Extended Yale B, CMU-PIE
Shan et al. [21]	LBP	Statistical local features	PETS, MMI and JAFFE
Liao and Young [22]	LTP	K-dimensional histogram features	Brodatz
Jahnavi et al. [14]	LBP	Appearance features (skin colour) and Ada boost	COHN-KANADE AU and FER
Vishal et al. [16]	LTP	Appearance and histogram based features	Face expression

A. Local Binary Pattern

LBP [3, 17] employed on frames to learn appearance features such as texture, contour. The LBP operator generated by extracting pixel value of an image that calculates the threshold value of 3 × 3 neighborhood with each pixel of center gray value which considering decimal value results in (1).

$$\mathrm{LBP(P,R)} = \sum_{p=1}^{P} f_1(g_p - g_c)2^{(p-1)} \quad \text{where } f(x) = \begin{cases} 1, \text{ if } x \geq 0; \\ 0, \text{ else} \end{cases} \tag{1}$$

where g_c represents pixel value of the center pixel, g_p is denote neighboring pixel gray value, P denotes total number of neighboring pixel of the center pixels, and R is the neighborhood value of radius. LBP operator is calculated by 3 × 3 center pixel. Binary 1 is generated if the neighboring pixels are greater than center pixel and binary 0 is generated when neighbor pixels are less than the pixel in center value. Figure 1 shows LBP operator example. Furthermore, LBP is applied in facial expression recognition due to its performance is improved than the Eigen face algorithm. It produce micro patterns by subtracting center pixel from the other neighbouring pixels (8 pixels) and it constructing the micro patterns through clockwise combination of neighbouring pixels. This technique is mostly used on face recognition system [3] due to the robustness, accuracy.

B. Local Ternary Pattern

LTP is an extended version of LBP. Tan and Triggs [1] discussed that LBP tends to be noise sensitive due it thresholds at the center pixel value. Furthermore, it has

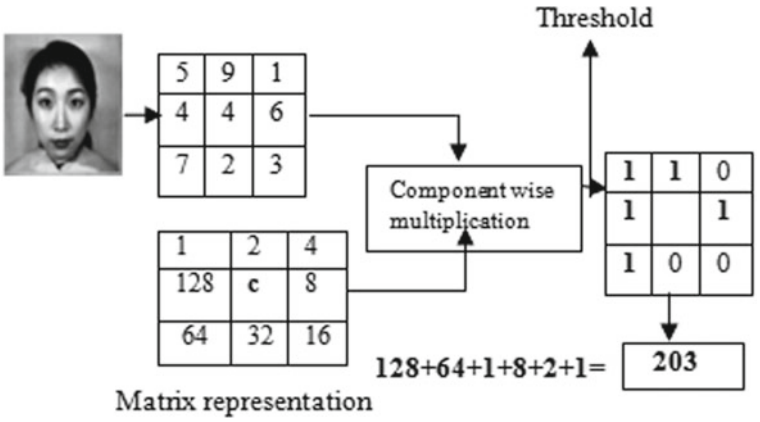


Fig. 1 LBP operator

extended the version through 3-valued codes, known as LTPs. LTP [18, 19] operators are sensitive to noise, the gray values is in the region with the width of ±t which around g_c that is quantized to be zero. Pixel values above levels are quantized to be +1, and the values below the gray are to be quantized as −1, indicator of s(u) that is replaced as 3 value function. Here, t denotes the user threshold that is represented in Eq. (2). LTP having more resistant for noises and this is not invariant for the transformations on gray value level.

$$f\left(u, g_c, t\right) = \begin{cases} +1, & u \geq g_c + t \\ 0, & \left| u - g_c \right| < t \\ -1, & u \leq g_c - t \end{cases} \tag{2}$$

C. Local Derivative Pattern

Zhang et al. proposed LDP on face recognition in [20]. The LDP operator generated from LBP, in which it considered as non-directional and first order pattern. This pattern extended as higher order (nth order). Moreover LDP having discriminative features compare than LBP. To compute nth order, and (n − 1)th-order of derivatives with 0°, to 135° which represented as $I_\alpha{}^{(n-1)}\,(g_c)|_\alpha = 0°$, 45°, 90° and 135°. Furthermore, nth-order pattern is calculated as in (3) and (4)

$$LDP_\alpha^n\left(g_c\right) = \sum_{P=1}^{p} 2^{(p-1)} S\left(I_\alpha^{(n-1)}\left(g_c\right), I_\alpha^{(n-1)}\left(g_p\right)|_{P=8}\right) \tag{3}$$

$$S(x, y) = \begin{cases} 1, \; if \; x, y \leq 0 \\ 0, \; if \; else \end{cases} \tag{4}$$

In literature, different local patterns have been applied for recognition with large database. Patterns based recognition approach performance is evaluated in terms of precision, recall, error rate etc. LBP [21–24], LTP [25], LDP [4, 14–16, 26] are extract facial features by the edges distribution with two directions. Moreover, the performance accuracy is degraded to the challenges in the dataset such as appearance variations (noise, size, texture, and color), pose. Hence the patterns need to be improved to achieve better accuracy by differentiating edges with another two directions. It leads to the motivational factor for LTrP [27] with four directions. Various techniques for feature extraction and facial image representation such as texture [11, 12, 28–31] features, directional facial features [32], local histograms [5, 13, 33–36] have been reported in literature is summarized in Table 1.

3 Proposed Work: Local Tetra Patterns (LTrPs)

LBP, LTP and LDP are extracting the facial images with edges distribution that are coded with pixel directions [12, 27, 28]. Yang and Chen [35] applied enhanced LBP histogram for recognition, and obtained better results when compare with holistic local binary pattern histogram. In enhanced LBP histogram the images are divided by d-patches, and LBP is applied on extracted patches. To extract the enhanced LBP histograms the d-histograms are to be concatenated. To evaluate the performance of proposed approach differentiating edges with two more directions. This analysis is the basic motivation for the proposed pattern generated with four different directions which is known as Local Tetra Patters (LTrPs) [5, 11, 18, 29, 30, 32, 34] for facial image analysis. Feature vector is extracted from the LTrP operator with the length of 12×256 and this can be reduced through uniform patterns. In the proposed method, to achieve the better result again the enhanced histogram the images are divided as d-patches, and LTrPs is applies on the d-patches. The second-order derivative is calculated through pixels direction by using horizontal, and vertical derivatives. Frame work for proposed approach has shown in Fig. 2. Proposed system algorithm is represented as follows,

Input: Query image;

Output: Facial image recognition

1. Load the input image, and covert in to gray scale
2. Applying first-order derivative
3. Calculate the four directions for ever pixel
4. Calculate the tetra pattern and histogram pattern
5. Calculate the magnitude pattern and histograms
6. Combine the computed histograms from steps 4 and 5
7. Feature vector construction
8. Query image comparison with face database
9. Facial image retrieval through facial images matches found in image database.

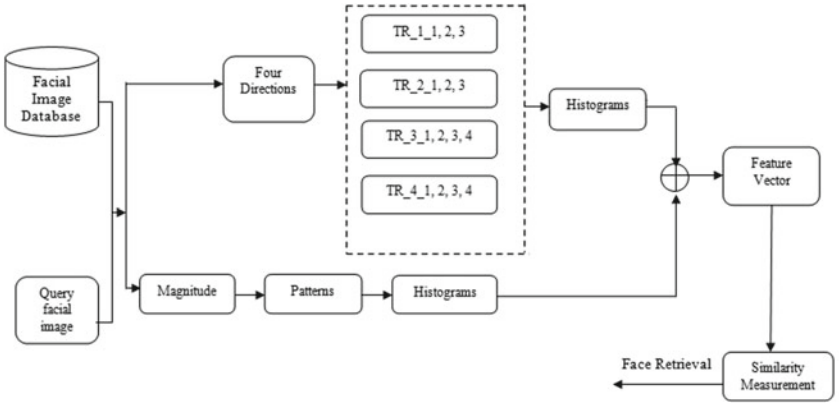


Fig. 2 Proposed LTrP based face recognition system

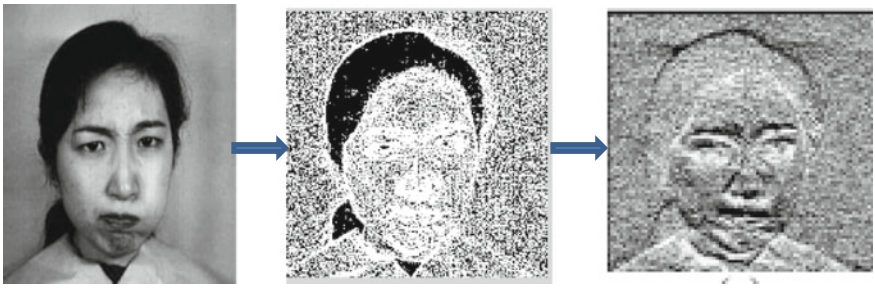
Descriptive feature vector is extracted from an image, and each image is represented as feature (vector). Selection of N best facial images are resemble the input query image. It selects n matched images through calculating distance between the input query image and the database. LTrP is differing from LDP by making use of 0° and 90° derivatives for generating direction of every pixel. Nth-order tetra pattern operator is represented by the derivatives of $(n-1)$th-order.

Architectural framework of LTrP based on proposed approach has shown in Fig. 2. Images are stored in facial image database such as JAFFE and ORL. The query image has enter into the preprocessing (resize and gray scale conversion) to make ease of the feature extraction and feature representation. Then the four directions of the LTrP patterns are generated namely TR_1_1, 2, 3, to TR_4_1, 2, 3 and then enhanced histogram is calculated from these directions. The queried image compares with facial database and it generates the LTrP and calculating magnitude with descriptive patterns. Afterwards, histogram applied on the patches to compute feature vector. Furthermore, the similarity measurement obtained with LTrP with face recognition of the query image. LTrP defines spatial features of local texture by computing direction of center gray pixel value which is represented as g_c. Image (I), 1st-order derivatives generated along with 0° and 90° directions which is represented as $I_\theta^1(g_p)|\theta = 0°$, 90°. Let g_c is center pixel of the image (I), g_h, g_v that denotes horizontal\vertical neighborhoods of g_c respectively. 1st-order derivatives are denoted as g_c can be represented as

$$I_{\mathbf{0}^\circ}^{\mathbf{1}}\left(g_c\right) = I\left(g_h\right) - I\left(g_c\right) \tag{5}$$

$$I_{\mathbf{90}^\circ}^{\mathbf{1}}\left(g_c\right) = I\left(g_v\right) - I\left(g_c\right) \tag{6}$$

Center pixel g_c direction is generated by comparing the different values which is between 0° and 90°. The center pixel direction is $(I_{Dir}^1(g_c))$ obtained by using 1, then



(a) Input images (b) Pre-processing image (c) LTrP Pattern images

Fig. 3 Transformation of an input images to LTrP

with $LTrP^2$ that defined through the segregation of following binary patterns

$$LTrP^2|_{Direction=2,3,4}$$

Mandhala et al. [26] applied magnitude on local difference between the operators to compute magnitude along with LBP sign for face texture generation. The sign, magnitude components are generating clues. It has motivated to generate binary pattern (LP) through magnitudes of vertical, horizontal first-order derivatives.

Transformation of input images from the dataset is to generate LTrP descriptive pattern shown in Fig. 3. Pattern with P neighing pixels, 2^p LBP combinations of descriptive feature vector direction and its length is 2^p. Generation feature vector computational cost is very high. Cost can be reduces, with uniform pattern is applied. This pattern known as uniform pattern which is having limited discontinuities of circular representation. These uniform patterns has discontinues which is (<=) less/equal to circular representation that are known as uniform patterns, and otherwise it is known as non-uniform pattern. After identifying these patterns (LBP, LTP, LDP and LTrP) images are represented through histogram generation. LTrP with other patterns: LBP, LDP and LTP are encoding the images only with two/three distinct values, respectively. Moreover, LTrP encode with four distinct pixel values. Hence, it extracts descriptive information from an image. It encodes the images on center pixel gray value and its neighbors, where LTrP encodes center pixel value depends on $(n - 1)$th-order derivatives.

4 Experimental Analysis

Proposed system performance is evaluated by modeling test images from data set. In this section, we discuss the experimentation analysis with two datasets namely JAFFE (Japanese Female Facial Expression) [30] and ORL (Olivetti Research Laboratory) [32] datasets described in Table 2. The experiments conducted and analyzed

Table 2 JAFFE and ORL dataset description

Dataset	Facial expression	No. of subjects	Total no. of images	Resolution frame rate
JAFFE	Neural, sadness, happiness, surprise, anger, fear, and disgust	10 (gray scale)	213 static images	256 × 256
ORL	All frontal and slight tilt of the head	40	400 images	112 × 92

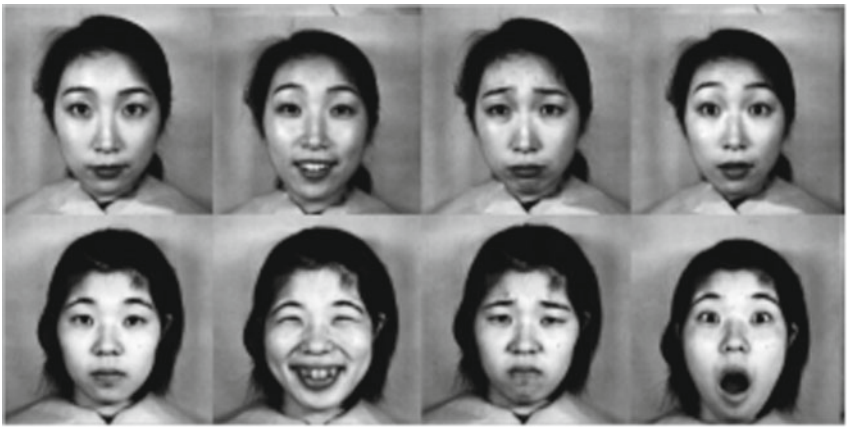


Fig. 4 Sample images from JAFFE dataset

the performance evaluation with different matrices. JAFFE dataset contains of 213 images with 10-Japanese female expression, 7-posted facial expression (6 basic facial expressions and 1 neural) and all other images are averaged semantic range on 6 emotion (60 Japanese viewer) with 8-bit gray scale. Each images resized as 256 × 256 pixels. Sample face images in JAFFE dataset is shown in Fig. 4. ORL dataset consists of 400 images with 40 different persons with size of 112 × 92. Video images are collected at various timing, different light settings, and expression. Sample images from ORL dataset is shown in Fig. 5.

Performance of the proposed method is estimated by the parameters accuracy, precision, and recall rate with JAFFE and ORL database. The accuracy is calculated with true positive with total number of images in dataset shown in Fig. 6. Error rate is shown in Fig. 7. As shown in Table 3 LTrP achieved the better accuracy as compared with LBP, LTP, and LDP.

Fig. 5 Sample images from ORL dataset

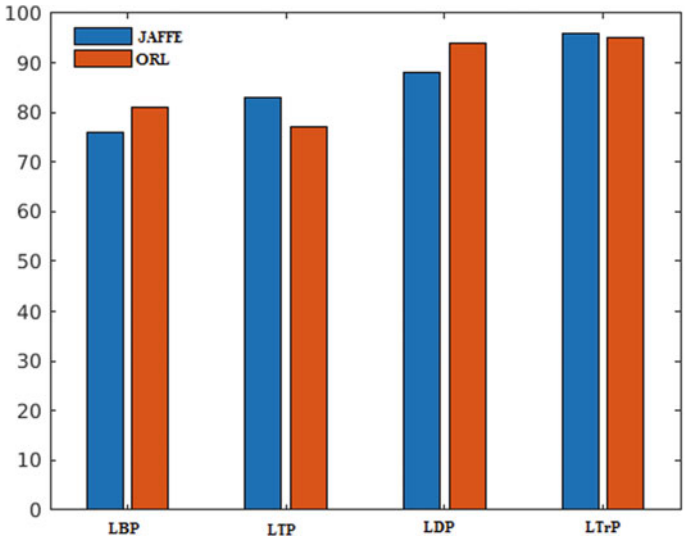


Fig. 6 Accuracy performance evaluation comparison with LBP, LTP, LDP, and LTrP with JAFFE and ORL dataset

5 Conclusion and Future Work

In this work, new derivative method is proposed through LTrPs on face recognition. Proposed method encodes facial images using pixel direction which is computed by both horizontal/vertical derivatives. Binary pattern magnitude is computed through derivatives of the magnitudes. Proposed method performance evaluated though accuracy and error rate with JAFFE and ORL dataset through LTrP. proposed method

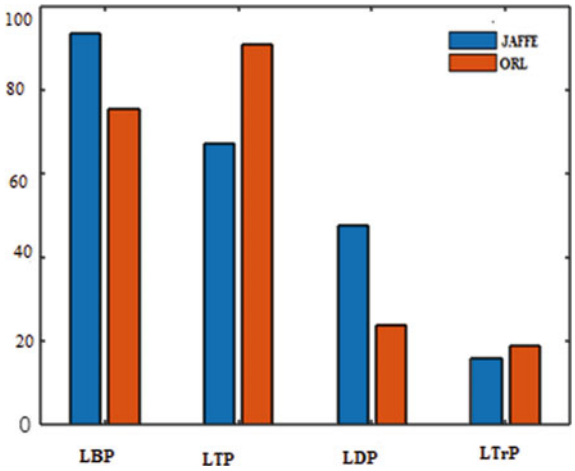


Fig. 7 Error rate evaluation comparison with LBP, LTP, LDP, and LTrP with JAFFE and ORL dataset

Table 3 Accuracy comparison of LTrP with JAFFE and ORL dataset

Pattern	JAFFE (%)	ORL (%)
LBP	76.67	81.2
LTP	83.2	77.3
LDP	88.1	94
LTrP	**96**	**95.3**

achieved the better accuracy compared with existing patterns such as LBP, LTP, and LDP. As LTrP performance improves, we would like to further explore this pattern as descriptor in expression recognition with deep learning.

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Challenges of International Online Shopping from the Customers and Merchants View

V. Lakshmi Lalitha, S. Hrushikesava Raju, Ashok Koujalagi, G. Subbarao, and P. Seetha Rama Krishna

Abstract Nowadays, every country has supermarkets and global stores are available local to the people. Many factors are based to satisfy the customer. One of them is providing quality items at an indicated price that customers could afford. In this, international product exposure is imposed over the people. The customers will make aware of international brands along with the history of the company that the product belongs to. The other aspect is the management also benefits a lot in managing the service. Here, one more connector is local consultancies along with goods garages will be established to solve the issues raised by their local customers. Over many countries, only central places in the globe and are the countries where infrastructures, as well as resources, are abundant will be given preference to have infrastructures of the online store. The success of the international online store depends on maximum rated customer reviews as well as transportation service in the specific time bounds. The span of the management in the global market purely depends on customer satisfaction with the products and the service. Through local consultancies, reduced infrastructure in every country, increase high infrastructure in central and high populated countries, efficient transportation to deliver and pick up goods, customer faith reviews, as well as monitoring of all the teams, will yield opportunities to the customers so that users will experience international brands with affordable price and will have international job experience for the employees of that online store.

Keywords Global stores · Products · Merchants view · Customer's view · Infrastructure

1 Introduction

There are many online services are available in their countries. Their services are maximum limited to their local areas. There are few cases that are available to import

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those goods that customer is purchased from foreign countries. In those situations, bringing and shipping those products from foreign countries are taken care of the authorized online store. The authorized online shopping will charge more on the customer than the actual charge. More ever, the advantage of establishing international online shopping is cost of establishing the infrastructure and recruitment of employees is very much reduced. The mechanism of online shopping is once the user login, need to search for item, the items of many companies and their reviews and costs compared to other vendors are listed. In every country, the owner of that online store has to provide infrastructure and employees to operate on this. There were many issues to be required to discuss and sort them out so that the online store is to function properly. The issues will be raised such as expenditure is incurred more because it depends on infrastructure, employees of that local store, misuse of services to be provided, lack of proper authentication, and many more leads to fall down of that store. Moreover, the management of that store has to face many financial problems to bear all these overloads and pitfalls. Hence, the proposed method where infrastructure is available only at central places that will cover few countries (that means every few set of countries have one central office from where shipping to be done), also local offices are established in order to deliver the products to the customers. With this proposed methodology, the owner of the management will reduce the expenditure to be spent on infrastructures at every country, and also reduce the employees at every country's store. The objective of this is to reduce number of stores that reduce infrastructure to the management and also provide international brand exposure to the customers with less price than products available at local stores. The number of product sales of a specific vendor suppose be increased means that vendor will sustain in the global economy. The more challenging is found here is to make advertisements (aware) of prices of the products specifying their international brand as well as history of the company. This will carry faith about the product and its usefulness.

2 Related Work

In this, in the view of merchant could be discussed more and also from end user and employment view to be discussed by considering profits for the merchant. Here, various retails stores and online stores are discussed along with their set ups and services. Here, promoting international brands with fewer prices to the end users is challenging and also delivery to be guaranteed in the expected date. Also, the plan for merchant shopping is also proposed so that revenue to be generated and profits to be get is to be enhanced. Hence, daily floating charges are to be calculated and minimized through analysis. In this, the various methodologies used for the functioning of each retail store and are addressed through the pitfalls. These pitfalls are to be vanished by making smart ideology that reduces management burdens. In studies [1, 2], first is described on designing a model and that model will ask the surveys about existing facilities, and various factors that influence online shopping are noted and

reports are discussed, whereas second is described about designing the model and that will mention the factors which influence the user buying habits and their consequences are noted. In study [3], the factors are discussed that attract the customer purchasing intention and the case study taken on Indonesia and consequences and more analysis is done using surveys and information extraction tools. In studies [4–6] states that description about expectations of online shopping in the future through advantages, the advantages and disadvantages of online shopping are discussed, and pros and cons of online shopping are described respectively. In [7–9], the description is given on online shopping website is designed through dfd diagrams, web based online shopping requires the need of e-commerce information system, and study of existing online systems, and its objective respectively. In [10], there are kinds of merchants in which ecommerce merchant is discussed and roles and consequences to be followed for the benefit of getting profits. In [11], the available online shopping sites are listed and discussed in the USA. In [12, 13] studies describe about the factors which are considered as customer satisfaction in the online shopping and its consequences are noted. In [14, 15] studies, first is demonstrating on the factors that will be useful in analyzing the task given and frictional and Reynolds number are considered for evaluation, the factors that are important in considering security of employees as well as security of workplace are considered in construction safety analysis respectively. In [16, 17] studies, the first work shows the opinions on the product in the online store based on reviews collected and uses a specific method in this case, and second is on factors that make uncertain in the construction industry and its consequences are noted in this case. In [18, 19] studies, first is discussed on the factors that influence the purchase decision in the online store, and second is description on various quotations that keep track of low cost budgets for construction of government buildings respectively. In [20, 21] studies, first is describing on similarity on poems and later on authors using PLSA factors and its consequences are listed, and second is on gap between placement and passed out is discussed based on the factors of employability skills respectively. In [22, 23], the studies include first is on the factors that are considered for success of construction industries and their consequences are listed, and second is on factors that affect the motion intensity in speech recognition through robotic welding and its consequences are listed respectively. In [24, 25] studies, first is on predicting the customer relation over the management is done and its them is discussed through examples and architecture, and the second is on a queuing system with customer reneging on the server vacations subject to delays and repairs is discussed and its consequences are elaborated in the study. In [26–28] studies, first is on customer reneging using queuing system over server vacations and its impacts, second is on factors that affect customer purchasing patterns in city if Vijayawada, and third is on grouping the customers based on similar feature using density based clustering respectively.

In the regard of information mentioned in [29], the present pandemic is to be restricted using the digital mask that reports the virus in the environment that the user is currently staying. The mask designed will provide statistics about the objects in the present environment. With respect to source specified in [30], the IoT is used

in detecting the location and automatically takes its currency and converts that into the user's currency. This user flexibility is provided in this context.

As per the study mentioned in [31], the IOT is used in the power banks and portable devices in order to exchange charging power in the user-friendly atmosphere. The customized way of charging is done through the designed app and IOT technology. With respect to the description given in [32], the IOT is used in communicating the weighted objects falling to the other devices in order to catch it and send it gently to the ground using automated net.

As the information of [33], the IOT is used in the industries where level of gas is monitored and detects the leakage if any such is identified during the passage of gas over the pipes that are placed from the source to destination. This detection avoids harmful incidents over the people. With respect to the source specified in [34], the IOT is useful over the users in such a way that users health bulletin to be monitored and provides a guide to maintain the fitness based on food diet. With the view of source mentioned in [35], the IOT and GSM are used in determining the popular places when a user wants to make a trip in the world. The guidance is to be provided about the top places and ranked places in those cities along with route map. As per the source demonstrated in [36], the GSM and IOT are used to monitor the garbage bins and alert the nearest the municipal office in order to clear it which avoids wastage of visiting many times of that bin. In the regard of [37], any intrusion is detected in the IOT based internet environment in the homes, which should be alerted and avoids future inconveniences. In the aspect description given in [38], the detection of premature bosom irregularity in the images related to especially personal healthcare systems is discussed and the role modality is explored in processing the system.

In all these studies, one point is bringing to clarify that shopping to be made to the users based on merchant perspective as well as customer view. From merchant perspective, there were factors influencing budget and plans of the merchant, and also there were factors that may affect customer interestingness towards purchases in the e-commerce applications. Nowadays, the online shopping is very much demanded by every place and every person needs to use for their purchases. In this, the machine learning and deep analysis is done on the background of every web site in order to grab the attention of the user when browsing. The internet is very much needed in order to access the items, reviews of the items, and price comparison with respect to other online shops in the market.

3 Proposed Approach

In this, the proposed method called international online shopping service to be discussed through use case driven architecture. The working of this proposed method is to be outlined through this architecture. From this, the modules and their input, outputs and their execution processing is also be specified. Its architecture could be broken into two categories such as merchant side architecture and customer side architecture. Customer side architecture needn't be required at this moment because

every online retail store is following this architecture only. Merchant side architecture to be discussed in terms of use cases which are nothing but activities of each module identified in this ideology.

In this, first merchant side architecture is to be discussed in terms of modules. Then, pseudo procedure of that proposed work is to be discussed. Then, flow chart of modules is to be discussed (Fig. 1).

The modules identified in the architecture are

(a) Countries that have abundant resources and population
(b) Countries that have users who purchase the items through the online.

The pseudo procedure for merchant side is as follows:

Pseudo_Procedure InternationalShopping_Merchant(country_locations, resources, covering_countries, Consultancies):

Step 1: Fix the plan and budget
Step 2: Call for populated_countries(locations, resources):

Search for countries for locations where to establish the infrastructure by keeping nearest countries to cover.

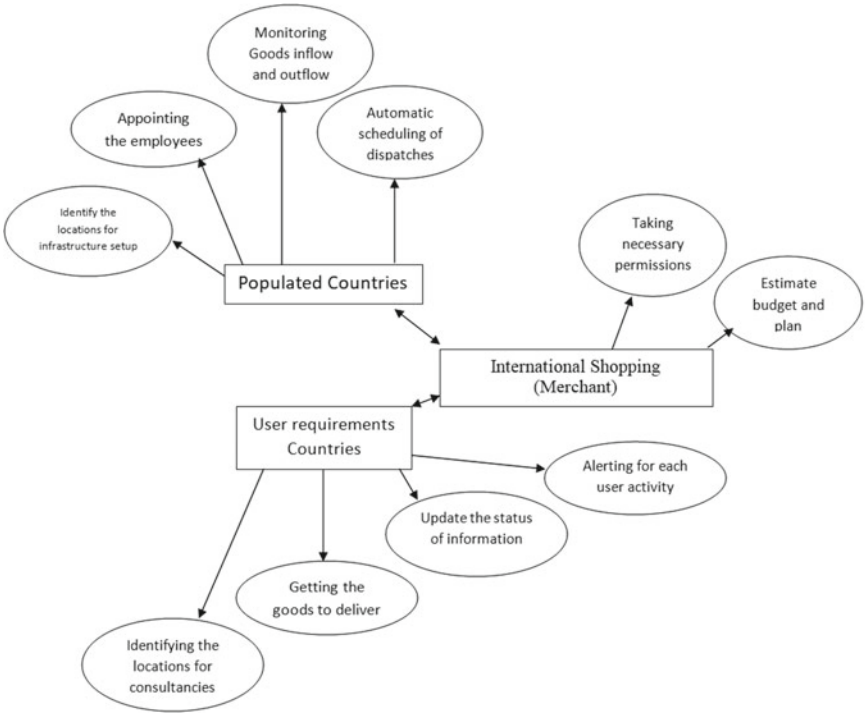

Fig. 1 Architecture of international shopping from merchant's view

Example: Suppose India is chosen as infrastructure, the neighboring countries such as Bangladesh, Burma, Tibet, Nepal, and Pakistan are considered as covering locations and need to supply the goods to the consultancies that are established in the covering countries.

2.1 The GPS module is used a lot, which directs the orders to the consultancies if the user of that country is ordered and estimated time for delivery.
2.2 Estimate the user needs according to the season and past purchase history, make stock always available through strategic plans.
2.3 Receive popups and alerting messages about the user purchases and goods arrival.
2.4 Submit balance sheets online daily about the updates.

Step 3: Call for Userrequirements_Countries (locations, resources):

3.1 Estimate the employees for the consultancy in the country, and assign the responsibilities.
3.2 Receive the user orders though the GPS facility and assign those orders to the store and country.
3.3 Once goods are received from the requested country, goods to be delivered and is to be tracked by the customer.
3.4 At the time of delivery, asking for feedback and after a week, asking for post feedback on that product.
3.5 Good rated products are keep tacked and less rated are ignored and will be less prioritized.

Step 4: Necessary automatic software to be developed and will give privileges to the employees of that online store.

After describing the merchant view, the customer view is also to be analyzed and is depicted as in Fig. 2.

The modules involved in this customer view architecture are

(a) Authentication
(b) Item delivery.

Pseudo_Procedure InternationalShopping_Customer(products,estimated_time, reviews):

Example: Suppose the neighboring countries such as Bangladesh, Burma, Tibet, Nepal, and Pakistan are considered as covering locations to the infrastructure providing country is India and these consultant countries to be keep track of user purchases.

Step 1: Use the software and login and update the schedules for customer orders.

Step 2: Call for Authentication(Credentials):

2.1 Asks for customer to do shopping and selected items are added to the cart, expecting shopping to be continued.

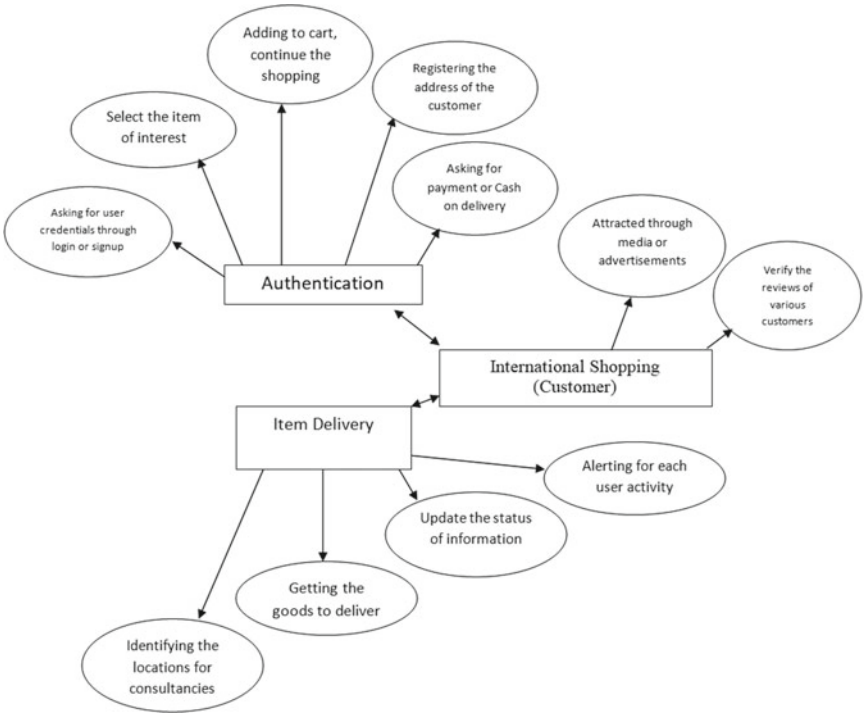

Fig. 2 Architecture of international shopping from customer's view

2.2 Checking the delivery address or update the delivery address in order to get the product.
2.3 The GPS module is used a lot, which directs the orders to the consultancies if the user of that country is ordered and alerted estimated time for delivery.
2.4 At the time of delivery the item, need to get review and also asking for post review after the specific period is over.
2.5 Submit balance sheets in the online daily about the updates.

Step 3: Call for item_delivery(customer_locations,resources):

3.1 Estimate the how many products to be delivery per a day according to schedule and update the end of the day.
3.2 Receive the user reviews and update delivery status.
3.3 Asks for post review after a specific period is over.
3.4 Products having good reviews are retained and are available in the stock always.

Step 4: Necessary automatic software to be developed and will give privileges to the employees of that online store.

The modules involved from merchant view and customer view are depicted in Figs. 3 and 4.

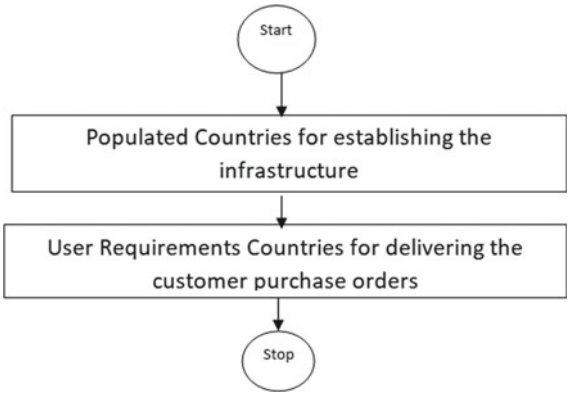

Fig. 3 Flow chart of modules in the merchant view

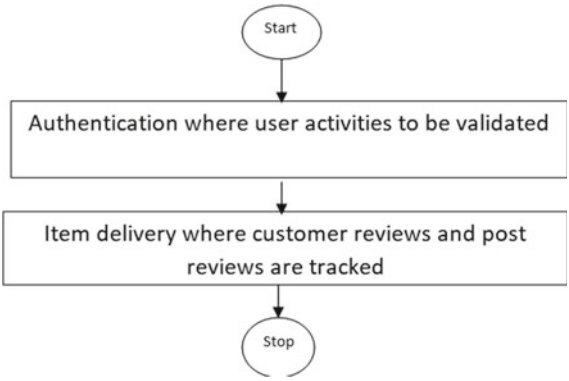

Fig. 4 Flow chart of modules in the customer view

From merchant view, modules to be interacted one after other are countries where population and resources are more, and then countries where consultancies are monitoring the user purchases. From customer view, authentication where user has to checked and allowed to do shopping, and Item delivery module where contact details and payments are done by the user and is contacted at the time of item to be delivered.

4 Results

In this, modules are identified. These modules start interacting through inputs and produces outputs to next module in the interaction sequence. The results are analyzed from the perspective of merchant view as well as from customer view (Fig. 5).

From the merchant perspective, the details such as e-commerce merchant sites, their features, annual turnover, and profits are to be addressed. Tables 1 and 2 shows the above details for few specific online site merchants.

(₹ in Crore)

Particulars	Financial Year 2017-18	Financial Year 2016-17
Revenue from Operations	18,477.97	17,075.09
Other Income	11.67	23.80
Total Revenue	18,489.64	17,098.89
Profit / (Loss) before Depreciation and Amortization Expense & Tax expense	668.61	400.86
Less: Depreciation and Amortization expense	53.43	32.58
Profit / (Loss) before Exceptional Item	615.18	368.28
Less: Exceptional Item	603.87	–
Profit / (Loss) before Tax	11.31	368.28
Less: Tax expense	–	–
Profit / (Loss) after Tax	11.31	368.28
Other Comprehensive Income for the year	1.96	(2.69)
Total Comprehensive Income for the year	13.27	365.59
Earnings Per Equity Share of Face Value of ₹ 2/- each		
- Basic and Diluted (in ₹)	0.23	7.81

Fig. 5 Retail stores turnover, profit and other factors for the financial years 2016–17, 2017–18

Table 1 Listing of characteristics of leading online store "Amazon"

Name of the online store	2019–20	2018–19	2017–18	2016–17
Amazon				
Investment	$280,522	$232,887	$177,866	$135,987
Annual turn over	$321.782B	$280.522B	$232.887B	$177.866B
Increase of profit %	24.58	20.45	30.93	30.8
Remarks	Sustainable competitiveness, dynamic CEO Jeff Bezos, and achieving big new revenues			

Table 2 Listing of characteristics of leading online store "Flipkart"

Name of the online store	2019–20	2018–19	2017–18	2016–17
Flipkart				
Investment	$6B	$16B	$11.6B	$15
Annual turn over	$9B	$24B	$16B	$22.5B
Increase of profit %	42	50	42	50
Remarks	Early access to sales, easy and exchange coins for rewards, and superior customer support			

According to sales, turnover in India, the two online giants such as Amazon and Flipkart although invest in the years 2016, 2017, 2018 and 2019, experienced losses and is listed in Fig. 6.

The differences in the retail store industries such as Amazon and Flipkart are based on the loss statistics is as in Fig. 6.

When taking the selected locations and monitoring of the user purchases through consultancies that may affect the performance of the proposed approach. The

Flipkart Internet	Revenue	Loss
2016	1951.7 Cr	2305.7 Cr
2017	2253.5 Cr	1639.3 Cr
2018	2790.9 Cr	1160.6 Cr
2019	4234.5 Cr	1625.7 Cr

Amazon Seller Services	Revenue	Loss
2016	2275.4 Cr	3679.9 Cr
2017	3256.6 Cr	4830.6 Cr
2018	5018.1 Cr	6287.2 Cr
2019	7594 Cr	5685.4 Cr

Fig. 6 Losses incurred in Amazon and Flipkart

proposed approach takes less investment (revenue), and makes more profits and good turn over for year by year. Compared to the existing mechanism used in the current scenarios, the proposed scenario such as one time infrastructure is fixed at selected locations, and floating goods via reliable transport approach to consultancies with smart garages will obtain better results because investment is almost 50% to be reduced (Fig. 7).

From the customer perspective, the details such as product comparison, comparison with respect to other online stores, service time, reviews, post reviews are to be considered. How effectively, the user is serviced by the consultancies at their countries. The idea is to make aware of international brands in the sense the brands that are most reviewed and are become more popular in the quick time. The merchant will sign with retail stores based on recommendations from the customer reviews and the product from that retail store to be made available at the requested locations. The merchant will have to give importance to the transport of the products to be made available to the requested stores and consultancies. In this customer view, the reviews, post reviews are gathered by alerting the users about the products they

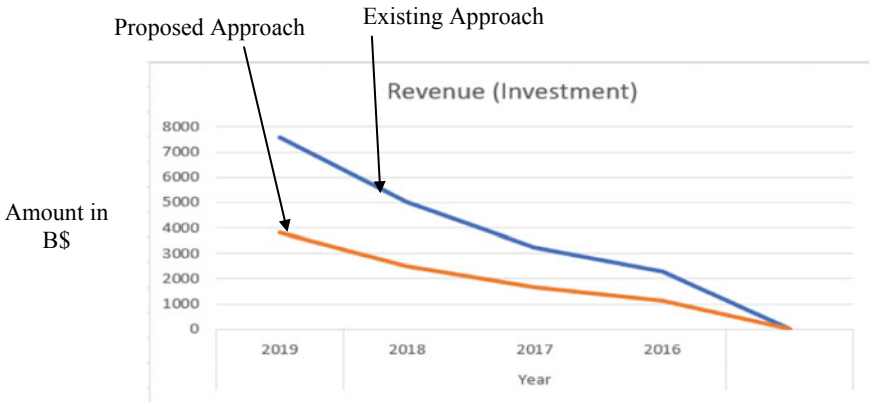

Fig. 7 Revenue to be reduced for existing versus proposed approaches

Table 3 User reviews for products to differentiate good or normal

User	Name of the product	Reviews	Post reviews
Hrushikesh	Dove	8/11	10/11
Krishna	Spinz	9/20	7/20
Rakesh	Table	3/13	6/13

purchased. The statistics also be demonstrated in order to estimate purchases in the future tentatively.

Here, the reviews and post reviews are collected from the current customer and old customers respectively. In this, first number specifies the positive opinion and second number specifies the total number of opinions. Example: 8/11 for Dove product where 8 users given positive feedback by the customers at the time of delivery and 10 users given positive feedback out of 11 after a specific period mentioned for the kind of product.

Based on Table 3, the user will login to the online app or online shopping store. Then, search for a product that will display that product with various brands. It also asks the criteria to filter out the products based on price, brand, and color and other features. But in this online store, international products only be available in the separate tab titled international products only in the website or in the app. Once the user selects the option international products only, then the products are displayed which are more popular and are internationally brand.

When the user selects a brand, the remaining features are same as normal features. The features to be performed after the selection of the product are adding to the cart, continue shopping, click on the payment option and proceed with payment. Before payment, user has to confirm the address to which the goods ordered are to be delivered. Also, user has to ask for expected delivery of item. Once the user is aware of delivery, and then during the payment, selects the type of making the payment such as credit card, debit card or UPI transfer or net banking. Once payment is done through payment gateways, the confirmation of delivery date is to be alerted. Once the delivery is alerted whenever the item is ready to dispatch, the service agent will call to the user and will drop the item at the user and collects the delivery feedback (Fig. 8).

From the graph, the sales are increased tremendously using automated and proposed approach called online shopping store through an app or website where as the traditional approach consumes less turn over because of lack of technology and plans.

5 Conclusion

In this, many advantages are listed using proposed ideology. This ideology expects profit oriented to the management by keeping employees safety as well as revenue to be generated consistently. Here, focusing the infrastructure related works at only

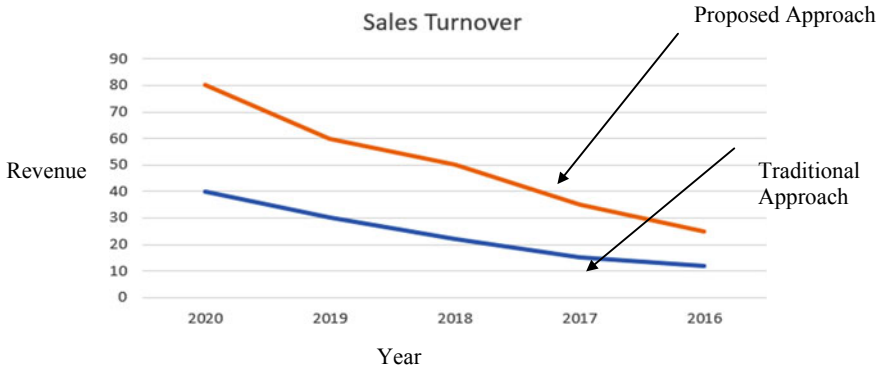

Fig. 8 Turnover of sales (India) in billion dollars by traditional versus proposed approaches

few places, and consultancies to be established at every country with the accessing of items that are ordered frequently with modern transport facilities. The objective of this ideology is to minimize the cost to the management of online shopping stores and preserve the employees safety as well as generate constant revenue or even more depending the projection of the features of the online store through the media advertisements.

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Finding Noisy Data in Social Websites Based on Semantic-Enhanced Method

G. Teja Sai Raghava, B. B. V. Satya Vara Prasad, A. Tarun Gopi, and D. Bhavani Sathvika

Abstract Cyberbullying has emerged as a major problem for internet mates, teenagers, and young adults as a result of increasingly mainstream online media. AI techniques allow for the programmable detection of vexing messages in online media, which could aid in the development of a stable and secure online media environment. One fundamental problem in this important. The research sector is efficient and discriminating. Mathematical representation learning of instant messages. Our process, dubbed Semantically or Meaningfully Enhanced or established Marginalized Denoising Auto-Encoder, works by enhancing the mainstream profound learning model stacked denoising autoencoder with semantic. The lexical augmentation consists of Meaningful dropout clamor and very little Demand, with the semantic dropout clamor planned using cloud data and the Letters and words implant process. My suggested technique can be used to exploit the shrouded highlight the tormenting framework knowledge familiarize oneself with a vigorous often discriminatory text reflexive. Full experiments on two public cyberbullying sites (Twitter) have been performed, with the findings showing that our suggested methods outperform other pattern text representation learning techniques.

Keywords Cloud computing · Cyberbullying finding · Text discovery · Illustration educating yourself · Slanted autoencoder denoising · Word surrounding

1 Introduction

If it's web-based or accessible via the internet, "A gathering of Internet put together with solicitation that toil with respect to the conceptual and automatic getting started of Web 2.0, and that permit the design and commerce of client-produced content" as seen in [1]. Individuals may gain access to vast quantities of knowledge and valuable communication through the internet, etc. In any topic, using the internet media can have some implications, for example, cyberbullying, which can possessed a drawback

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effect based on lives of individuals, kids and teens in particular. Cyber intimidation might probably be described as a set of forceful, purposeful actions carried out or performed by an individual person, a performed by, or a group of individuals using advanced Super specialised techniques, for example, sending obscene Texts and timeline updates attacking a normal individual or a customer. In contrast to traditional harassment, which usually occurs at meeting places or schools during communication, cyberbullying via web-based media can occur anywhere, at any time, and in any web browser. They are allowed to aggravate their squint in the case of threats so they do not have to face anybody and can make up behind the Internet. Since we all, especially the youth, are constantly associated with the Internet or online media, casualties are easily handed over to provocation. According to [2] the percentage of cyber persecutors who are exploited rises from 10 to 45%. Around 47.5% of young and youth people in the United States have been tormented by web-based media for a long time [3]. Cyberbullying, like conventional abuse, has negative, slick, and very noticeable consequences on children [4–6]. The consequences for victims of cyberbullying may be tragic, for example, Self-harming behavior or suicides are examples of self-harming behavior. Core, as well as a verbal representation that isn't used. Two public cyberbullying corpora (Twitter) were thoroughly examined, and the results indicate that our proposed methods outperform other pattern text portrayal learning strategies.

2 Related Work

A convincing mathematical depiction of phonetic variable is a valuable point of interest in material quarry, data rejuvenation, and natural language handling. The Bag-of-Words replica is the most famous conventional information as well as inclusion it serves as the basis for Latent Semantic Analysis (LSA) is an example of a model (LSA) [7] and point models [8, 9]. The pack of words model refers to a file in a printed corpus that uses a vector of real numbers to describe the occurrence number of words in the document. Despite the fact that replica has proven to be proficient and viable, the representation is often extremely limited. To solve this problem, LSA uses Singular Value Putrefaction (SVD) to decide a low-position guess on the word-report network for the Bag of Words mock-up. To alleviate the problem of sparsity, each new feature is a direct mix of all specific highlights. Point replicas are also suggested, along with Probabilistic Latent Meaningful Analysis [10]. The basic idea behind point replication is that the theme of a document would influence word judgement in an archive in a probabilistic way. Subject models aim to describe each word's age period inside a record. With the increase in prevalence of new. In recent years, cyberbullying has become a common subject in the media, major. This is an epidemic that affects children and young adults. Previous instances of cyberbullying investigations based on large findings the psychiatric repercussions for victims and were mostly conducted by psychological psychologists and clinicians [6]. Despite the fact that these efforts help us understand cyberbullying, the mental science approach is based

on close proximity Reviews are time-consuming and may not be enough in order to automate monitoring the act of cyberbullying. Because AI has recently gained popularity, a technological analysis of cyberbullying has risen to the surface as a genuine problem for scientists. Cyberbullying exploration is closely correlated with a few examination areas, including pattern recognition and emotional examination. As a result of their efforts, automatic cyberbullying detection is becoming a reality. Cyberbullying detection based on AI.

The success of AI computation is largely dependent on specifics portrayal, and we believe that this is due to the fact that different representations will entrap and obscure the various conceptual elements of diversity lurking within the particulars. While clear land details can be used to assist the S plan portrayals, learning with traditional emphasis can also be used, and AI's moto is to refresh the concept of all amazing representation learning computation actualizing priorities. This is a paper about explores developments inside the fields of single segment deep learning and learning, including developments Auto-encoders are used in probabilistic models, dynamic computing, and profound organizations. This leads to longer-term unresolved questions about the best places to study better portrayals, how to figure out portrayals (i.e. deduction), and the statistical relationships between representation learning, depth evaluation, and difficult learning. For certain businesspeople now, the idea of using social networking sites is at the on top of their list. Masters, like professionals, strive to work out how to use apps like Wikipedia, Instagram, Tinder, YouTube, Email, Happen, Second Life, and Twitter to support their businesses. Regardless of this interest, there continues to be a somewhat poor definition of what the word "Social Media" means; this object aims to offer some clarity. We begin by defining Social Media and examining how it differs from similar concepts for example, Content was born as a result of Web 2.0 and Patron. In light of this specificity, we present a classification of Social through Web Networking, which divides applications currently categorized under the umbrella term into more precise trademark classifications: synergistic projects, web newspapers, content networks, informal connectivity terminus, effective game universes, and effective communal universes. Finally, we give 11 tips for businesses who want to use social media.

3 Proposed System

The Proposed System is divided into four parts

1. OSN System Creation Part.
2. Development of Bullying Options Set.
3. Cyberbullying finding.
4. Semantic-Enhanced Disregarded Denoising Auto-Encoder (Fig. 1).

Bullying Words	Reconstructed Words for	
	mSDA	smSDA
bitch	*@USER*	*@USER*
	shut	*HTTPLINK*
	friend	*fuck up*
	tell	*shut*
fucking	*because*	*off*
	friend	*pissed*
	off	*shit*
	gets	*of*
shit	*some*	*abuse*
	big	*this shit*
	with	*shit lol*
	lol	*big*

Fig. 1 Term rebuilding on Twitter dataset. Every row says specific bad letters, including with top-four reconstruct letters (along with commonness values from altogether) with m SDA (left hand column) and SM SDA (right hand column)

3.1 OSN Part Creation Module

The Online Communal Networking (OSN) substructure section was built in the main section. The substructure was designed with an aspect of Online Communal Networking in mind. This segment is used for new client enrollments, and users can sign in or login with their confirmation or credentials after that, which have already been mentioned. Alternatives are set up after which the existing users can send messages anonymously or freely if they wish. Users may also share their material with others. Users have access to other customers' accounts and public messages, but not to private posts. Users may also provide input and submit companion requests in this area. To explain and evaluate our substructure highlights, all of the fundamental elements of Online Communal Networking Framework modules are built in the underlying module (Fig. 2).

3.2 Development of Bullying Feature Set

Bullying draws attention to or reflects on a relevant role, and it should be addressed accordingly. The definition for constructing tormenting highlight or focuses set B is defined or mentioned in the following, in which the principal layer or main layer, as well as different layers, are tended to independently. Master details or records, as well as word embeddings, are worn on the primary layer. Discriminative factor determination is guided for different layers. We create a rundown of terms with derogatory mental, including curse words and messy words, in this segment right off the bat. At that point, we separate our own corpus's words list from the Bag of words highlights, and we consider the convergences as bothersome focuses. Finally, our submitted replica model's key head layer is analyzed using the updated bad words spotlight and focuses. It has two main sections: the first is offending seeds based on

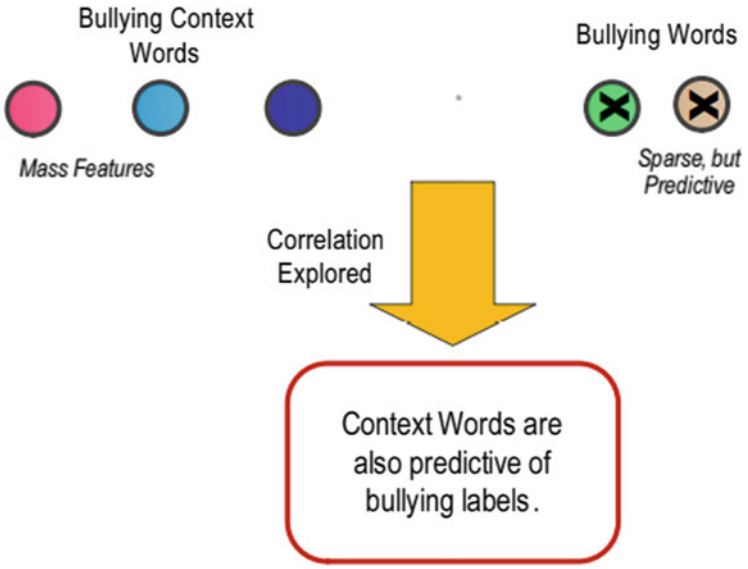


Fig. 2 System architecture the into sparse shows that its correlate option is SU-born, turn out

data field, and the second is all-encompassing bullying or bad words through word implanting or embedding. Observe carefully for a period of time.

3.3 Cyberbullying Recognition

We defined the Meaningful established Oppressed line wise Denoising Automatic-encoder in this replica. We addressed how and why to use it to spot cyberbullying in this module. The studied arithmetical calculational depiction or portrayal should then be retained in our scheme because it has stable and discriminative depictions. Because of the grasped or taken choice connection and meaningful knowledge, even a very short duration of instructing corpus will achieve a well-presentation on testing documents in the new room. Browbeat functions, which are based on word embeddings, cannot be taken manually but must be done automatically. Furthermore, the use of the term embedding will help to mitigate the potential limitations of expert expertise.

1. Put the accounts on hold.
2. Unusual user.
3. User of cybercrime (Fig. 3).

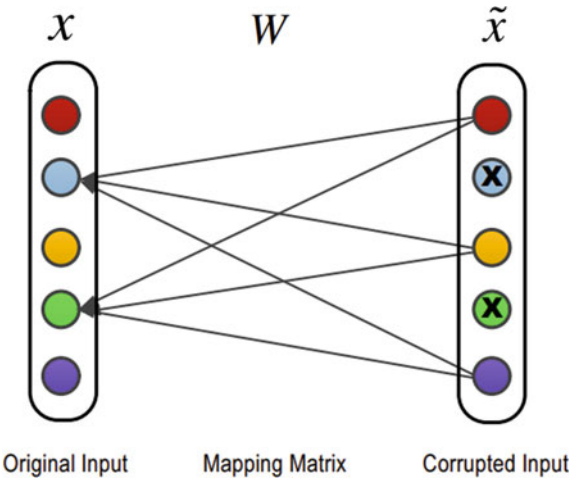


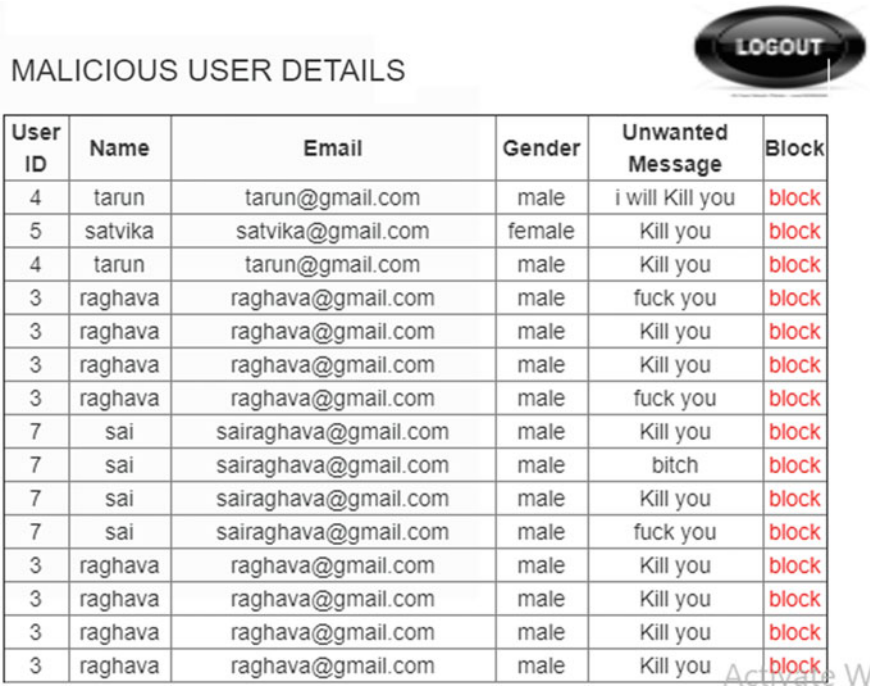
Fig. 3 Engraving of stimulation behind SM SDA

3.4 Semantic-Enhanced Disregarded Denoising Auto-Encoder

With the intention of reducing the very long man task, a programmed automated extraction of harassing and bullying terms based on letter or phrase embeddings has been developed. We tried to replicate tormenting highlights from other general letters by scanning the idle structure, such as link, among poor and difficult words during planning. This definition is based on the fact that some tormenting non-bullying texts do not include harassing terms. The relation data discovered aids in recreating harassing focuses from common language, which facilitates the position of bad or loud messages without the use of harassing words. Since they often occur together, there is more, close link between noisy and quiet the word fuck and general off the record for a period of time. If harassing bad threatening tweets do not have those tidy loud bad highlights for example, fuck is regularly incorrectly spelled as duck, the relation can help in recreating harassing highlights from popular ones, allowing the negative and bullying message to be remembered. It should be made clear to administrators that displaying dropout clamor has the effect of lengthening the community of data, including planning information or data size, which alleviates the problem of information scarcity.

4 Results and Discussion

See Fig. 4.



User ID	Name	Email	Gender	Unwanted Message	Block
4	tarun	tarun@gmail.com	male	i will Kill you	block
5	satvika	satvika@gmail.com	female	Kill you	block
4	tarun	tarun@gmail.com	male	Kill you	block
3	raghava	raghava@gmail.com	male	fuck you	block
3	raghava	raghava@gmail.com	male	Kill you	block
3	raghava	raghava@gmail.com	male	Kill you	block
3	raghava	raghava@gmail.com	male	fuck you	block
7	sai	sairaghava@gmail.com	male	Kill you	block
7	sai	sairaghava@gmail.com	male	bitch	block
7	sai	sairaghava@gmail.com	male	Kill you	block
7	sai	sairaghava@gmail.com	male	fuck you	block
3	raghava	raghava@gmail.com	male	Kill you	block
3	raghava	raghava@gmail.com	male	Kill you	block
3	raghava	raghava@gmail.com	male	Kill you	block
3	raghava	raghava@gmail.com	male	Kill you	block

Fig. 4 Users who used cyberbullying words in with their respective email id, gender, name, user id and unwanted message

Discussion

Bullying Word Match (BWM), as simple as thing and offers an intuitive method for using meaningful information worst performance. At BWM, there is bullying letters are explained as classification rules. That shows Only the complicated or detailed use of such persecute or oppress in terms place in a normal one can assist in the identification of cyber scoldings (Figs. 5 and 6).

Discussion

Built-in intimidation options are utilized to help the first and most part in our SM SDA proposal. Having 2 more parts: one is the actual bullying paths depends on dominance knowledge and the next is the enlarged or extended intimidation letters through letter inlays.

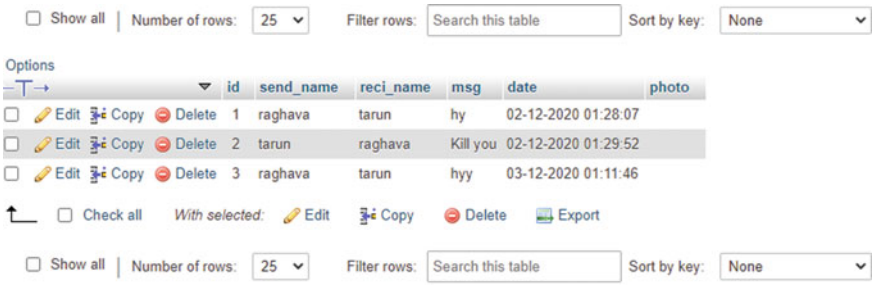


Fig. 5 Conversations between users with detailed sender name and receiver name with the message content along with the date

Dataset	Measures	BWM	BoW	sBow	LSA	LDA	mSDA	$smSDA_u$	smSDA
Twitter	Accuracies	69.3	82.6	82.7	81.6	81.1	84.1	82.9	**84.9**
	F1 Scores	16.1	68.1	68.3	65.8	66.1	70.4	69.3	**71.9**
MySpace	Accuracies	34.2	80.1	80.1	77.7	77.8	87.8	88.0	**89.7**
	F1 Scores	36.4	41.2	42.5	45.0	43.1	76.1	76.0	**77.6**

Fig. 6 Inconsistencies (%), and F1 results (%) for contrasted methodologies on Twitter and MySpace group of data

5 Experimental Results

This part, we given an examination of our given framework strategy along on seven standard proposal on Twitter and datasets. The normal outcomes, for these group of data, on grouping precision. Show the consequences of seven thought about methodologies on all sub-data network built from Twitter and datasets, individually. Since sack of words should not need preparing records, its outcomes above the entire the corpus are accounted. Unmistakably our methodologies out flank different methodologies in these two data sets or group of data in Twitter and corpora.

The main consciousness is that semantic Bag of Words models performs somewhat in a path that is better than sack of words. In view of pack of words, just discretionarily scale the tormenting highlights by a factor of two. That implies that meaningful data will support the exhibition of cyber scolding recognition. To a reasonable correlation, the scolding highlights utilized in my techniques are brought together to the equivalent. Our methodologies, particularly our strategies, gains a huge execution improvement contrasted with pack of words. This is on the grounds that tormenting highlights just record for a little bit of all highlights utilized. It is hard to learn strong highlights for little preparing information by strengthening each harassing highlights' adequacy. Our methodology intends to discover the connection between typical highlights and tormenting highlights by reproducing debased information in order to yield vigorous highlights.

Furthermore, Bullying Word Matching (BWM), is a basic and instinctive strategy for utilizing semantic data, gives the most noticeably terrible execution. In BWM, the presence of tormenting words are distinguished as order for characterization. That

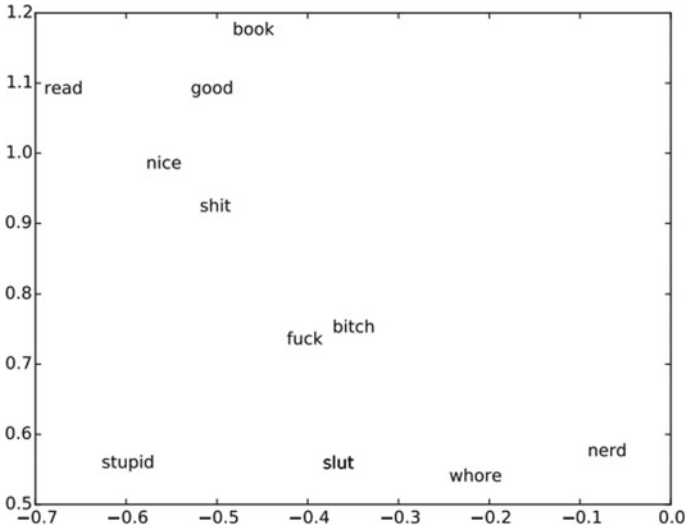


Fig. 7 2-dimensional demonstration of our utilized letter embeds via PCA. The rules shown will have both bad and normal words. This proven that identical letters are close to the vector

demonstrates lone an explained that harassing letters rather than a straightforward every human can help in tracking cyberbullying location (Fig. 7).

6 Conclusion

This work is relevant to the content-based noisy bad words user position problem, where strong and discriminating representations of data are required for a persuasive and forcing recognition framework. We built a semantic-uplifted underrated as a denoising autoencoder basic more about representations replica for the purpose of cyberbullying recognition by preparing semantic dropout commotion and upholding sparsity. Furthermore, word implantation has been used to grow and purify distressed word data that has been instated by area data. Our system was demonstrated in a timely manner using two cyber noisy terms corpora from social media: Twitter and Facebook. In the coming time, we plan to boost the verdure of the academic sketched by taking word requests in text messages into account.

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Cyber Hacking Breaches for Demonstrating and Forecasting

T. Guru Akhil, Y. Pranay Krishna, Ch. Gangireddy, and Anumandla Kiran Kumar

Abstract Now a days cyber hacking is the serious problems facing in real life from small organizations to very big organizations. This is a generally new exploration subject and numerous investigations stay to be completed. In this paper, we report a measurable examination of a break occurrence datasets relating to 11 years (2005–2018) of digital hacking exercises are incorporate breach assaults. We show that, as opposed to the discoveries revealed in the writing, both the hacking break going to happen in the middle, appearance times and the penetrate size need to be shown by stochastic cycles, rather than by disseminations since they show auto associations. At that point, we proposes specific stochastic cycle models to independently fit the between entry time and the break size. We moreover appear that the between 21 appearance times and the break sizes can be anticipated by these models. We conduct subjective and quantitative pattern reviews on the dataset in arrange to pick up advance insights into the progress of hacking break episodes. We draw a lot of knowledge from network protection bits, counting that the risk of digital hacks is certainly deteriorating as distant as their repeat is concerned, but not as to the degree of their damage.

Keywords Data breaches · Cyber security · Prediction report · Cyber risk analysis

1 Introduction

While mechanical arrangements can strengthen digital frameworks against assaults, breaks in data proceed to be the major issue. This energizes us to portray the growth of incidents of data breaks. That will not as it were expand our understanding of information that penetrates, but will also shed light on various methodologies, such as protection, alleviate the harm. However, the advancement of accurate digital risk measurement to manage the tasks of protection rate is beyond the span of the current understanding of information breaks. Many accept that protection will be useful. The

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current examination is propelled by a few inquiries that have not been investigated as of recently, for illustration, are data breaks brought almost by advanced attacks growing, reducing, or settling? The principled reaction to this request will grant us an absent from into the common circumstance of advanced dangers. This request was not replied by past examinations. In particularly, the dataset examined in fair secured the interim of time from 2000 to 2008 and doesn't truly contain the break events that are brought approximately by advanced attacks; the datasets inspected [1], is afterward, be that as it may contains two sorts of events: careless breaks (i.e., scenes brought almost by misplaced, arranged of, taken contraptions and different reasons) and vindictive penetrating [1]. We propose a system for anticipating assault rates within the sight of extraordinary qualities. The technique dissects the extraordinary worth wonder by means of two corresponding methodologies: the Time Series Theory and the Extreme Worth Theory. Regardless the reality that our contextual investigation depends on explicit digital assault information gathered by a honeypot, the strategy can be similarly applied to break down any digital assault information of its sort. In particular, we make two commitments [2].

2 Previous Work

The current examination is propelled by a number of request those that were not explored as of not long prior, for case, are data enters brought approximately by computerized attacks growing, diminishing, or settling? A principled reaction to this request will deliver us an absent from into the common circumstance of computerized perils. This request was not answered by past examinations. In specific, the dataset examined. fair secured the amplify of time from the beginning of 2000 to conclusion of 2008 and doesn't truly contain the break events that are brought approximately by advanced ambushes; the dataset broke down is afterward, be that as it may contains two sorts of scenes: careless enters (i.e., events brought approximately by misplaced, arranged of, taken contraptions and distinctive reasons) and harmful entering. Since careless enters talk to more human botches than advanced ambushes, we do not think approximately them within the current examination. Since the vindictive penetrates concentrated, [3] carry four sub-classes: hacking (counting malware), insider, installment cards deception, Obscure, this investigation is going to be will zero in on the hacking sub-classification (called a break in hacking datasets from there on), while taking note of that the other three sub-classes are fascinating all alone and ought to be examined personally. As of late, scientists began displaying information break occurrences. Maillart and Sornette examined the factual properties of the individual personality misfortunes within the Joined together States, between year 2000 and 2008. They Founded sum of break episodes significantly increments from 2000 to July 2006, however stays stable from that point. Edwards et al. broke down the dataset containing 2253 break episodes that length longer than 10 a long time (2005–2015). They 2 found that not one or the other the measure nor the recurrence of information penetrates has expanded throughout the long term. Wheatley et al.

inspected a dataset that's solidified from relates to progressive enter events from the years 2000 until 2015. They found the repeat of colossal entrance events (i.e., the ones that break in abundance of 50,000 records) that happened to US firms is free of time, in any case the repeat of tremendous enter scenes happening to non-US firms appears an extending design [4, 5].

3 Proposed System

In this paper, we make the accompanying three commitments. To begin with, we show that the hacking has penetrates both occurrence entomb appearance times (reflecting episode recurrence) and break sizes ought to be demonstrated by stochastic cycles, instead of by Conveyances. Reports. We're finding that a specific point cycle can enough depict the advancement of the hacking penetrate occurrences Between times of appearance and that a specific ARMA-GARCH demonstrate can sufficiently portray the advancement of the hacking break size, where ARMA is abbreviation for "Auto Backward and Moving Normal" and GARCH is abbreviation for "Summed up Auto Regressive Conditional Heteroskedasticity." We appear that the stochastic cycle models can anticipate the between advent time and the penetrate sizes. To the most amazing aspect our insight, this is often the essential papers indicating that the stochastic cycles, as opposed to circulations, ought to be utilized to demonstrate these digital danger About factor. Second, we find a positive dependency on the between the occurrences between appearance time and the break size, and appears that this reliance can be enough portrayed by a specific copula. We likewise show that when foreseeing it takes place between advent time and break sizes, is important to think about the reliance; in any case, the expectation results are not precise [6]. To the most awesome aspect our insight, this is the main work indicating the presence of this reliance and the outcome of overlooking it. Third, we coordinate couple subjective and assessable pattern, the digital hacking exams break occurrences [4]. We locate that the circumstance is in fact deteriorating regarding the episodes between appearance time in light of the reality that hacking break occurrences become increasingly incessant, yet the circumstance is balancing out as far as the occurrence penetrate size, showing that the harm of individual hacking break episodes won't deteriorate [4]. We believe the current examination will spur more examinations, which can offer significant bits of information into substitute peril control draws close. Such encounters are important to protections offices, government organizations, and controllers since they have to be significantly comprehend the thought of data break risks [7, 8] (Fig. 1).

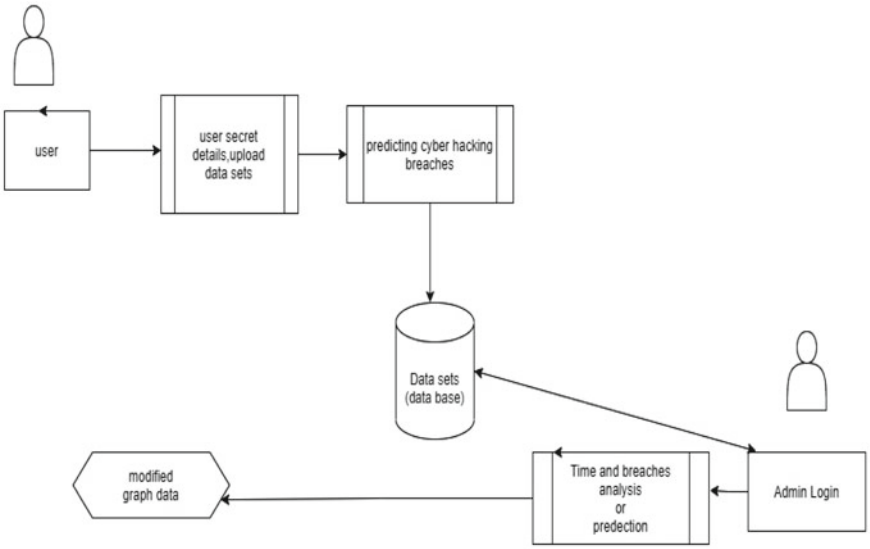

Fig. 1 Proposed system for demonstration of cyber hacking breaches

4 Algorithm

The "Bolster Vector Machine" (SVM) is the directed AI calculations which can be gained for both order and backslide difficulties. Nonetheless, it is for the most part utilized in course of action issues. In this calculation, we plot every data thing as a point in n-dimensional spaces (where n is number of highlights you've got) with the evaluation of each component being the evaluation of a particular organization [2]. At that point, we perform order by finding the hyper-plane that isolated the 13 two classes well undoubtedly (take a gander at the underneath depiction). Backing Vectors are basically the co-ordinates of person recognition. Backing Vector Machine can be a boondocks which best limits the two classes (hyper-plane/line). All the more authoritatively, a offer assistance vector machine creates In a tall or perpetual dimensional space, a hyper plane or set of hyper planes that can be utilized for, backslide, or diverse assignments like special cases recognizable proof. Impulses, a conventional division is finished. The hyper airplane with the most noteworthy remove to the closest data arrangement objective of any lesson (gathered utilitarian edge) since when all is said in done. The bigger the edge, the lower the classifier speculation botch [9]. In spite of the fact that the primary issue can be communicated in a restricted dimensional space, it regularly happens that the sets to isolate are not straight particular in that space. Consequently, the primary confined dimensional space was prescribed be arranged into a parcel Higher-dimensional space, which is likely to form the partition simpler in that space [9].

PSEUDO CODE:

```
Characterize number of highlights + 1 as F and SVs + 1 as SV
  FOR each SV
      FOR each feature of SV
      Read streamed data
      Convert it to drift
      Store into array_SVs[SV][F]
      END FOR
  END FOR
  Read streamed data
  Convert it to drift
  store into array_ay[0](b valve)
  FOR each SV
      Read streamed data
      Convert it to drift
      Store into array_ay[SV]
  END FOR
  FOR each highlight
      Read streamed data
      Convert it to float
      Store into array_test[F]
  END FOR
  FOR each feature
      Clear array_AC[F]
  END FOR
  FOR each SV
      FOR each highlight of the SV
      array_AC[F]+=array_ay[SV]*array_SVs[SV][F]
      END FOR
  END FOR
  FOR each highlight
      Distance_value+=array_AC[F]*array_test[F]
  END FOR
  Distance_value−=b
  IF(Distance_value>=th)THEN
     RETURN 1
  ELSE
     RETURN−1
  END IF
```

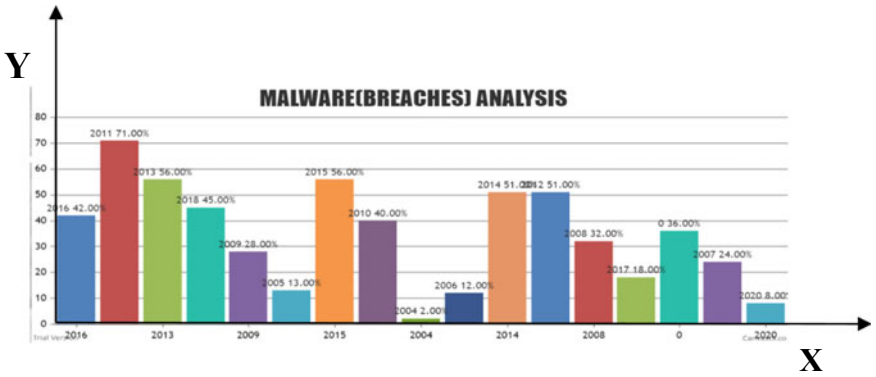

Fig. 2 Malware analysis using SVM

5 Module Implementation

Upload Data

The information asset it is possible to transfer the data set to both overseer and approved client. The Data may be transferred with key to keep up the mystery about the information that isn't delivered without information on client [1]. The clients are approved dependent on their subtleties that are shared to administrator and administrator can approve every client. Just Authorized clients are authorized to get to the framework and transfer or solicitation for documents.

Access Details

The entrance of information can be gotten from the data set, given by chairmen. Transferred information are overseen by administrator and administrator is the lone individual to give the rights to deal with the getting to subtleties and favor or unapproved clients dependent on their subtleties [10].

6 Results

See Fig. 2.

7 Conclusion

We broke down a hacking penetrate datasets from the points of see of occasions between appearance times and the break estimate, And uncovered that the two of them got to be illustrated by stochastic cycles instead of circulations. The factual models

created in this paper show acceptable fitting and forecast exactness. Specifically, we propose utilizing a Copula-based strategy of managing with expect The Joint likelihood to an occurrence with a particular greatness of break size will happen amid a future time outline. Measurable tests appear that the systems proposed in the paper are superior, to those which are displayed in the composed in light of the truth that the final one is disregarded both the worldly relationships and the dependence between the occurrences. Between the periods of appearance and the penetrate size. We directed subjective and quantitative investigations to draw further experiences. We drew an bunch of network protection experiences, counting that the danger of digital hacking break occurrences is in reality deteriorating regarding their recurrence, yet not the extent of their harm. The philosophy introduced in this paper can be grasped or balanced to break down datasets of a comparable sort [9].

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Novel Programmable Solar Based SIMO Converter for SMPS Applications with IoT Infrastructure

Sumanjali Chundhu, Kalyan Dusarlapudi, Venkata Siva Kumari Narayanam, and K. Narasimha Raju

Abstract The twenty-first century innovation allow Internet of Things (IoT) spread its winds across the power engineering leads to design programmable DC-DC converters. The modern architecture minimize hardware requirement for compact design. A novel programmable DC-DC converter design is proposed and demonstrated for renewable energy harvesting application. The cost effective and less ripple output of the converter is achieved using SPELEC board which generated 25 kHz gate pulse. The SIMO (single input multi output) converter is moulded into SOLAR SPIKE for different load configurations. The SPIKE output power, voltage and currents are monitored over IoT based ThingSpeak cloud service with smart mobile monitoring interface to SPELEC board using blynk mobile application. The Perturb and Observe (P&O) MPPT Technique algorithm is implemented from the SPELEC board to maintain the converter output voltage constant irrespective of the change in supply voltage. Novel Converter performance is discussed in comparison with Arduino. The sensor data that is recorded from solar panels and load are uploaded to cloud through ThingSpeak and AWS for remote monitoring which helps to reduce operating costs, downtime and enables the predictive maintenance. The recorded voltage is in range of 24, 12 and 9 V and current is 0–20 A and power is from 0 to 230 W.

Keywords SPELEC board · SMPS · Programmable controller · DC-DC converter · Arduino · P&O MPPT technique

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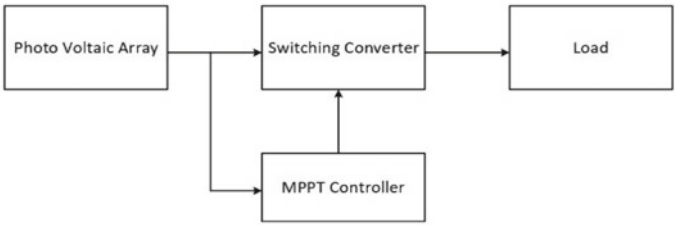

Fig. 1 Block diagram of PV system comprising of switching converter

1 Introduction

The rapid growth for IoT can be seen in near future with increased use of sensors and actuators for embedded intelligence. These products which were always connected and showing high impact on global energy consumption are demanding a compact and highly efficient power converters with very less standby power consuming capacity [1].

Thus, these DC-Dc converters are having significant importance in now a days, as generation of power from renewable energy resources is becoming more these days. The countries like China and India are more focusing on generation of power from renewable energy resources as these two countries are emitting more green house gases and polluting the environment [2]. There are many ways to produce power from renewables but solar power generation was proven most economical and easier way both for off grid and for on grid. In literature nearly 24 maximum power point tracking techniques were proposed as tracking the maximum power from solar panels is the major challenge faced in the solar power generation [3]. Also, many DC-DC converters were proposed to track the maximum power and to reduce the voltage levels efficiently as per the requirement [4, 5]. The main aim of this paper is to design a novel reconfigurable and reprogrammable converter and also observing the load characteristics by using IoT infrastructure (Fig. 1).

2 Methodology and Implementation of Proposed Embedded Controller

The basic block diagram for the proposed work is shown in Fig. 2. The integration of PV panels to load is done through SIMO Buck Converter. The implementation of solar spike which can cater the multiple voltage levels for multiple loads. The SPELEC board was proposed for generation of gate pulses and to implement the maximum power point tracking technique.

The circuit diagram that describes generating the gate pulses from the proposed SPELEC board was shown in Fig. 3. The gate pulses of required duty and frequency

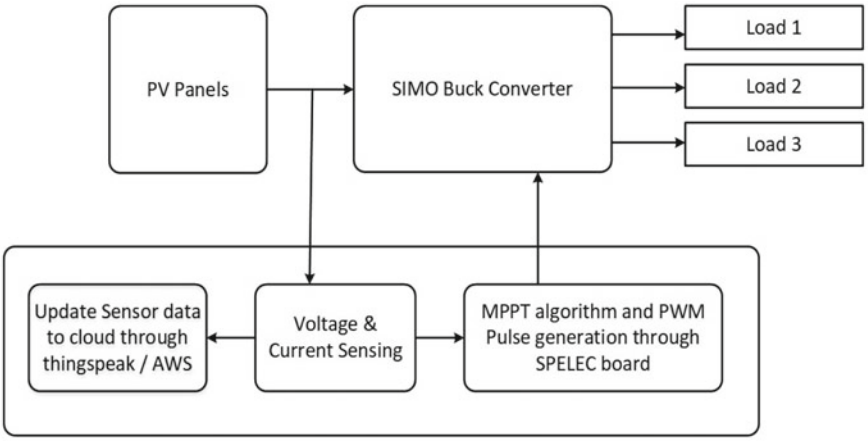

Fig. 2 Basic block diagram of the proposed controller

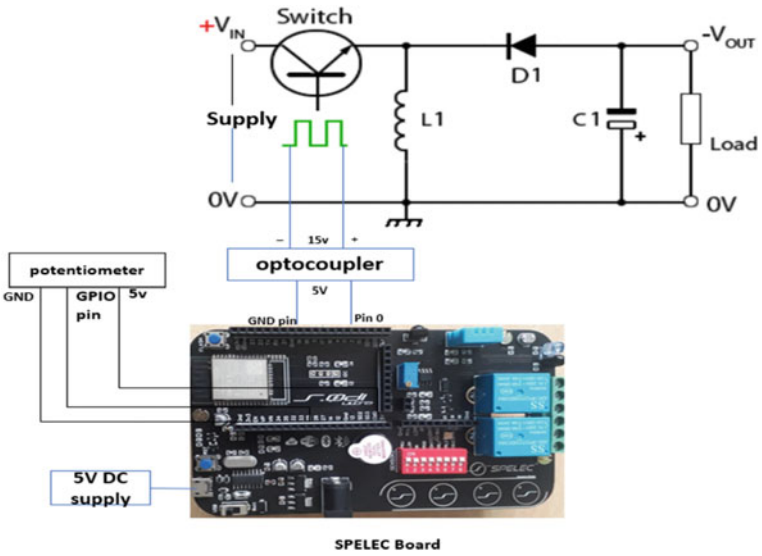

Fig. 3 Embedded board interface to the converter

can be generated from the in built PWM pins of the board. The purpose of opto-coupler is to isolate the control circuit and power circuit and also to amplify the gate pulse generated from the embedded board from 5 to 15 V which is essential to trigger the MOSFET in DC-DC converter. Potentiometer is connected in the circuit to change the duty cycle of the generated gate pulse. The board can offer very high PWM frequency and can support multiple programming IDE. The comparison of the proposed SPELEC board with other trending boards can be seen in Table 1.

Table 1 Comparison of SPELEC board with trending boards in market

Features	Arduino	Node-MCU	SPELEC
Processor cores	AVR RISC (8-bit)	ESP8266 (LX106) (32-bit)	Xtensa LX6 (32-bit)
CPU frequency (MHz)	16	80	240
Speed (1 million operations) (s)	7.11	3.82	0.39
Wi-Fi	No	No	Yes
Bluetooth	No	No	Yes (v4.2)
BLE	No	No	Yes
Flash memory	32 kB	4 MB	16 MB
EEPROM	1 kB	4–4096 bytes	4 kB
SRAM (kB)	2	128	520
GPIO	14 (10-bit)	17 (10-bit)	32 (12-bit)
Buses	SPI, I2C, UART	SPI, I2C, UART, I2S	High-speed SPI, 2-I2C, 2-I2S, 3-UART, SDIO, CAN
PWM frequency	500 Hz (8 bit)	1 kHz (8 bit)	70 kHz (8 bit)

3 SIMO Converter Simulation and Results

Three Buck converters are connected parallelly and the loads are connected across capacitors to use it as multi output converter (Fig. 4). The same panel voltage of 12 V is applied to all three parallel branches of the converter. Simulation is performed in

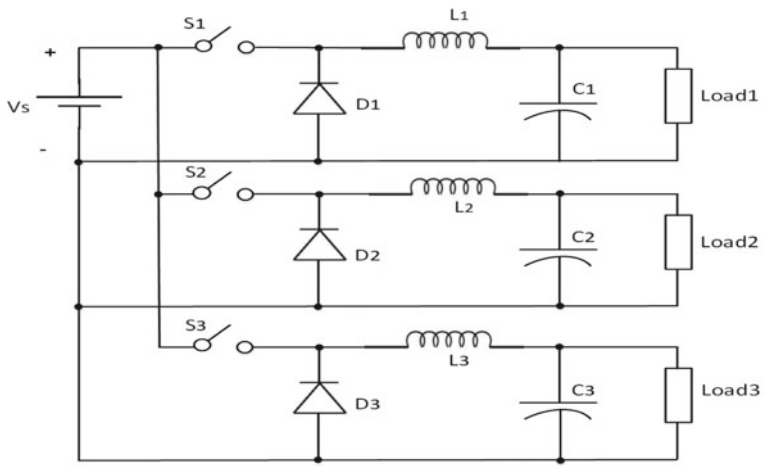

Fig. 4 Single input multiple output Buck converter circuit diagram

NI-Multisim to check the performance analysis and the output waveforms were captured for 30%, 50%, 75% duty for 3.6 V, 6 V, 9 V respectively and shown in Fig. 5.

4 Experimental Setup

The hardware setup has the DC-DC Converter (SMPS), DC Regulated Power Supply, a variable load (rheostat), DSO to observe the output and the proposed embedded controller board (SPELEC). Figure 6 shows the experimental setup. The proposed SPELEC board which is used as an Embedded Controller has many advanced key features when compared to other trending boards available in market like Arduino, Node-MCU. A comparison table is given in Table 1. From the table, it is clear that the proposed board is superior among other boards in terms of CPU frequency, Flash memory, SRAM, No. of GPIO pins, buses, no. of PWM pins and PWM frequency. The board has many features of FPGA board and is very economical.

5 P&O Algorithm Implementation from SPELEC Board

The advantages of P&O algorithm over other MPPT techniques are mainly its ease of implementation and higher conversion efficiency [6, 7]. It doesn't involve solving any complex mathematical equations like fuzzy and neural network algorithms [8]. Its cost of implementation is also less so this P&O algorithm was chosen to implement MPPT technique [9] (Fig. 7).

The MPPT technique employed will promise the constant voltage at the converter end irrespective of change in irradiations and change in load. In Perturb and Observe algorithm power is calculated as the product of load current and panel voltage [10, 11]. The panel voltage of that instant and previous instant are compared and if any difference occurs due to change of irradiations or change of load, the duty cycle of the gate pulse is adjusted accordingly to maintain the constant output voltage at the converter end [12]. The implementation of P&O technique is shown in Fig. 8. Voltage and current sensors will measure the panel voltage and load current respectively which is essential part in implementing the P&O technique [13]. Since the current sensor takes 3.3 V as input voltage, calibration is done to get the proper accurate results through a voltage divider circuit. Unlike the current sensor, voltage sensor can measure the panel voltage directly when connected in parallel to it.

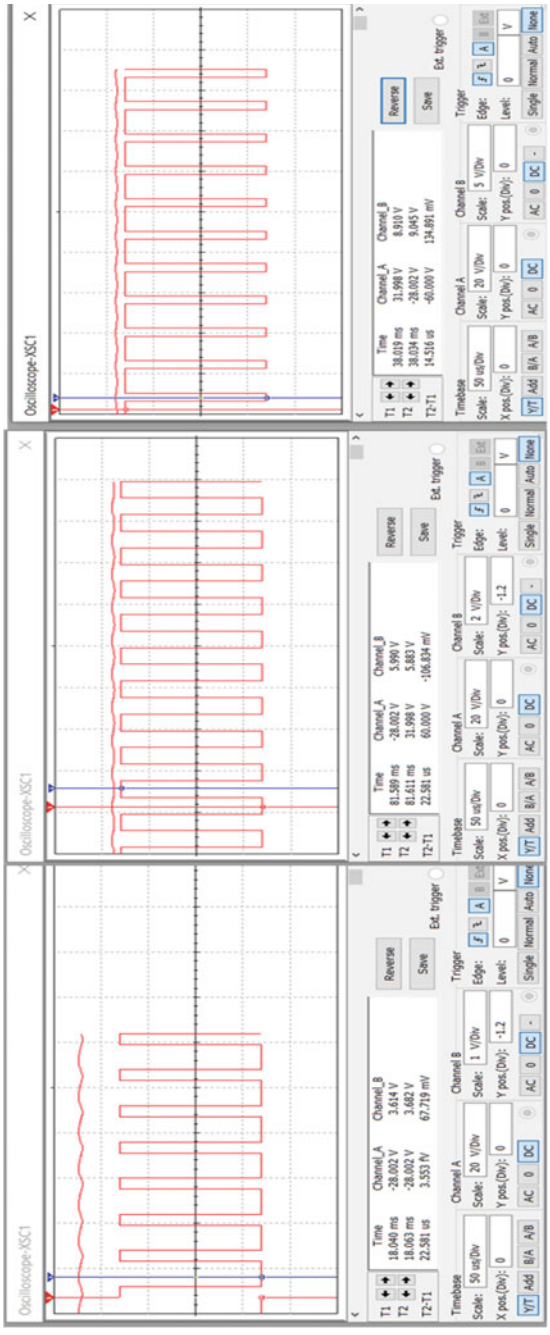

Fig. 5 Gate pulse and output voltage waveforms in multisim

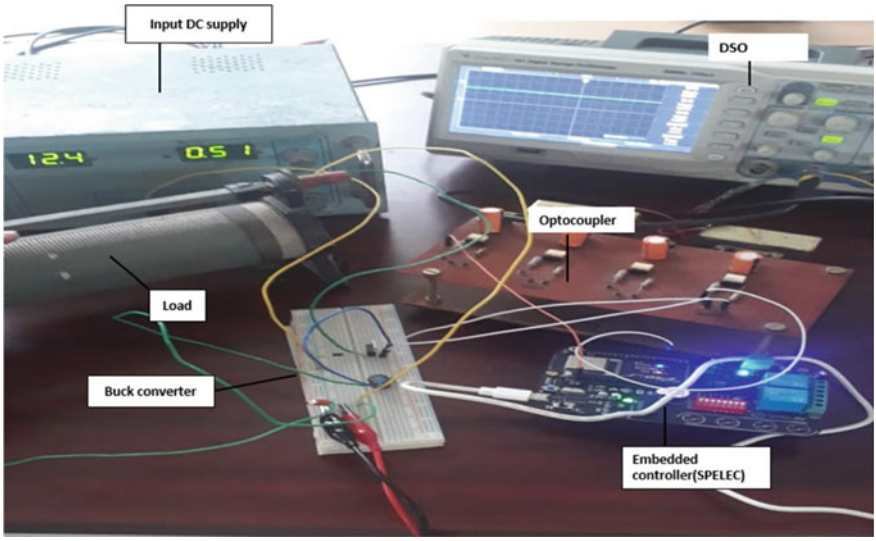

Fig. 6 Experimental setup for hardware

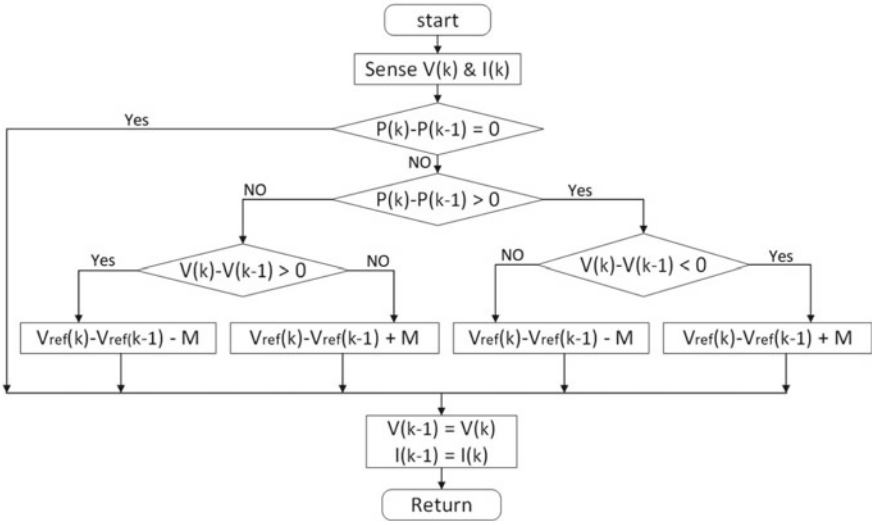

Fig. 7 Flow chart of P&O algorithm

6 Uploading Sensor Data to Cloud Through ThingSpeak

Remote monitoring not only ensures the efficient utilization of the system equipment, but also promises the safety of the equipment and security and moreover estimation

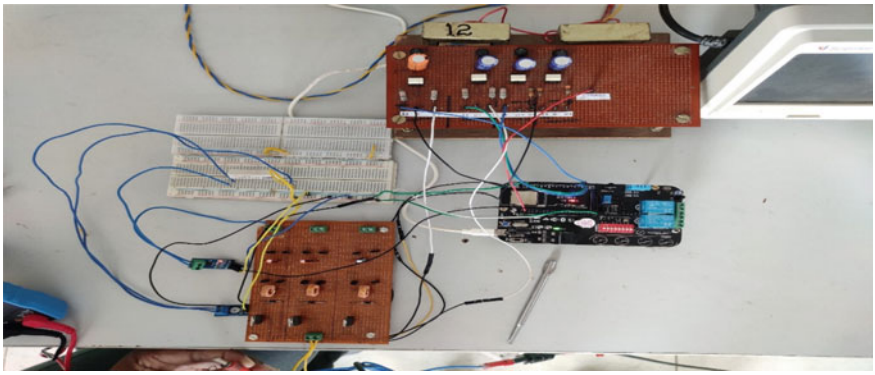

Fig. 8 Hardware setup for P&O implementation with SPELEC board

and planning will become easy with remote monitoring. The only best way to achieve remote monitoring is through IoT. Reading the sensor data and uploading it to cloud makes remote monitoring possible. The change in irradiations and load current can be tracked with remote monitoring. The sensed data is uploaded to cloud through an application called as ThingSpeak. In ThingSpeak a channel is a specific space assigned for us to save our data in cloud. Every sensor can be represented by a field through which data will be uploaded to the channel in cloud. Data from ThingSpeak can also be uploaded to cloud in forms of videos provided the github link (Fig. 9).

7 Results and Discussions

Figure 10 shows the generation of gate pulse from the proposed SPELEC board having frequency of 25 kHz and amplitude of 5 V. The amplitude of the generated gate pulse can be amplified using optocoupler. The pulse width or duty cycle can be varied from 0 to 100% programmatically without additional use of potentiometer and the same was shown in Fig. 10.

The gate pulse that was generated from the embedded board is used to trigger the semi conductor switches of SIMO converter where three switches operating at 30, 50 and 75% duty ratios. The respective output voltages were recorded and tabulated in Table 2. Figure 11 shows the gate pulse of 50% duty and the second plot represents the corresponding output voltage of SIMO converter. The same procedure was repeated by replacing the proposed SPELEC board with Arduino board to check the performance analysis and the results are tabulated in Table 2. From the table it can be understood that the ripple in the output voltage is very high when used with Arduino board as the board can generate the gate pulse of 945 Hz frequency and eventually the mean converter output voltage also reduces when compared with SPELEC board.

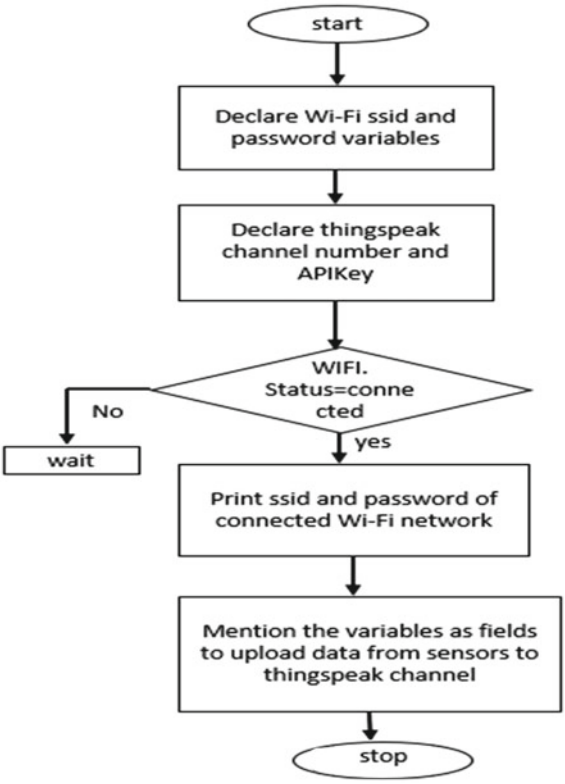

Fig. 9 Flowchart to upload the sensor data to ThingSpeak cloud

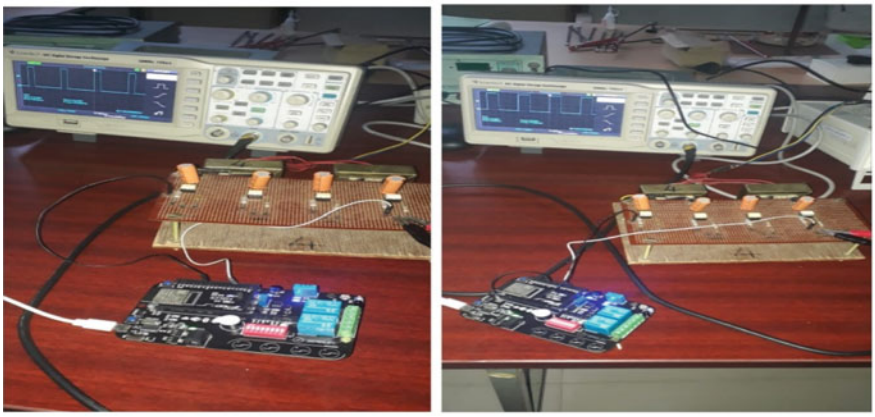

Fig. 10 Gate pulse of variable duty generated from SPELEC board

Table 2 Converter output voltage using SPELEC board

S. No.	Input voltage (V)	Duty ratio (%)	Output voltage (V) (SPELEC board)	Output voltage (V) (Arduino board)	Output voltage (V) theoretical	% deviation for SPELEC board	% deviation for Arduino board
1	12	70.5	8.2	6.3	8.46	0.03	0.255
2	12	49.85	5.2	4.3	5.9	0.11	0.277
3	12	31.55	2.4	1.6	3.7	0.35	0.56

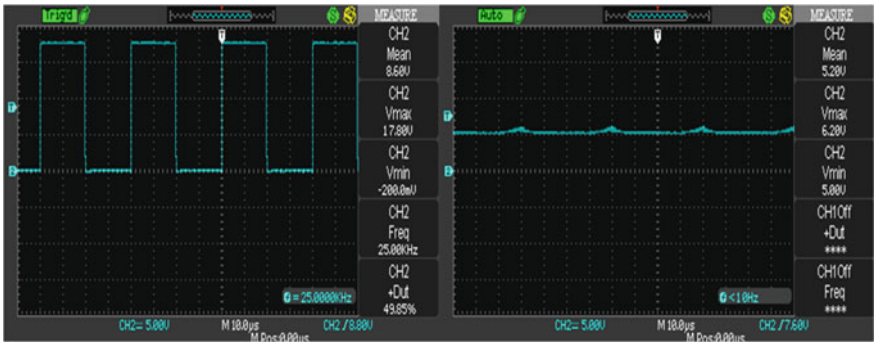

Fig. 11 Gate pulse of 50% duty and corresponding output voltage

The input voltage to the converter, duty ratio, corresponding mean output voltage obtained using SPELEC and Arduino boards both expected and actual, % deviation is tabulated in Table 2.

Through ThingSpeak the recorded sensor data is uploaded to cloud by creating a channel in the cloud. Two fields named as voltage field and current field are created for voltage and current sensors respectively. The sensors data is uploaded to cloud at the rate of 15 s. The variations of solar voltage and load current are observed and uploaded to cloud ranging from 0 to 12 V and 0 to 1.5 A respectively (Fig. 12).

The same sensor data that is uploaded to ThingSpeak can also be monitored through a mobile application called “blynk”. The load voltage and load current can be observed from mobile using this app. This helps in monitoring the fluctuations in load voltage and current remotely (Fig. 13).

8 Conclusion

A novel programmable converter for solar based SMPS applications is proposed in this paper and its performance is compared with Arduino board for generation of high frequency gate pulse. The average SIMO converter output voltage is improved

Fig. 12 Uploading current and voltage sensor data to cloud through ThingSpeak

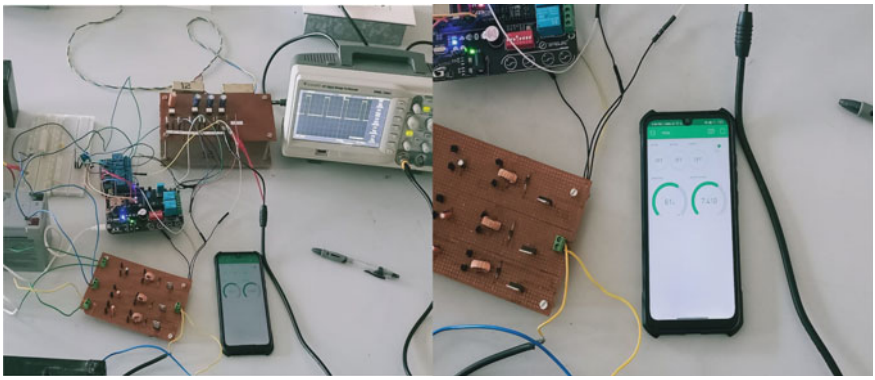

Fig. 13 Uploading load voltage and load current through blynk app

and percentage deviation or ripple in the output voltage is also reduced when used with the proposed SPELEC board. The SPELEC board is cost effective compared to FPGA controllers. The P&O algorithm was implemented using SPELEC board and Arduino boards as well. The sensor data which is panel voltage and load current are also uploaded to cloud through ThingSpeak and load characteristics were observed from mobile using blynk application using IoT infrastructure to ensure the remote monitoring of the system.

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Low Power Comparator-Triggered Method of Multiplication for Deep Neural Networks

K. Mariya Priyadarshini, C. Santosh, G. U. S. Aiswarya Likitha, I. B. V. Sai Srikar, and Peram Ramya

Abstract In today's era of technologies developing with the help of Neural-Networks need high frequency methods of multipliers than slow and accurate devices. Rounding off methods of multiplication developed for floating point numbers are in high need. The designer now days lean towards power efficient and high speed devices rather than accuracy and fineness. Running towards these demands in this paper a new method of multiplication procedure is proposed which can reach the demands of customers. Instead of conventional method of multiplication using Ex-OR gates comparator logic is used to trigger the multiplication process. These multipliers are named as Comparator Triggered Multipliers. This reduces the power, area and delay to greater heights. Comparative results are shown with the help of Verilog programming using Xilinx-ISE simulator. Post layout simulations are done at 45 nm technology to show the switching power comparisons using Mentor Graphics.

Keywords CTM · LUT · RTL · DNN

1 Introduction

Multipliers play a vital role in today's digital signal process and numerous other applications. In high performance systems like microprocessor, DSP etc. Multipliers and summers became two crucial operators binary in many of the Machine Learning (ML) and Artificial Intelligence (AI) applications.

Statistics identify greater than 80% programming methods in microprocessor and mainstreams of ML-algorithms implement multiplications and summations [1]. These mathematical operators dominate the execution speed. The demand for high speed processors is growing to expand ML and AI applications. Power consumed should be low to meet the standards of customer, this can be met by optimizing the set of operators in the flow of multiplication [2–4]. Hence the necessity of high speed and low power multiplier has increased. Designers mainly focus on extraordinary

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speedy and power competent circuit strategies [5–8]. First we will understand diverse multipliers like Booth multiplier, Wallace tree multiplier, Sequential method of multiplication and combinational method of multiplication. The vital part of almost all sort of fashionable mathematical structures are Floating-point multipliers. All most all data-intent systems, like Deep-Neural Networks (D-NNs), go through the majority of their resources and energy take under consideration [9–12].

The error-resilient nature of those applications usually suggests using approximate computing to boost the performance, and space of floating-point multipliers. Earlier work has shown that using hardware-oriented approximation for computing the fraction (mantissa) product might end with energy reduction of a main system at the expense of a reasonable computational error [13, 14]. This helps us understand the layout of an approximate comparator used inside the floating point multipliers for doing mantissa product. First, we appear to display the use of actual comparators to improve floating-point multiplier power, area, and delay. After that, the planning area of approximate comparators for approximate comparator-enabled multipliers (AxCEM) [15] would appear to be explored. The results of the simulation here show that the proposed design can give us a 66% decrease in power dissipation, another 66% decrease in die-area and a 71% delay reduction [16, 17]. The accuracy loss in DNN applications due to the proposed AxCEM may also be smaller than 0.06% [18–20] relative to the state-of-the-art approximate floating-point multipliers.

Energy consumption is the main issue in the design of VLSI, especially in nano-scale devices, while the continued demand for higher process power for growing applications is increasing. Computing systems are now increasingly firmly calculated in wireless and battery-operated devices such as mobile phones. Research reveals that for many applications, such as data processing and transmission applications, correct computing units are not required. They will tolerate inaccuracy [21]. In several levels of types, approximation strategies are applied to include a trade-off between the desired device parameters such as power consumption, latency, and accuracy, provided by several metrics such as Mean Error Distance (MED), Mean Square Error (MSE), and Mean Relative Error Distance (MRED) [22]. Floating-point multiplication is the DSPs, multimedia, and it will cause heavy delay and energy consumption in many applications are the key factor. The primary resource-intensive component of floating-point multiplications is that the fraction product calculation unit intensifies nearly 80th of the overall device energy [23]. Therefore, various approximate multiplications within the temporal order or functional behaviors have been designed by several researchers to minimize logic complexity or voltage scaling techniques [24–26].

In the creation of estimated floating-point multipliers, there has also not been much effort. There are two key steps; (1) adding exponents, and (2) multiplying the mantissa. So, we did a 23-bit and 53-bit multiplication of single accuracy and double accuracy (mantissa), respectively. And for a few multipliers, such as booth, Wallace, etc. In order to acquire partial products, a few approximate multiplier blocks are granted [27], and some approximate adders are also proposed to assemble these

partial products [28]. In order to minimize its power consumption and silicon footprint when keeping the error at a reasonable range, we decided to use the approximation techniques within the one described. In this, we bring in an approximate multiplier allowed by the comparator, called AxCEM, that will subtract the delay and energy consumption. Using an estimated comparator [29–31], we put forward a fully unique floating multiplier. We used an approximate comparator instead of the mantissa multiplication (23-bit single accuracy multiplier and 52-bit double accuracy multiplier in IEEE-754), which decreases the delay and provides an energy-efficient multiplier. The advantage of this paper is that: (1) We studied the use of comparators to improve the power, area, and delay of floating-point multipliers as a novel approximation technique. (2) We explore the design space of approximate comparators for designing effective approximate comparator-enabled multipliers (AxCEM) [32] to further enhance the circuit metrics. By performing gate-level logic simplification for CEM, we bring in two designs called AxCEM1 and AxCEM2. (3) Lastly, we show that, when used in DNN applications, the proposed designs show less than 0.06 accuracy loss, though showing improved performance compared to the state-of-the-art estimated floating-point multipliers [33] (in both training and inference steps).

2 Floating Point Representation (IEEE 754)

For two numbers, the product of X and Y, can be realized with three simple operations (Fig. 1). Z63 in Fig. 2 represent sign value of the product and is easily calculated by EX-oring X_{63} and Y_{63}. Summing the exponential terms of X and Y results in exponential bits of final product. 52-bits of mantissa equals to the product of input (i/p) segments.

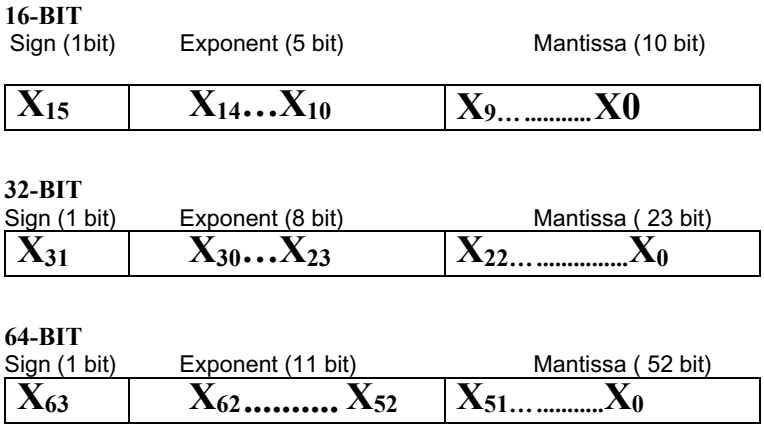

Fig. 1 IEEE 754 standard representation of 16-bit, 32-bit and 64-bit floating-point numbers

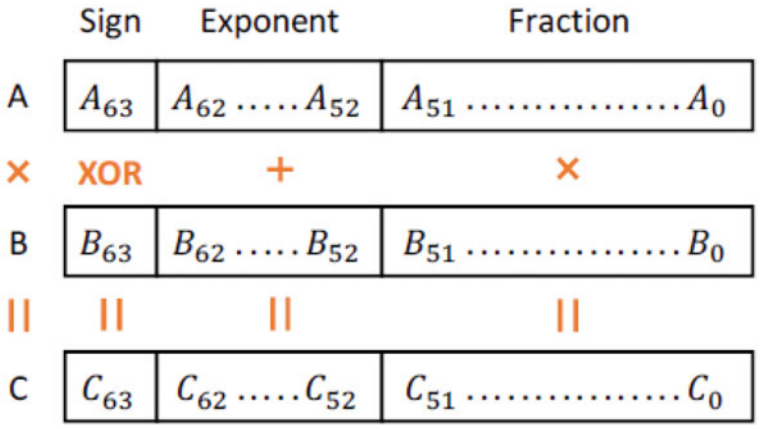

Fig. 2 Multiplication of A and B 64-bit floating point bits according to IEEE 754 standard [34]

2.1 Related Multipliers

This section, reviews some of the prior research that focuses on approximate and accurate multipliers. In [35] authors proposed circuit designs that permit the implementation of hardware to even with more extensive voltage. A dynamic and fast bit selection scheme to reduce multiplier size is defined in [36]. In [37], the authors designed a versatile multiplication approximation method that reduced the total number of intermediate AND gates. In [38], less-powered micro-level cells are proposed and later linked to create an effective multiplier. Paper [39] used incorrect summers, such as CMA [40] and ICAC [23], to sum up and miss intermediary AND products, otherwise few LSB's [41], Imani et al. Correspondingly, Al suggested R-MAC, C-FPU, C-MUL and RMAC. In [42], Jiao et al. suggested a multiplier that unlocks the openings of calculation reuse and strengthens them by performing assumed design. Many previous works are suggested to place on estimated computation on D-NN's manipulating output parameters due to the natural versatility of Neural-Networks (NN's) to failures. Zhang et al. concentrated on improving power usage and improving speed by controlling memory access is not critical [43]. In most D-NNs, multiplication of floating numbers has become a leading block that continues to consume a significant part of the dynamism and production cost of D-NN. Before employing inaccurate procedure of multiplication in D-NN's a keen work need to be carried in minimizing power utilization. From [44], Sarwar et al. proved any imprecise method of multiplication using the idea to share computational blocks can back up power. Neshatpour et al. explored on iterative C-NN by re-formulating single forward feedback system by cascading micro networks serially. This allows C-NN to lay off with very few computations [34].

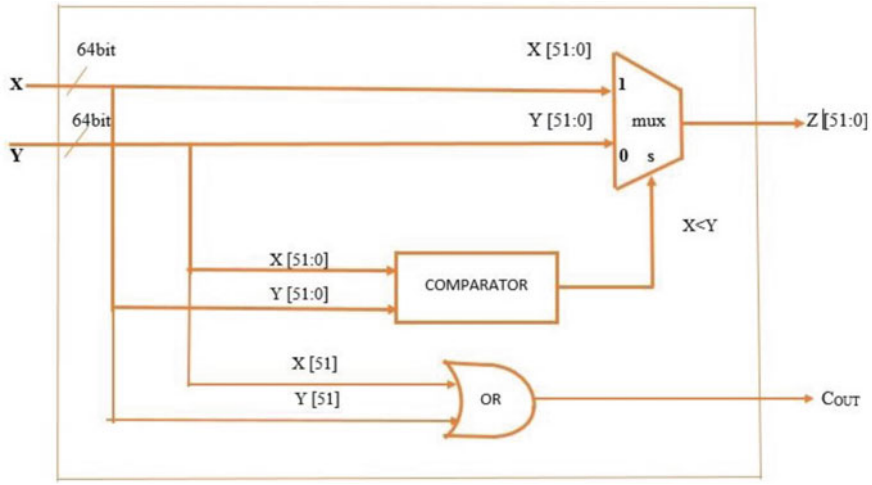

Fig. 3 RTL level diagram of 64-bit CTM

2.2 The Comparator-Triggered Multipliers (CTM)

We recommend replacing accurate multiplier with CTM module. A CTM generates output LSB bits (0 to 51) of product bits by considering mantissa X [0 to 51] and Y [0 to 51]. After comparing them the output Z [0 to 51] will be the lesser value among X and Y. Figure 3 displays Register Transfer Logic (RTL) level of 64-bit method of multiplication. A CTM is advised over generic structures of multiplication as it consumes less power and silicon cost. Owing to the fact that the CTM logic requires to perform X < Y no extra logic circuitry is necessary for outputs like X = Y and X > Y. The constraints over which the CTM shows low power and less error over exact multipliers are:

(1) When the entire XOR-difference between X and Y is noteworthy,
(2) Any one of the operand among X and Y is between 1 and 2 or any value closer to them.

In Fig. 4 bit wise operations performed on 64-bit operands using CTM method of multiplication is shown.

3 Experimental Results and Analysis

Simulations are done to prove the efficiency of proposed multiplier with Array and Vedic methods of multiplication. Table 1 shows dissipation of power due to switching of gates. Power supply is changed by varying voltage from 3.2 V down to 1 V for performing power analysis on Array, Vedic and Comparator-Triggered multipliers.

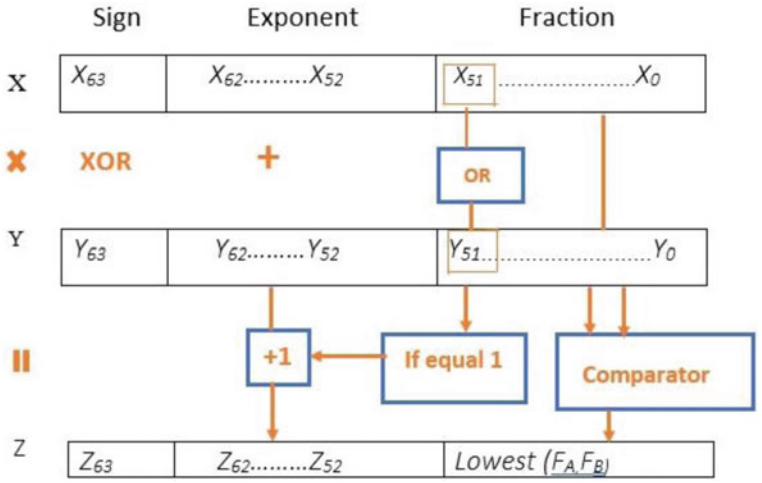

Fig. 4 Bit wise operation of 64-bit float numbers using CTM

For 32-bit CT-Multiplier a show a difference of 26.6 nW, Vedic multiplier shows a difference of 61.85 nW and Array multiplier shows a difference of 74.3 nW with a voltage difference of 2.2 V (3.2–1 V). For 64-bit and 128-bit no much increase is observed for proposed multiplier when compared with the other two techniques of multiplication.

Figures 5, 6 and 7 shows the (Look up Table) LUT utilization of multipliers when simulated and synthesized using Xilinx ISE tool. The number of LUT's consumed by Array, Vedic and CT-Multipliers are 408, 276 and 196. It can be inferred that approximate multipliers are more efficient than accurate method of multiplication in terms of power and area (with reference to LUT utilization) (Table 2).

On chip power of CTM is reduced by 22.5% when compared with Vedic-Multiplier and 40.7% of power is reduced by CTM when compared with Array multiplier. An amount of 2.04 W of static power is reduced by proposed method when compared to Vedic-Multiplier and an amount of 6.52 W is diminished by proposed method when compared with Array Multiplier.

4 Conclusion

From the results and discussions made in the above session it can be concluded that approximate method of multiplication yields less dissipation of power in terms of switching power, On-chip and Static power. As major portion of power is consumed by multipliers in ML (Machine Learning) and AI (Artificial Intelligence) based application, the CTM helps in high frequency operations with less on-chip power. The number of logic slices utilized by proposed method of multiplication is reduced by

Table 1 Comparison of switching power dissipation of 32-bit, 64-bit and 128-bit multiplication techniques

Voltage	Power dissipation for 32-bit (nW)			Power dissipation for 64-bit (nW)			Power dissipation for 128-bit (nW)		
VDD (V)	Array multiplier	Vedic multiplier	Proposed multiplier	Array multiplier	Vedic multiplier	Proposed multiplier	Array multiplier	Vedic multiplier	Proposed multiplier
1	45.3	37.82	16.2	86.68	68.4	32.1	95.3	79.422	35.7
1.2	58.9	49.16	21.1	112.6	88.9	41.8	123.8	103.23	46.5
1.4	64.14	53.45	22.9	122.5	96.7	45.5	134.6	112.24	50.5
1.6	68.6	57.23	24.6	131.1	103.5	48.7	144.2	120.18	54.13
1.8	83.16	69.3	29.7	158.8	125.4	59	174.6	145.53	65.5
2	85.9	71.64	30.8	164.1	129.6	60.9	180.5	150.44	67.7
2.2	95.7	79.77	34.3	182.8	144.3	67.9	201	167.51	75.4
2.4	100.9	84.16	36.18	192.8	152.3	71.6	212	176.73	79.6
2.6	107.06	89.22	38.3	204.4	161.4	75.9	224.8	187.36	84.4
2.8	109.8	91.5	39.3	209.7	165.6	77.9	230.5	192.15	86.5
3	117.4	97.91	42.1	224.4	177.2	83.3	246.7	205.61	92.6
3.2	119.6	99.67	42.8	228.4	180.4	84.8	251.1	209.3	94.2

Fig. 5 LUT utilization for Vedic multiplier

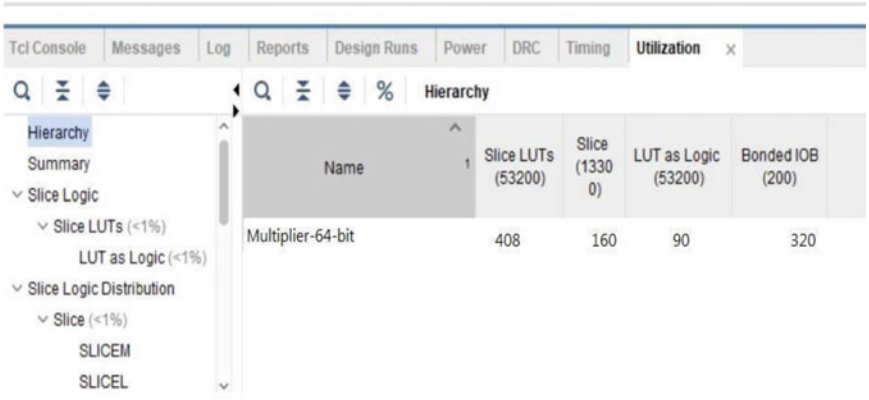

Fig. 6 LUT utilization for Array multiplier

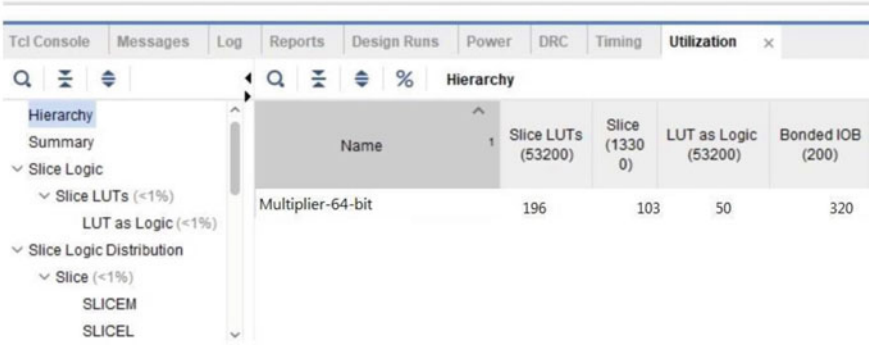

Fig. 7 LUT utilization of proposed multiplier

Table 2 Summary of power dissipation and LUT utilization

Parameters	Vedic	Array	Proposed
On chip power utilized (W)	99.2	129.6	76.8
Static power dissipation (W)	8.96	13.44	6.92
Slice LUT	276	408	196
Logic slice	128	160	103
LUT as logic	75	90	50
Bounded IOB	320	320	320

33% when compared with Vedic-Multiplier, and 44.4% when compared with Array-Multiplier. Finally we would like to conclude that Comparator-Triggered Multiplier can be replaced with any method of approximate and accurate multipliers.

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CAE Based Image Compression for Energy Compaction

N. Venkatram, T. Sri Vatsa, M. Vinuthna, and J. Sankeerth

Abstract Image Compressions has been a significant theme for research for a long time. Top to bottom investigation was a significant forward leap in numerous PC supported applications, and its utilization in image compression was developing consistently. In this paper, a cutting edge power pressure framework dependent on image compression with conventional auto-encoder (CAE) makes high coding capacity. The primary contribution is to incorporate three angles: (1) Presenting CAE image compression by disintegrating into different examining activities; (2) in the CAE plan, factual examination in the region of force joining and are the principal errand to advance basic code discovery in planning organizations, which can go about a proportion of strength; (3) Depending on the coding benefit metric measurements, set the force sharing system, which adds to the propensity for losing work in the preparation stage cycle to help CAE increment coding benefit and kill pressure proficiency. Test outcomes show the BPG yield technique, as indicated by standard MS-SSIM measurements. Also, this method accomplishes more noteworthy effectiveness contrasted with existing adjustment techniques and give better coding execution contrasted with minute clog learning strategies at more exorbitant costs. The research this time is thus focused on developing a better standard for compression and also does this in the most energy efficient format. To conclude, in the end that a standard can be made above the best and show this at the end of the paper.

Keywords Convolutional auto-encoder · Energy compaction · Excellent distribution · Image compression · Power integration

1 Introduction

An Image Compressions has been a significant exploration theme on the field of image processing's for a long time. Standard image compression norms, for example, JPEG's [1], JPEG2000's [2], and BPG's, which use HEVC inserted text, depend

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on available coded manual codecs [3]. Moreover, they utilize fixed networks, for example, discrete cosine change (DCT) or discrete wavelet change (DWT), with a similar quantization's as the entropy-coder. Powerful suppression benign accomplished many years of exertion. Be that as it may, with the multiplication of high-goal pictures and the production of novel picture designs, existing norms are not the ideal pressing factor answer for a wide range of picture content. As of late, inside and out learning has been utilized effectively in an assortment of PC seeing exercises and can build image compression execution, for various reasons. At first, the encoder-decoder pipeline at standard pressure levels incorporates an auto-encoder, which is a kind of neural organization structures for the investigation of packed portrayal. In earlier years, the auto-encoder was broadly used to diminish size, coordinated picture portrayal, and creation learning models [4]. In this manner, it can accomplish better pressing factor execution. The latest types of learning-based pressure, including redundant neural organizations [5–7] convolutional neural organizations [8–14], and gainful resistance networks [15–17], have all accepted the design of auto-encoder. The 2nd advantage of pressing factor base learning is start to finish learning structures. Rather than planning calculations for every module, for example, surmises, in-circle channel in standard codecs, start to finish learning modes can rapidly adjust to the fast improvement of new picture designs, since everything boundaries can be consequently perused paying little heed to picture designs.

Existing inside and out examinations on image compression have accomplished promising execution, as revealed in [12, 15] with an attention on choosing neural organization structures and the development of quantization and backup balance method, which are significant in at last—driving preparing. Accordingly, in this study, this method presents image compression dependent on energy decrease utilizing a convolutional auto-encoder (CAE) [18–30]. The significant commitments are summed up as follows:

1. Presenting the CAE design of image compression, along these lines, the root of the examination and the plan of the words into a progression of deduction and test tasks.
2. Remain by the CAE plan, break down the zone of CAE's energy limitations and ascertain the general issue of continuous portion as a coding benefit metric, which incorporates the capacity to pack from the reference structure of the consequences of the consolidation impacts.
3. In accordance with the measurements proposed above, propose a force based force based dissemination framework by adding a norm for work misfortunes, and introducing the CAE preparing system can be of incredible advantage to composing.

2 Methodology

This part initially portrays the suggested convolutional autoencoder (CAE) design as gauge, as demonstrate in Fig. 1. This method also presents the numerical investigation

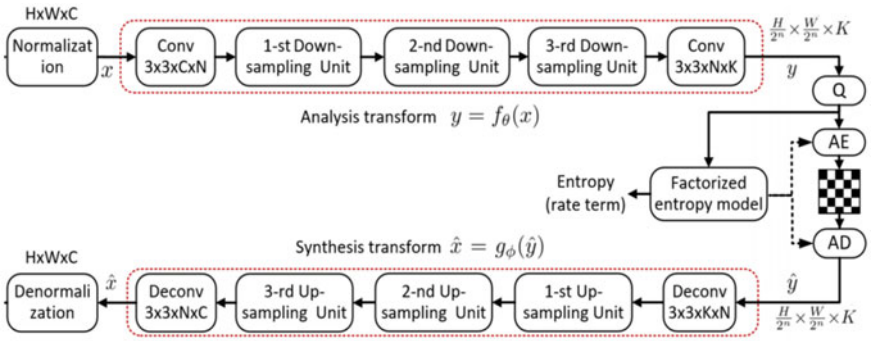


Fig. 1 Proposed architecture overview [1]

of the energy-compaction properties and proposes a standardized code acquire metric. In light of the proposed coding acquire metric; proposing an energy compaction based preparing system helps the gauge CAE network accomplishes better outcomes.

2.1 Hand Crafted Compressions

Managing image compression guidelines depend available made module configuration independently to accomplish image compression. The modules incorporate highlights in particular, if this comprises of RGB information, the encoders will initially change over it into YUV space as a pre-processing step. Besides, BPG (intra-coded HEVC) uses adaptable sizes (up to 32×32) for DCT, recreation quantization control and a substance versatile parallel number-crunching coder (CABAC). Besides, BPG presents intra forecast with five sorts of sizes and 35 tributes to eliminate the spatial connection. In any case, there is still space to improve the exhibition of image compression dependent on HEVC. For instance, the saliency data was joined into image compression advancement for HEVC-MSP in, and new shading image compression usage were proposed in dependent on the YUV420 chromo design. During the advancement of cutting edge pressure calculations, some half and half techniques have been proposed to improve the presentation of individual modules, by exploiting both traditional pressure calculations and most recent AI draws near. For instance, in the down sampling of the information pictures was applied before BPG and utilized super-goal neural organizations as a post channel.

2.2 Learning-Based Compression

As of late, numerous neural organization structures have been proposed for start to finish learning-based image compression, including intermittent neural organizations (RNNs), convolutional auto-encoders (CAEs), generative antagonistic organizations (GANs), and others. To sum up current turns of events, discuss the structures underneath. RNN structures can be utilized to foresee the remaining data between the crude picture and the reproduced pictures in a few cycles. Toderici previously utilized a long short term memory (LSTM) intermittent organization to pack little thumbnail pictures (32 × 32), and furthermore utilized a binarization layer to understand the quantization. This methodology was additionally stretched out in to pack full-goal pictures. Preparing and spatially versatile piece rate were additionally viewed as in to accomplish higher pressure execution. A RNN can be considered as a versatile coding framework to produce numerous reproduced pictures with various quality levels. Nonetheless, it involves a mind boggling organization. Theis et al. what's more, Balle's first proposed the model of convolutional auto-encoders for learned image compression. They joined differentiable approximations of round-based quantization and completely factorized the entropy model for start to finish preparing with angle backpropagation utilizing an auto-encoder.

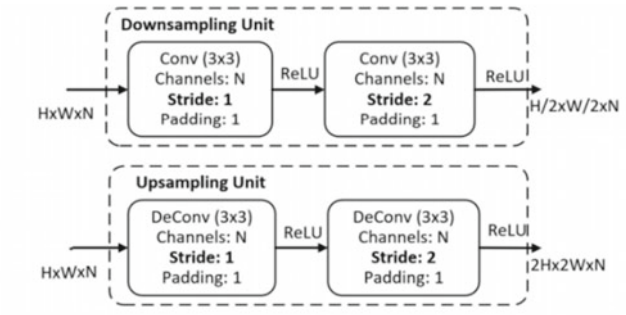
3 Experimental Analysis

3.1 Architecture of Convolutional Auto-Encoder (CAE) Based Compression

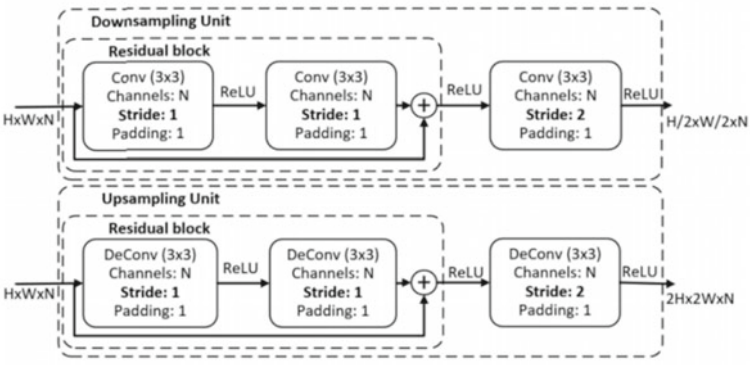
The lone pre-preparing ventures before the CAE network comprise of balancing the crude RGB picture to [−1, 1] by ascertaining (x/127.5 − 1.0). The size of the info is meant as H × W × C, where C addresses the quantity of shading segments. We thought about that C = 3 for the RGB pictures. The investigation change and union change have symmetric organizations, aside from utilizing convolutional and de convolutional channels, individually. Plain units utilize two convolutional channels, while a leftover unit replaces one convolutional channel with a leftover square. The organization structure is appeared in Fig. 2. Correlation of various sorts of downsampling and upsampling units.

In view of the rate-bending cost work in customary codecs, the misfortune capacity of CAE can be characterized as follows where λ controls the trade-off between the bending and rate. D addresses the contortion between the first pictures x and reproduced pictures addresses the pieces needed to encode the quantized compacted information y^.

$$J(\theta, \phi; x) = \lambda D(X, X^{\wedge}) + R(y^{\wedge}) \tag{1}$$



(a)"Plain" Unit



(b) "Residual" Unit

Fig. 2 Two types of downsampling/upsampling units [1]

As said by the hypothesis in the model, the amount of lower-limited by the entropy of the discrete likelihood dispersion of the quantized codes, as follows:

$$R = \sum_{k=0}^{0} \left[-\log 2\left(py\left(y^{\wedge}\right)\right)\right] \tag{2}$$

where q is the real dissemination of the packed code is the backup model. To forestall an exorbitant organization structure overhead to be brought about by backup assessment, utilized the univariate non-parametric thickness model to address the completely factorized preceding as certain the backup as a rate most of the signs and create a huge number for recurrence coefficients. Past advanced coding speculations have given hypothetical answers for the assignment of pieces from the perspective direct framework energy.

Table 1 Notations

Notation	Definition
k	The index channel for the last layer, k Є [0, k − 1]
y_k	The compressed data for the kth channel
q_k	The quantization error for the kth channel, $q_k = y^{\mid}{}_k - y_k$
r	The reconstruction error of the image, $r = x^{\mid} - x$
σ_x^2	The variance of the raw image x
$\sigma_{y_k}^2$	The variance for the compressed data y_k for the kth channel
$\sigma_{q_k}^2$	The variance of q_k for the kth channel
σ_r^2	The variance of the reconstruction error r

For simplicity of looking, Table 1 sums up the documentations in the accompanying investigation. Great energy compaction property is basic for effectiveness execution. In customary advanced coding frameworks, energy compaction suggests the creation of the quantized coefficients, which can accomplish a higher pressure proportion. In this manner, numerous energy compaction-based coding apparatuses have been created. For instance, DCT and DWT display brilliant energy compaction by utilizing a couple of low recurrence coefficients to address

$$\sigma_{y_k}^2 = A_k \sigma_x^2$$

$$\sigma_r^2 = \sum_{k=0}^{k-1} Bk\sigma qk2 \tag{3}$$

At that point characterize both Ak and Bk, where Ak = {A0, A1, …, AK − 1} T, dictated by input x and the boundary θ during the investigation change; Bk = {B0, B1, …, BK − 1} T, controlled by both the quantization mistakes and the boundary φ during the combination change. Ak and Bk have the requirement of K × 1.

First, analyse a single neuron, To begin with, dissect a solitary neuron, as demonstrated in Fig. 3. At that point, sum up the energy portrayal from change to amount of squares. For a direct convolutional activity, this fulfils the accompanying:

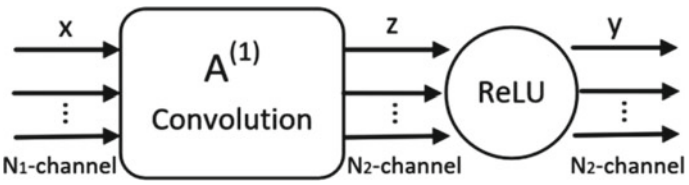


Fig. 3 Diagram of a single neuron [2]

$$\mathrm{E}\left[\mathrm{z}^2\right] = \mathrm{A}^{(1)}\mathrm{E}\left[\mathrm{x}^2\right] \tag{4}$$

$$\mathrm{E}\left[\mathrm{y}^2\right] = \int_{-\infty}^{+\infty} \max\{0, \mathrm{z}\}^2 \mathrm{p}(\mathrm{Z})\mathrm{dz} = \int_{0}^{+\infty} Z^2 p(z)dz$$

$$= \frac{1}{2}\int_{-\infty}^{+\infty} Z^2 p(z)dz = \frac{1}{2}E\left[Z^2\right] \tag{5}$$

$$\mathrm{E}\left[\mathrm{y}^2\right] = \frac{1}{2}A_{(1)}E\left[x^2\right] \tag{6}$$

$$\mathrm{A}^{(1,2,\ldots,\mathrm{M})} = \frac{1}{2}^{M-1} \mathrm{A}^{(1)} * \mathrm{A}^{(2)} * \ldots * \mathrm{A}^{(\mathrm{M})} \tag{7}$$

where A(1) × A(2) addresses framework augmentation, the quantity of convolutional layers is M, and the last part will commonly have no enactment work. Allow us to expect that the last part has K channels; at that point, A(1, 2, …, M) will have the element of K × N0. The info picture x for the most layers has three RGB channels or one dark channel. At that point, N0 will get 1 and A(1, 2, …, M) has an element of K × 1. In this manner, characterize $\mathrm{A_k}$ essentially by computing the amount of-squares of x and $\mathrm{y_k}$, as follows:

$$\mathrm{A_k} = \mathrm{A}^{(1,2,\ldots,\mathrm{M})} = \frac{E\left[y_k^2\right]}{E\left[x^2\right]} \tag{8}$$

$$\mathrm{A_k} = \frac{\sigma_{y_k}^2}{\sigma_x^2} \tag{9}$$

Second, decide how to figure Bk in the blend change. During the preparation arranges, the quantization blunder was expected as uniform commotion; in this way, the quantization mistakes are not corresponded with one another, which brings about Bk just being identified with {gφ}. In a direct framework, Bk can be figured by the square-amount of the channel bank coefficients. Nonetheless, it is hard for CAE to ascertain the square-amount of channel saves money with various convolutional activities. Subsequently, do the phony code $\mathrm{c_k}$ by setting the kth channel as 1 and different channels as 0, and feed ck to a given pre-prepared union change. At that point, the gauge vector Bk = {B0, B1, …, BK − 1} as follows (Fig. 4):

$$\mathrm{B_k} = \left\{\sigma_x^2 | \left(y_k \triangleq C_k\right)\right\},\ k \in [0, k-1] \tag{10}$$

$$\sigma_x^2 \quad \alpha \sum_{k=0}^{k-1} B_k \sigma_{q_k}^2 \tag{11}$$

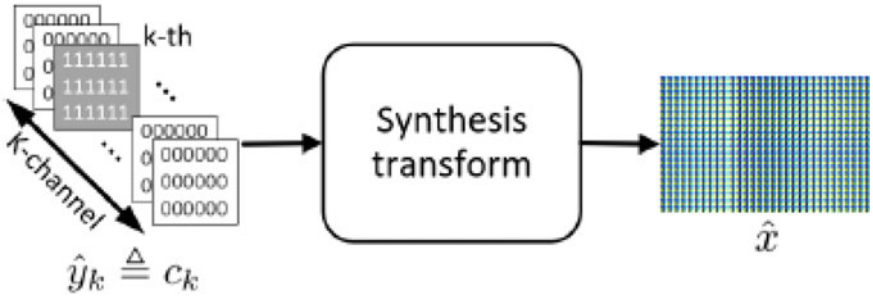


Fig. 4 Construction of fake codes to calculate B_k

As indicated by, the ideal piece assignment issue is portrayed straightaway. Under the accompanying steady piece rate requirement:

$$\sum_{k=0}^{k-1} \alpha_k R_k = \mathrm{R(const)} \tag{12}$$

$$\text{minimize } \sigma_x^2 = \sum_{k=0}^{k-1} B_k \sigma_{q_k}^2 \tag{13}$$

where R_k is the bit rate for the kth channel. By substituting the approximating relationship

$$\sigma_{q_k}^2 \cong \in^2 2^{-2R_k} \sigma_{y_k}^2 \tag{14}$$

$$\min\{\sigma_r^2\} = \prod_{k=0}^{k-1} \left(\frac{A_k B_k}{\alpha_k} \right) \cdot \in^2 2^{-2R} \sigma_x^2 \tag{15}$$

$$\mathrm{G}\ \alpha \frac{1}{\prod_{k=0}^{k-1} A_k B_k} \tag{16}$$

$$\mathrm{G} = -\log_{10} \left(\sum_{k=0}^{k-1} A_k B_k \right) = -\log_{10}(\mathrm{A_k} \cdot \mathrm{B_k}) \tag{17}$$

$$\mathrm{P(A_k)} = \mathrm{E}\left[-\log_2 \mathrm{A_k} \right] = \sum_{k=0}^{k-1} -A_k \log_2 A_K \tag{18}$$

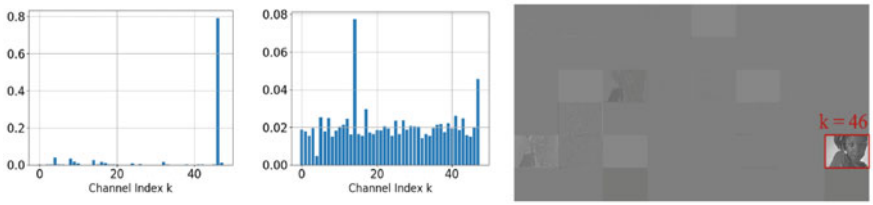
3.2 *Proposed Energy Compaction Placed Bit Allocation Method*

In the beginning, focus the energy in a couple of courses however much as could reasonably be expected. Since A_k is as of now standardized, in this manner, A_k quantifies the energy conveyance for the packed code y_k. This implies that if Ae = 0.8 for the eth channel, 80% of the energy will be appropriated in the eth channel. At that point, build a punishment term by using of the entropy of the energy appropriation as follows:

$$P(B_k) = B_e \tag{19}$$

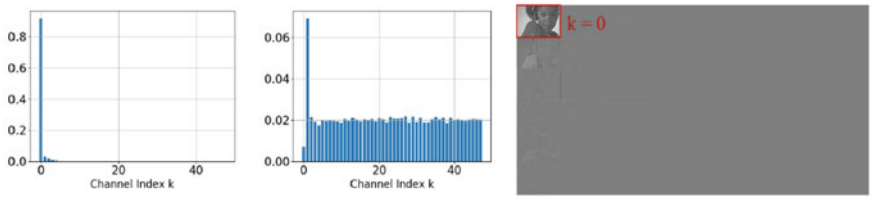
$$J(\theta, \phi; x) = \lambda \cdot D\left(X, X^{\wedge}\right) + R\left(y^{\wedge}\right) + \beta P(A_k, B_k) \tag{20}$$

The inactive explanation is the plan of energy-compaction property comes from the rate-mutilation streamlining as Eqs. (12)–(15), which is steady with the Lagrangian multiplier-based rate-contortion misfortune $J(\theta, \varphi; x) = \lambda \cdot D(x, x^{\wedge}) + R(y^{\wedge})$ (Figs. 5 and 6).



(a)channel index A_k (b)channel index B_k (c)G=1.681

Fig. 5 Visualization examples for baseline



(a)channel index A_k (b)channel index B_k (c)G=2.012

Fig. 6 PCA based bit allocation

4 Discussion of Results

4.1 Effect of Different Types of Down Sampling Units

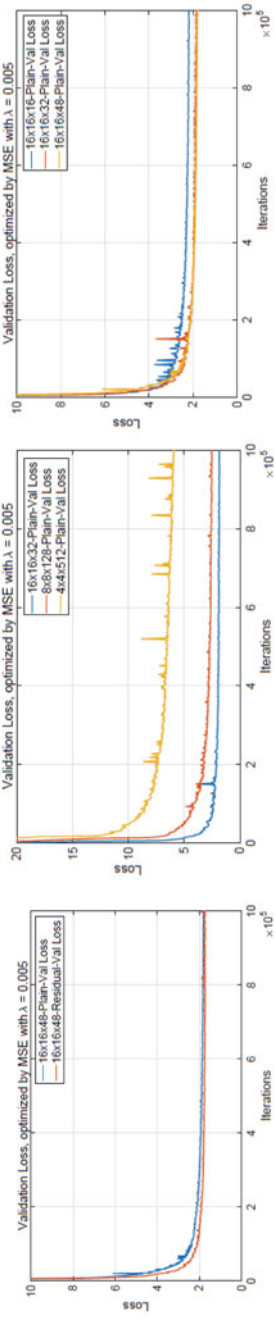
To look at the presentation of various kinds of down sampling units, advance the models utilizing MSE and set the λ as 0.005 in the misfortune work for this fundamental trial. The misfortune bends of lingering unit and plain unit are appeared in Fig. 7. Figure 7a shows the deficiency of two down sampling units with the design of 16 × 16 × 48. The leftover unit showed a favourable position than the plain unit and merges somewhat quicker than the plain unit. The quick union of remaining unit comes from the alternate way association with gain proficiency with the leftover planning without any problem. In the interim, lingering unit covers the responsive field as 7 × 7, while plain unit can just arrive at 5 × 5 open field. Enormous responsive field can add to catching spatial relationship, which prompts better coding execution. After 1 × 106 cycles, the misfortune nearly keeps stable. The rate distortion execution at 1 × 106 cycles is recorded in Table 2. The lingering unit attain preferred end result over plain unit, while the quantity of boundaries for the hold out unit is about 1.5 occasions of that for plain unit. This is the trade-off between model intricacy and coding execution. In this paper, thinking about the model's intricacy, utilized the plain unit.

4.2 Effect of Different Number of Down Sampling Units

To contrast the variations and distinctive number of down sampling units, direct the investigations with a similar exploratory setting as the past part. The misfortune bends of 3:4:5 downsampling units are imagined in Fig. 7b envisioned. Change the quantity of channels to keep up the estimate of packed codes steady. The rate-contortion execution at 1 × 106 emphases is recorded in Table 3. It very well may be seen that 16 × 16 × 32, that is, 3 down sampling unit, accomplishes the littlest misfortune among them, since more down sampling units add to higher pressure proportion, yet seriously pulverized the remade picture quality. Along these lines, given an information size of 128, utilized three down sampling units.

4.3 Effect of Different Number of Channels

Given three down sampling units for the info size of 128 × 128, directed analyses with λ = 0:005 to approve the concept of mixed numbers of course on the coding effectiveness. The misfortune bends of 16; 32; 48 diverts are appeared in Fig. 7c. The rate-mutilation execution at 1 × 106 emphases is recorded in Table 4. It very well may be seen that alongside the expanding of number of channels, the misfortune



A) Different types of downsampling units B) Different numbers of downsampling units C) Different numbers of channels

Fig. 7 Loss curves of different variants

Table 2 Influence of different types of down-sampling units

Variant	PSNR (dB)	MS-SSIM	Rate (bpp)
Plain unit	33.541	0.981	0.679
Residual unit	33.872	0.981	0.734

Table 3 Influence of different numbers of down-sampling units

Variant	PSNR (dB)	MS-SSIM	Rate (bpp)
$16 \times 16 \times 32$	33.329	0.980	0.683
$8 \times 8 \times 128$	30.523	0.970	0.503
$4 \times 4 \times 512$	25.969	0.903	0.231

Table 4 Influence of different number of channels

Variant	PSNR (dB)	MS-SSIM	Rate (bpp)
$16 \times 16 \times 48$	33.541	0.981	0.679
$16 \times 16 \times 32$	33.329	0.980	0.683
$16 \times 16 \times 16$	31.477	0.976	0.513

gets more modest. Almost when the quantity of channels increments to 48, the model practically immersed. Select 48 channels to have a high limit. Effect of differentiable quantization (Figs. 8, 9 and 10):

$$\varphi(y) = \text{softmax}\left(-\sigma\left(||y - c1||^2, \ldots, ||y - cL||^2\right)\right).$$

The examinations between the round-based quantization, added substance uniform commotion, and delicate vector quantization are appeared in Fig. 7. In the

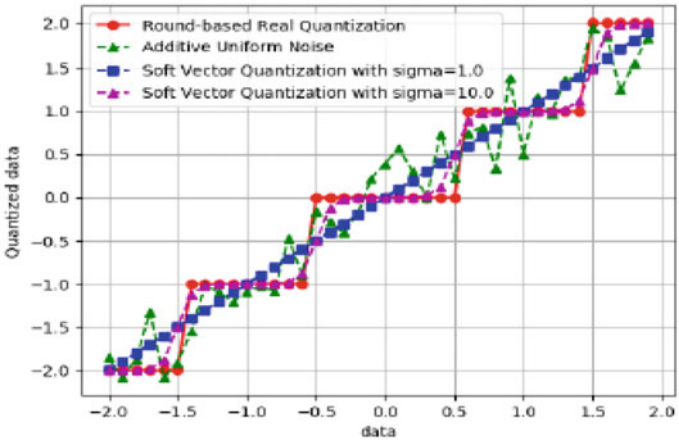


Fig. 8 Visualization of different quantization methods

Fig. 9 With the help of analysis transform

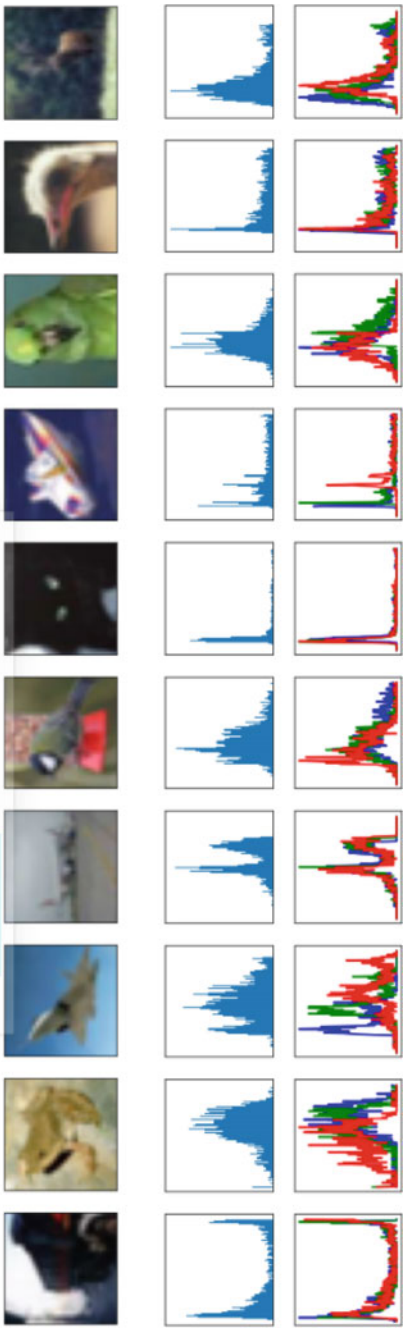


Fig. 10 With the help of synthesis transform

first place, present A_k and B_k with no piece designation strategies for the pattern appeared in Fig. 6. The main segment shows the reproduced pictures, and the one beneath is the relating MS-SSIM esteem. The subsequent section shows the standardized A_k for 48 channels, which quantifies how a lot energy is assigned in each channel.

5 Conclusion

In this examination, we proposed a CAE based image compression for energy compaction designing. Above all else, we presented the CAE designing and analyzed the impact of different association structures on the coding execution. Besides, we gave a mathematical examination regard to the energy compaction highlight dependent on CAE to portray a normalized coding gain, which is an extent of pressing factor limit. Thirdly, considering the above examination, we present a reach and add it into an incident extent to make the CAE to achieve a higher coding get. The test outcomes uncovered that the strategy beats the image compression principles to the extent MS-SSIM quality estimation. We estimate an increase of almost 83% compared to this quality estimation. We also estimate that the higher this model is trained, it may reach almost 90% higher accuracy in quality.

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Preserving Electronic Medical Records Using Blockchain Technology

Indugula Sanjana, Mude Pranathi, Gunti Sai Durga, P. S. G. Aruna Sri, and M. Anusha

Abstract In our increasingly digitalized lives, privacy and protection are crucial. As security measures were put in place to monitor how information could be accessed, privacy controls were put in place to control whether and when they could access personal data. For fulfilling these constraints block chain technology is one of the most suitable technology. One of the most important resource for patients is reliable and full medical record records. Creating a secure storage room and loading it out. Nonetheless, protection, secrecy, confidentiality, and decentralization are all issues in the healthcare field. The emergence of the block chain technology can bring an ingenuity to solve this problem. So block chain technology and Ethereum based smart contracts provides an interesting and innovative way to keep track of Electronic Medical Records. This technology can help the patients to have a better control of their own data. In this design, a modern storage scheme based on block chain and database storage would be used to handle individual medical records. This assists in the storing and sharing scheme, which is invariant for any third party, and no one party can have full leverage over refinement.

Keywords Blockchain · Security · Storage · Information · Technology · Medical records · Smart contracts · Ethereum

1 Introduction

Several aspects of human life have been influenced by technological advancements in recent decades. It helped us in a variety of areas, including healthcare [1]. In recent years, the healthcare sector has made substantial strides. The recent emergence of technologies is affecting day to day life of humans. The use of technologies is changing the way every one used to see the things previously. Long before the advent of new technologies, he healthcare industry relied on a publication method to store patient information, which was done by hand [2]. This publication medical record

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method was inadequate, unsafe, disorganized, and unforgiving. It also had to do with multiple servers and redundancy because all of the hospitals where the patient went had several backups of the patient's medical records [2].

And this is appealing for healthcare in the advancement of research, medicine precision and having ground breaking approaches in disease prevention. But when it comes to healthcare data interoperability, it is being a problem that is open until now. So how can an open access be providing to sensible medical data? When the sensible data is given open access then preserving the personal data, privacy, avoiding data misusage and operational inefficiencies will be at risk. In order to make them having trusted access, Ownership and administrative the block chain technology is one of the solution [3]. Block-chain has materialized as one of the key technology for the healthcare ecosystem. The medical records, private diagnosis and treatment records are crucial and extremely vulnerable assets for patient. The exchange of health data is an important step in improving the health system's intelligence and efficiency.

For patients with chronic diseases in hospitals, electronic health records (EHRs) are often extremely confidential private information. EHR sharing is thought to also be a positive strategy for improving patient outcomes, speeding medical advances, and lowering patient costs [3]. However, many private hospitals and organizations choose an access point to keep records of each patients, but they do not share details with several other healthcare organizations, making medical services more difficult and expensive, as well as creating a knowledge island. To address the problems with the current healthcare sector, a reliable data sharing platform must be built.

Through making electronic medical records more methodical and safe, block chain technologies will provide a new paradigm for healthcare knowledge sharing. It has the power to transform health care by placing the patient at the forefront of the system and increasing health data security, anonymity, and interoperability [4]. This specifics constitute a vital medical resource. An electronic medical record (EMR) is a multimedia structure of patient health records that is created and maintained over the course of a patient's life, and is usually stored and disseminated through many hospitals, clinics, and healthcare facilities. Usually, providers maintain primary record access, which prohibits quick patient access to prior records. When patients have access to their medical data, they communicate with documents in a fragmented way that can represent the essence of the records. Our work represents the healthcare ethereum based smart contract system for the medical data preservation and to minimize complex medical procedures. And also use of block-chain for medical sector which introduces new solution for privacy, security and confidentiality [5] (Fig. 1).

2 Literature Review

Healthcare is a sector that requires a great deal of important medical information. But for decentralized storage of health data, hence the blockchain technology can be used. Which may include patient's medical records, personal information etc. Every time when people hear about block-chain technologies, in general, their minds could

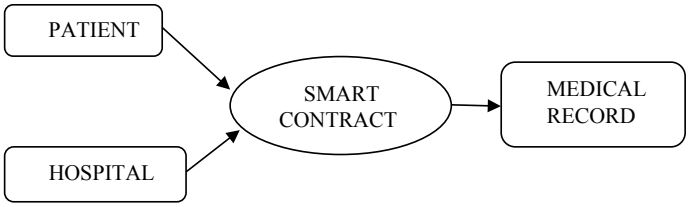

Fig. 1 Basic structure

think about financial and banking markets. But Block-chain is rapid and an important area of research and many companies have used its benefits. Similarly, due to security, privacy, security and decentralization, the healthcare sector will benefit greatly from block-chain technology. The electronic medical record nevertheless data protection, authenticity, and management challenges are facing systems. These structures can be converted using block-chain technology and could solve these problems.

We are presenting a system to be used in the EHR healthcare sector for the application of block-chain technology. It is challenging to share healthcare data among institutions [6]. While structure and semantics can be accepted, there are plenty of questions regarding security and data accuracy. Central data storage and authority providers are ideal targets for cyber-attacks and it is difficult, over a network of the data sharing, to obtain a clear view on the patient record. In this work, the approach is focused on Block chain to the sharing of patient information. The method represents one centralized source of confidence to help network consistency and offers agreement on evidence of compatibility in structural and semantic fields [7]. Block chain technology that has the potential to overcome the problems of information sharing that currently exist in IT systems, and is a technological standard for the safe exchange of electronic health data between people, health professionals, healthcare organizations and medical scientists.

3 Background

3.1 Block Chain

A decade ago block chain technology was introduced by an unrevealed person Nakamoto [7]. This helped various sectors like healthcare, education, business etc. Which helped for the profits of these sectors in unique bundle of characteristics. Block chain benefits in transparency, credibility, identification, trust ability, collaboration and decentralization.

Block chain technology is a peer-to-peer distributed ledger technology, for a new generation of transactional applications that establishes transparency and trust [8].

Since the implementations and transactions that were demanded for centralized architectures or trustworthy third parties to validate them, block chain has added major intrusion to conventional business operations. Now can run with the same level of certainty under a decentralized scheme [8]. Any member of the distributed network has the ability to document digital transactions in a shared ledger. Each participant keeps an exact copy of the shared ledger and switches to the shared ledger that contains all copies. The most important contribution that technological innovation is making to improving security, customer interface, and different facets of the healthcare sector. Interoperability is a means for disparate information systems to communicate with one another. The information that is used must be interchangeable and usable for other purposes [9]. Cyber-attacks in the healthcare industry necessitates the creation of a more robust infrastructure.

3.2 Ethereum

Ethereum was founded in 2014 and launched in 2015 with the aim of being a big universal block chain-based application portal. It included a turing absolute vocabulary, which technically enabled smart contracts to demonstrate all realistic data processing. Advanced security problems associated with terminology, architecture, and safe programming implementation are introduced by this improved capability.

This technology helps people to share their peer-to-peer networking, enabling it to be distributed. The Ethereum network uses Ethers, which are their own digital currency. This crypto currency may even be used to break data between accounts linked to the Ethereum block-chain. Ethereum provides programmers with a vocabulary that they can use to build their own block chain, Solidity is another name for it. Solidity was developed for smart contracts [10]. Transactions can be divided into two categories. To deploy a new contract, use the contract formation transaction. It has an extra field that defines the EVM code that will be deployed when the contract is created, as well as the new contract's ethereum virtual machine code. The message call transaction is used to call a feature of a current contract or to send ether.

3.3 Smart Contracts

On the network, smart contracts are code blocks that are used to execute particular tasks. Whenever users submit transactions, the same block of code is executed [11]. This were directly connected to the block chain, rendering them impenetrable to tampering and modifications. Solidity is a popular programming language for smart contracts, and it can be used to programme any kind of operation that a programmer needs to do on the block chain. EVM byte code is a low-level Turing complete stack-based language that runs on 256-bit words and is built to be easy in comparison to general-purpose virtual machines such as Ethereum virtual machine. It executes

deterministically and natively supports cryptography. And once the code has been compiled, it can be run and deployed on the Ethereum block chain [12]. To write code in smart contracts, programming languages such as JavaScript (JS) and Python (PY) are encapsulated in the Solidity language given by Ethereum.

4 Methodology

In this healthcare management system, preserving of the patient medical data and use of smart contracts is done. At the core, block chain is distributed system that stores and records every transaction [12]. To be more accurate, peer-to-peer transactions are constructed from connected transactional blocks and stored on a digital ledger in a shared and permanent database. The asset provenance is tracked and connected, allowing for a complete transaction history. With a concerned accord each and every transaction will be added to block chain and that will be validated. Through validation each and every level will be encrypted and thus provides a new layer of security to the data. In this the patient will be provided by documentation for the services. The healthcare and other record keeping system must encrypt the data and thus send the data to the public ledger through transactions [13]. These will be stored on the ethereum block chain and the patients have a tendency to authoritize to revoke the access to the hospital or their primary physician. They encrypt the data using a referential Id with the block chain. To ensure the security, ledger will be implemented. Smart contracts are used by Ethereum as proof of work for transfers or peer-to-peer agreements. Smart contracts are written in Solidity and held on block-chain ledgers. The ethereum virtual machine is used to implement smart contracts. They are in charge of holding, revoking, and initiating transfers [13] (Fig. 2).

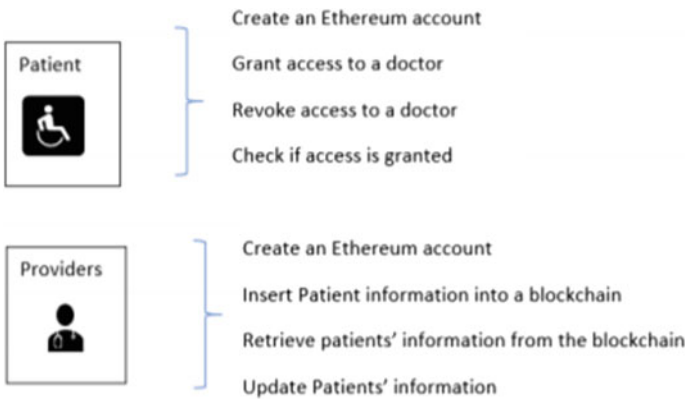

Fig. 2 Tasks performed by patient and the provider in the system

4.1 Process Flow

Invoking the Transaction: Only the hospital administrator can initiate transactions on the block chain network, and he is the one who selects lab-admin and assigns him a specific account.

New Record Creation: The patient's current records are stored in an array called Records, and a function called new-Record is used to apply new data to the existing record by adding values to the parameters (Fig. 3).

Key Generation: To ensure security, block chain employs cryptographic techniques for encryption and decryption. Because of their special quality of hash function to generate unique outputs when given various inputs, the most widely used stable algorithms associated with the block chain are SHA-1, SHA-2 and SHA-256 encryption. The private key and public key are used to maintain integrity based on

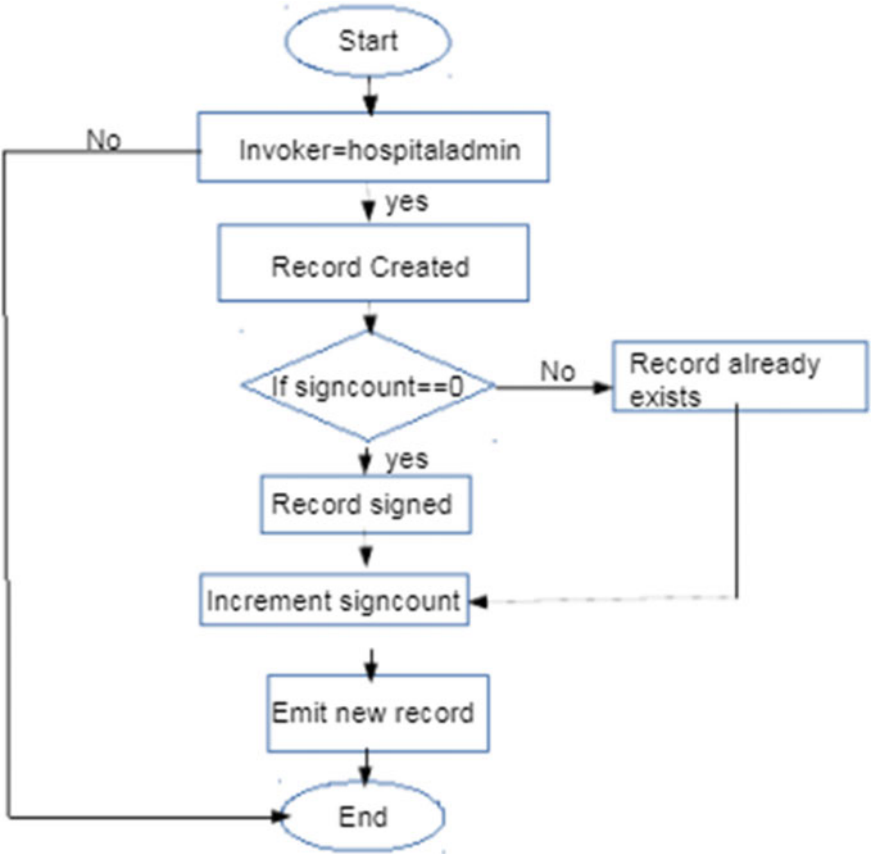

Fig. 3 Transaction process flow

the type of algorithm. The suggested system's private key is used in the transaction's subsequent stages.

Hashing of Blocks: The hash contains 32 bytes requires processing data from block through mathematical functions that results in a fixed length output. By using hashing, it is hard to change the data inside the block. And also the hash of a transaction makes it easy to keep track of transactions on the block chain.

Validation: In a computer network the transaction needs to be verified or validated with a set of rules set by the creators of the block chain. For record validation, a feature called "validrec" was developed, which tests if the record has already existed. If the record still exists, no transaction for the new record is made. It also scans to see if the requested sign has been checked.

5 Results

1. Select the USER whether user is a patient or a doctor or an researcher. Now the user has to enter his/her user id and password in order to login. If the user id and password are correct and are already stored in database. He/she will get logged in.
2. If the user id and password entered by the user are incorrect or if that user id and password doesn't matches the data in the database. The user will not get logged in (Figs. 4 and 5).

The home page consists of three elements

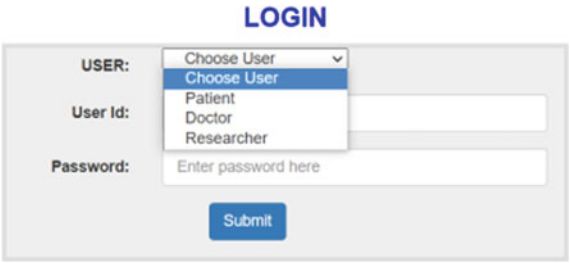

Fig. 4 The figure represents the front end login page for doctor or patient to or a researcher to access to the home page and can manage their required operations in the home page

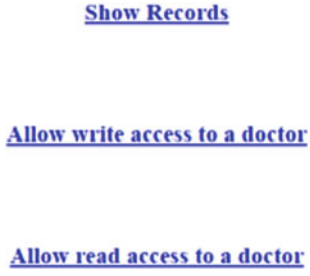

Fig. 5 The figure represents the home page after logging with id and password

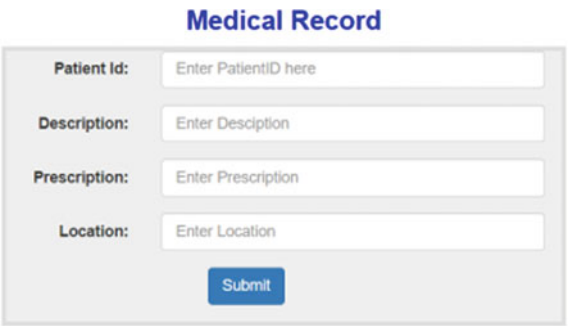

Fig. 6 The picture represents the form for the patient to access their medical record details by entering the mandatory fields

1. Show records: where if we select "show records" it shows all the records stored in database of that user.
2. Allow write access to a doctor.
3. Allow read access to a doctor (Fig. 6).

Entering details into it will add an record or update the already stored record into the database (Fig. 7).

After the submission of Fig. 6 the data entered will be added accordingly into the above database (Fig. 8).

The user had an access to upload the medical record i.e., which the user already had an soft copy and wanted to upload it. That medical record soft copy can be any type of document i.e., pdf, doc, png, jpeg etc. (Fig. 9).

If the doctor wanted to download the medical record of the patient, where the patient had uploaded in Fig. 8 first he should have an permission from the patient. Later the doctor can download and check the report (Fig. 10).

And now these stored data in database can be accessed (Fig. 11).

These is the complete record of the patient which has been update by the patient i.e., either from Fig. 6 or from Fig. 8.

Fig. 7 The figure represents the format of the medical record data of the patient

Fig. 8 Can have access to upload a medical record into the page

Fig. 9 Doctors can have an access to download the patient records by seeking the permission of the patient

Fig. 10 Adding hospital with their address is been done and deployed so the information can be stored in database

Fig. 11 Record of the patient

6 Conclusion and Future Scope

The focus of this paper is on how Block Chain technology can benefit the healthcare industry and how electronic health records can be used. Patients can manage their own EHR and direct control data can be readily used by users or organizations using this block chain infrastructure without jeopardizing the privacy of patients. This also solves the issue of EHR structure inequity in terms of detail.

Using Block chain technology, individually seen how the concepts of decentralization for massive data management in medical environments can be applied. We also introduced a data collection and sharing system focused on medical criteria. Block chain technology can also be used to ensure confidentiality, protection, availabilities and comprehensive monitoring of EHR data access. The ultimate aim is to strengthen health care systems and thus patient results by using the block chain technology.

This concept and application can be expanded in the future by incorporating multiple smart contracts to manage the EHR system's additional features. To incorporate a full-fledged healthcare management program, various industries such as payment, accommodation, and so on should be connected to the network.

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Enhanced Security with Crystography Using AES and LSB

Kovuri Harshini, Bandla Naresh, Kutumbaka Sahitya, and B. B. V. Satya Vara Prasad

Abstract In the digital modern age, where all data is processed with respect to automated transfers and protection provision are a major concern the remaining reason for the intruders/hackers' popularity is that much of the intelligence they receive from a device is they can interpret and can easily understand. Even if the data is encrypted, the attacker may quickly access the encrypted data and can use techniques such as the method of brute force and attempt to decrypt it and may even succeed in decrypting it also reveal the information to other incognito users or alter the data to deceive a person or organization or the knowledge gathered could be used to launch an attack. Appropriately, a technique for hiding sensitive messages during transmission is required. Communication of data between the parties while preserving its secrecy is a big problem everywhere, so a non-conventional solution to Crystography is recommended to enhance the protection of shared data. Crystography the advanced method of encryption approach in which steganography, cryptography is fused into two major methods. In this, cryptography is used for data scrambling, while steganography is to mask scrambled data in a file of image which provides two layers of encryption. The purpose of this is to concentrate on AES symmetric cryptography, its applications and techniques, and steganography of images and to providing the most convenient move of stegno image through a zip file format. In this paper the advanced approach of images using histogram is used which has conceals the hidden image recovery without failure of data.

Keywords Crystography · Steganography · Cryptography · AES

1 Introduction

Cryptography and steganography are well-known for detecting the presence of details. Steganography refers to the process of concealing a message that it would make no sense to someone else but the intended receiver, whereas cryptography

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refers to the assistance of translating plaintext into an unreadable format. Steganography can also be applied to cryptographic data, so the suggested algorithm improves the security of this data where steganography, cryptography technique that is really accurate. While there is a probability that combining all approaches straight forward will result in the initial message being intercepted by the attacker, there is also a probability the attacker may intercept the secondary message. Thus, the plan is to incorporate all of them together with more layers of protection and to have a very highly secure data hiding technique. In the wireless network, the field where this strategy is applied. So, the ultimate intended of algorithm is to create a modern technology that is incredibly protected even though the stegno data is retrieved by attackers. The Advanced Encryption Standard (AES) algorithm is used here, and the encrypted message is then inserted. According to a unique key within an image using the LSB process. It is not incredibly safe to conceal the data using LSB alteration alone.

The suggested approach is to use the LSB technique to provide surveillance with the aid of AES for the confidential information found inside the cover image. This algorithm is used to read the hidden data, and the concealed image is the first step. By the LSB encoder in the concealed picture, the next is to hide the details. The stego image is then sent to AES encryption to compute the attacker's data, where the pixels are encoded. The stegano image recovered using AES decryption, and the output is sent to the LSB decoder, where the secret data is eventually recovered. Consequently, the message is reliably transferred from one end to the other.

2 Literature Survey

Vikas Singhal proposed the Advanced Secure Hashing algorithm—256 to secure data. The encrypted text is inserted using LSB techniques in image format. The hashed data is modified in a way that makes it completely unreadable in cryptographic hashing in [1]. The 256-bit hash described above will be nearly impossible to transform back to its original state here, it can not solve this. The implementation of steganography and cryptography using Advanced Encryption standard algorithm and Least Significant Bit techniques is described in [2]. The encrypted image or text inside a concealed file is indicated by this method. Malathi proposed that steganography and SPIHT compression was implemented using an asymmetric cryptographic algorithm in this paper. Steganography is used with SPIHT compression where image wavelet transformation occurs by AES cryptographic algorithm. Using SPIHT encoding, the cover image is used to compress and encrypt the secret image. To perform decrypt on over the stego-image in [3] using the Diffie-Hellman technique to share the key. The file is exposed to SPIHT decompression after decryption used to recover the initial data from an image. It is possible to combine steganography with cryptography to improve computer confidentiality. In [4] new approach to provide 24-bit protection is proposed in Steganography and Cryptography integration. In this method, using the technique randomized method based on LSB is applied to mask and hide the

infirmation. This modern optimized approach ensures the improvement in the hiding ability of the information. Chikouche and Chikouche [5] focuses on the analysis of three methods focused on LSB techniques that mean that in each pixel of the image the bits of message are located in the LSB. In addition, it recommends an improved approach to LSB-based image steganography. The Deflate algorithm, which is a Lossless' data compression algorithm which incorporates the LZ77. algorithm and the Huffman algorithm, is the length of the concealed message. Protection of the reduced secret data by the AES algorithm is another significant aspect. Bandekar and Suguna [6] proposed the primary aim in this paper is to use LSB strategies to conceal hidden data. Providing data protection using the AES algorithm. Peak Signal to Noise Ratio (PSNR), Mean Square Error (MSE), where the high-quality picture provides a higher PSNR value, estimates algorithm performance. Saini and Verma [7] proposes a advanced approach that incorporates both encryption and steganography for image protection. Using the proposed new variant of the AES algorithm, the image is encrypted and then covered in the stegno image using the principle of steganography. This hybrid technique promises higher protection against threats. Audhi and Mascarenhas [8] targets on a tactic to assure the safe transfer of data over a network that has modified the mode of data transmission. This is performed using the AES algorithm and steganography techniques for Bit Plane Complexity Segmentation. To get a different image by snap the cover image. Finally, to acquire two stego images, these encrypted images are further inserted separately on the original carrier image.

Anwar suggests a combination of LSB and AES base64 to provide security for messages and diverse file formats contained in digital images. Until being embedded into the picture using the LSB process and using AES hidden messages are encrypted and Base64 techniques in [9]. The research also proven performance of the combination of LSB and AES-Base64 algorithms on different files and the size of the cover image. An image with RGB channels is used for cover images. Implementation of separable and reversible encrypted knowledge concealed in Encrypted image as a workaround using the AES and Lossy technique. AES algorithm, using LSB technique to conceal the cipher data in encrypted image, device automatically generates all 3 respective keys in [10]. Receiver can work as per the respective keys, such as if he only posses data hiding and image using decryption key, then reciever can can only get the image in its original form, or if reciever has data hiding and data decryption key, then can get original data, system also provides auto-generated key protection and auto-generate system mail if the user fails to complete any operation.

3 Working Methodology

Both approaches cryptography, steganography used to give the data's authenticity to hide from its abuse. The merger of the two results in secure and confidential source of knowledge that can be kept secret easily. The key aim of cryptography is solely to mask the message from any insecurity and avoid unauthorized access to it.

Essentially, the notion of cryptography, steganography is to have secret and secure communications (Fig. 1).

Algorithm for generating stego-image and embedding data into image:

Step a: Start.

Step b: Add the information that needs to be transferred to the receiver.

Step c: Enter specified key of some length.

(The user must enter the password to secure their information).

Step d: Specify the cover image with its path and extension.

Step e: Besides the AES encryption algorithm, the key encryption and plain text are converted into cipher text.

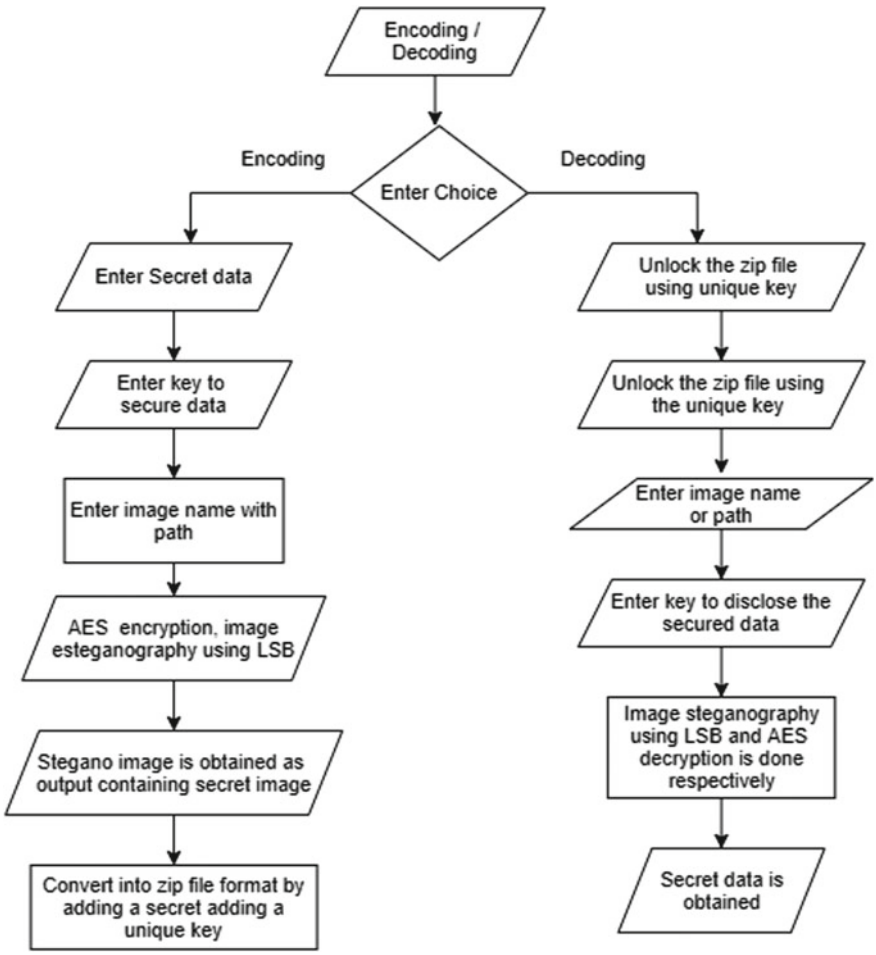

Fig. 1 Interface diagram

Step f: Using LSB, In the image a steganographic method is embedded with cipher text and a stego-image is obtained.

(This image is communicated through a channel to the recipient.)

Step g: At the receiver's end enter the path and extension of the stegno image.

Step h: Steganalysis is done on the stego image and cipher text is obtained.

Step i: A protected key is acquired from which data can only be accessed from AES decryption by AES decryption algorithm, encrypted text is translated to plain text (Actual information message received by the sender is obtained).

Step j: End.

4 Block Diagram

As the underlying model of the proposed system, as seen in Fig. 2 The application of an approach from one end to another is not normally applied in this paper. Here, the sender first enters the message and then applies the AES encryption methods that now have a specific key, which in turn transforms it into cipher text. In addition, the translated encrypted text is inserted using LSB techniques to the concealed image. Finally, the information transmission system is set, and this is called in simple terms as Image with steganography or stegano image sent via a Zip file. The sent stegano

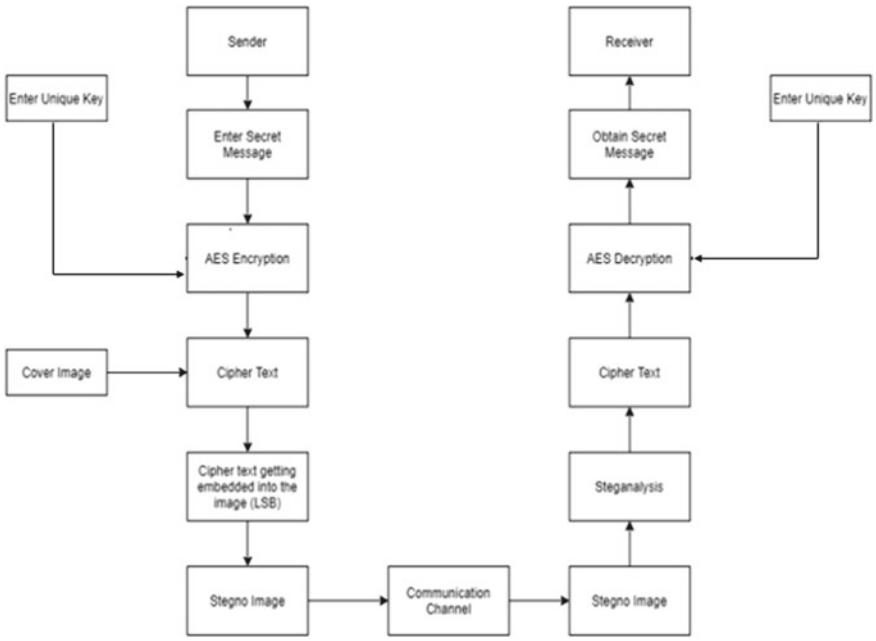

Fig. 2 AES combined with LSB from sender's to receiver's end

picture is decrypted via a channel to the recipients by applying the AES decryption techniques additionally the specific key shared to the sender. The data is eventually decrypted from the cipher text after imposing all the techniques.

Histogram analysis:

A histogram of image is a schematic view of the pixel distribution strength in a visual image. For each strength value, it charts the number of pixels. In Fig. 7 shows the Red, Green, and Blue cover plane histograms, stegno, and encrypted image. It reveals that the concealed image, stegno image histograms are the same. Therefore, it does not support steganalysis. The histogram for image of the cover and the encrypted image is entirely different and provides no sign of the primary image. It therefore avoids statistical attack.

5 Results and Discussion

It is believed that AES have good protection for block cipher key sizes, something that in many tasks is very useful applications. Using key sizes, they can proceed a quicker execution. Timings for the schemes, which are useful for frameworks where schemes are used a crucial factor is real-time efficiency (Figs. 3, 4, 5, 6 and 7).

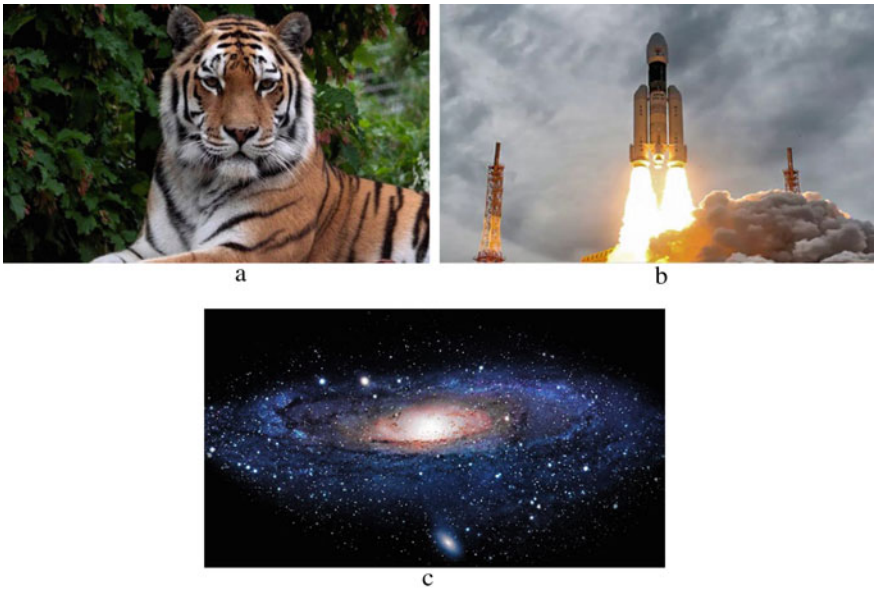

Fig. 3 **a** Secret image, **b** Cover image 1, **c** Cover image2

Fig. 4 **a** Stego image1, **b** Stego image2

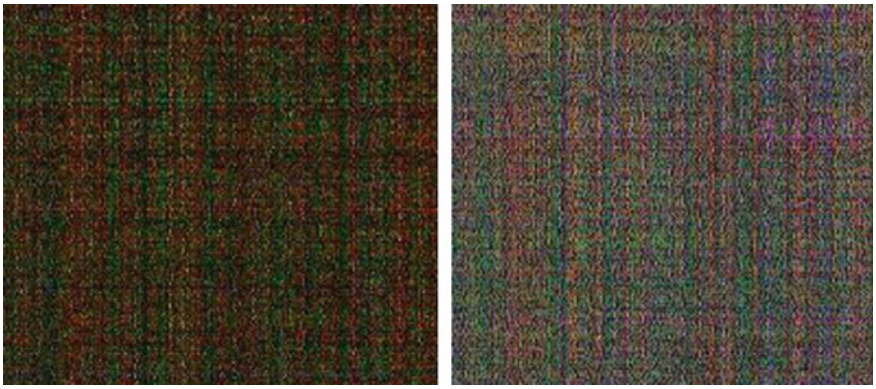

Fig. 5 **a** Encrypted stegno1, **b** Encrypted stegno2

Fig. 6 Secret image

Figure 8 shows that a red, green, and blue plane histogram of the stegno image and the retrieved image. This disclose that two histograms are precisely the same. Therefore, this approach guarantees hidden image recovery without failure.

Fig. 7 Histogram for Cover, Stego and encrypted image

Fig. 8 Histogram for secret and recovered image

6 Conclusion

For better results, it provides satisfying variables by integrating the characteristics of cryptography and steganography. Creation, preparation, and implementation of the AES algorithm and LSB strategy. It uses the AES algorithm to encrypt the results encoded using the shape of the LSB to mask confidential data and steganography. Throughout the process, the data is still shielded. Transmission of an available

channel over the network. The proposed structure offers great complexity and security. Therefore, this strategy is beneficial to hackers when you encounter trouble accessing the secret data.

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Implementation of Artificial Intelligence Based Sustainable Smart Voice Assistance

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Abstract Artificial Intelligence (AI) technologies are being part in the human life. This article is related to the implementation of an artificial intelligence-based voice assistance system, which works by the user given commands as a request and give back the output as a response in the speech format. Core innovations are voice initiation, automated speech synthesis, speech-To-Speech, understanding common language. The proposed voice assistance system helps us to make a hand-free model, which acts as a personal assistance and mimics same as like human. Applicability and usability of the proposed model is to create an intelligent mechanism between human and computers as a natural language. Python plugins are used to train the system by using various libraries such as speech recognition, pyttsx, pyAudio. The customization of this project model makes it more flexible and freer to add new features and functionalities without disturbing the current system functionalities. It assists to eradicate the unnecessary kind of manual work required in the user life which will be performed in daily activities, not only does it operate on human instructions, but it also refers to the user based on the question or terms demanded. This Intelligent assistance communicate with the user as a result it gives a desired output as a response to the user as a voice and displays its response on the screen of the user gadget.

Keywords Artificial intelligence · Assistance · Pyaudio · RNN · Speech recognition · Text -to- speech

1 Introduction

Currently developments in computational capabilities have led to substantial evolution in AI, developments of ANN are capable of organizing human and machine natural communications. Speech, communication, gestures, facial expressions, etc.

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are gaining popularity. Among the most interested to study and popular in the world. It was the direction of communication, based on the machine's interpretation of natural human language. A robot is taking longer time to learn from a human, but a machine learns faster to examine his behavior, acts, and to aspire to become his personal assistance. Progress has been further implementation on for a long time to build and improve these personalized assistants. There are machines that continue to grow and change, step beyond personal computers and have now established in a variety of ways. Smart computers and tablets alike. Siri, from Apple, Amazon Echo, is among the most popular voice assistants. Names of Alex, Amazon, Cortana, Artificial Intelligence In-Home Voice Assistants experienced exponential advances. However, we have so few Understanding the reasons that drive people to use those devices. Have respect to the features of the Technology, in the main hands, open, speech powered, and presentation of a voice user interface. Automated systems are growing rapidly in their way. Communicate both with a person and with oneself. New capabilities lead to the advancement of diverse mechanisms for the introduction of smart social networks into the IOT. One of the important advances in AI is the acceptance of technology as the basic language of a human being. New findings on this topic will lead to new means of natural human communication in which human and machine interaction takes place. Computers can know how to understand, alter, and express natural speech. One such tool is the voice assistant, which can be implemented with a number of other intelligent programs. Guidelines for the operation of voice assistants are set out in this article. Key limitations and weaknesses are identified. Method for creating a local voice assistance without using cloud technology that would make it possible to massively expand the applicability of those products in the future.

This paper work is carried forward with different measures by explaining. In Sect. 2 the paper reference will be discussed and the methods and technologies used in the earlier publication and the work is done by referring the various methods. In Sect. 3 the procedure to work with this model is explained and the elements used as voice inputs, voice output, speech recognition, python backend work which includes the user commands and user given quires used in the part of coding and text-to-speech conversion module. In Sect. 4 the assistance working and the interaction of the smart voice assistance is shown in the form of results to the user-end and the final assistance working performance is described in Fig. 1 there is the user

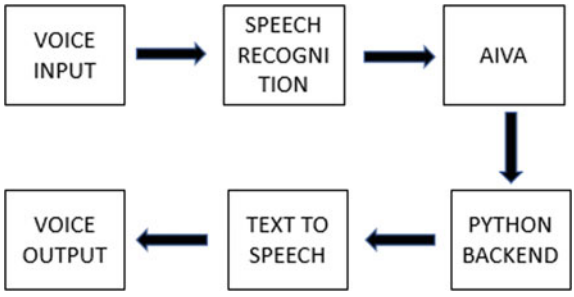

Fig. 1 Architecture for voice assistance

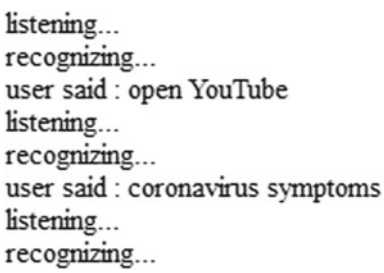

Fig. 2 Commands recognizing from user side

interface commands and recognized quires as commands by the user side in Fig. 2 final display of the communicated requests and responses between human and smart voice assistance.

2 Literature Survey

McLean and Osei-Frimpong [1] Understanding the reasons that drive people to use those devices. Have respect to the particular features of the technology, in the main hands, open, speech powered, and presentation of a voice user interface, Current technological implementation models are not adequately detailed to clarify the adoption of this emerging technology. The advancement of technology and its deployment in a number of fields are not adequate to ensure market use and the exploration of the possible benefits it offers [2]. For this reason, advanced understanding of the performance factors relevant to AI-based smart goods is required from the planning stage. Due to the ability of AI technology to transform culture, AI-based smart products would have a significant effect on life. Features associated with the introduction of mobile smart technologies the mobile technology studied included Intelligent Glass and Smart Device the Innovation Adoption Paradigm was tested in a wide variety of scenarios in the field of technology acceptance research and gained substantial empiric support [3]. Model framework has also been developed, featuring a dynamic graphic assistant capable of displaying speech patterns and allowing recognition technology and recognition, facial detection and face detection for user identity [4]. Multimodal Dialog systems that process two or more combined user inputs Aspects such as voice, picture, film, touch, physical motion, head and body movement to develop the Next Generation VPAs model [5]. In order to make a new generation of robotic personal assistants as multi-domain multi-application decentralized speaker recognition [6]. This is the first addition is the Assistance Design, which consists of separate third-party programs managed by the Controller. In this view, frameworks are electronic devices that respond. Voice assistants are useful in a variety of areas, such as Education, everyday life, home appliances, etc. Voice Assistant is also helpful for those who are illiterate [7]. Get some details only by asking the secretary. Open to users, thanks to AI-based voice assistants. Voice assistants are

useful in a variety of areas, such as Education, everyday life, home appliances, etc. Voice Assistant is also helpful for those who are illiterate. Get some details only by asking the secretary. Open to users, thanks to AI-based voice assistants. Voice Assistant is developing more and more in everyday life. Most voice assistant firms are seeking to improve Connection and more about the next level functions and much of the youth began using a voice assistant in their everyday lives and from there. The product of multiple outlets shows very positive reviews. A virtual, integrated voice assistant in customized assistant creation consisting of gTTS, AIML Artificial Intelligence Markup Language, and Python-based state-of-the-art technology. It integrates the influence of AIML in the gTTS libraries and with the industry-leading Google text-to-speech conversion tool and the voice of the Male Pitch. This is a unique consequence of the inflated contribution of many contributors, such as the feasible use of AIML and its complex merger with platforms.

A virtual, integrated voice assistant in customized assistant creation consisting of gTTS, AIML Artificial Intelligence Markup Language, and Python-based state-of-the-art technology [8]. It integrates the influence of AIML in the gTTS libraries and with the industry-leading Google text-to-speech conversion tool and the voice of the Male Pitch. Iannizzotto et al. [9] design a method to test and compare proprietary speech recognition systems with open-source speech recognition systems such as Sphinx-4, such as the Microsoft Speech API and Google Speech API. In comparison, human-chatbot contact lacked a great deal of the richness of words used in people's discussions and displayed greater profanity [10]. These findings indicate that while human language skills are easily translated to human-chatbot interaction the substance and nature of such discussions are markedly different. Innovations in smart assistants and intelligent assistants [11]. Lately, home automation has attracted attention and excitement. Consumers and scientists. Virtual Assistants Allowed Speech often referred to as smart speakers provide a broad range of network-oriented services and can connect to smart services in some situations. Cloud-based applications are highly dependent on smartphones, thereby transmitting potentially confidential data to servers that are distant. Exponential growth of artificial intelligence and mobile computing offers the blind a more comfortable existence and people with vision disability [12]. This essay introduces a prototype for of a specially built voice assistant for them. Koppula and Negi [13] building a voice controlled personal assistant here. The commands of the human voice are issued to the robotic by using a smart cell phone, assistant remotely. The Robot various gestures, twists, start or stop procedures may be carried out relocating an object from one position to another. The Voice commands are processed using an online cloud in real-time. Artificial intelligence is one of the priorities of realization of normal human and computer dialogue [14]. Dialog applications, sometimes referred to as immersive systems, have been used in recent years. The fastest developing field of AI is conversational systems.

Physical connectivity with the intention of having commands or access to a computer system are now available [15]. Systems stimulated by voice or speech are a part of the culture of digital smartphones. The Automatic speech acknowledgement is an important application of artificial intelligence Technologies for artificial intelligence are starting to this is encouraged by the appearance of being consciously

used in human life, the Internet of Things, and its wide distribution IoT [16]. To connect, autonomous devices are getting smarter. With an individual as well as with themselves. New capacities contribute to development similar mechanisms for incorporating smart things into social systems the Internet of Things networks. One of the pertinent developments in Artificial intelligence is the science of natural recognition. It enhances a normal contact between humans and robots, in which the computer must learn how to comprehend the language of human modifying and engaging inside it. Speech assistants are one of those methods are used to implement many other smart systems [17]. One of mankind's biggest challenges is vision disability. To execute everyday activities, some individuals require some support. This describes a system that helps users to read messages about the world, words, letters used in postal letters, daily newspapers, and so on to cope with social life [18]. Earlier, these persons needed paper type Braille to read messages or require assistance. For greater and smoother contact with culture, environmental messages are translated to voice or audio.

Understanding the reasons that drive people to use those devices. Have respect to the particular features of the Technology, in the main hands, open, speech powered, and presentation of a voice user interface, Current technological implementation models are not adequately detailed to clarify the adoption of this emerging technology.

3 Working Procedure

A continuous network be a style of artificial neural network which can be used in speech recognition and language processes, the recurrent neural network is used to find the successive features of the data and it also used to forecast the subsequent apparent conditions, this RNN unit which is also used in deep learning and in the creation of models that mimic the behavior neurons inside the human brain. They are especially effective in the use of cases where the meaning is present. In other ways recurrent neural networks are the state of sequential data algorithms has been used by the companies like apple, google etc. you know how the google is autocomplete the feature of the reminders of the google typing or about google assistance "McLean et al. [1]".we will give our input as an audio however the audio format is sensed and recognize by the speech recognition then the pyAudio is used to convert the received audio format input into the text format to make it as the user given input to generate the output. In these a large amount of data can be observed by the machine and it helps to find the frequently used words.

While the user when using the Speech Recognition, the machine utilizes Google's online speech recognition system to translate speech data to text. Speech input given by the Users can obtain text from a microphone from a special corporation arranged. The corresponding text would then be sent and It's fed to the user as an output. In the Context Extraction the process is automatically extracting structured information from unstructured and semi-structured content. Machine-readable papers, please. In most cases, this practice involves the retrieval of human language texts by natural

means. Production of languages. Latest activities in multimedia text preparation such as automated annotation and content extraction Out of the images/audio/video may be used as test Outcome context extraction. We use Text-To-Speech refers to computers ability to translate text aloud. A TTS Engine transforms written text to phonemic text. Representation, then it transforms the phonemic representation to waveforms which can be output as an audio. TTS engines of different specifications Languages, dialects and advanced terminology are accessible from third-party publishers. In this we are also having the AI Virtual Artist it can be used as request and response medium weight is based on its uses to your response of them to get the desired input and output required by the users. Generally, Voice input and Output Speech or voice input or output is the ability of a computer to accept and translate dictation or to recognize and execute spoken commands which was given by the user. Voice recognition has gained popularity and benefit from the advent of AI and intelligent assistants such as Amazon's Alexa, Apple's Siri and Microsoft's Cortana. Speech recognition technologies allow users to communicate with devices simply by talking to it, allowing hands-free questions, alerts and other basic tasks. Import speech recognition as sr-Speech recognition is used in the python backend to detect our voice and convert it as a text by using the Pyaudio library and it is useful for taking input by voice audio control speech innovation mission which is used for speech to text and text to speech conversion and it is able to take comments by using this inbuilt microphone in other devices also helps the user through microphone taking the voice and convert it as a text it gives and response by assistance. An another library Import pyttsx3-Pyttsx3 is used by the user for doing the functionality text-to-speech translation library in Python. Unlike alternative libraries, it operates offline and is compliant with both Python 2 and Python 3. The program invokes the pyttsx3.init() factory function to obtain a connection to pyttsx3.

From Fig. 2 how the commands are taken from the input source and the response given to the output source is clearly explained and each module functioning. It is a very easy-to-use method to translate the text you entered speech. Import datetime—Date and datetime are objects in Python, because when you modify them, you are simply modifying objects, not strings, or timestamps. Whenever you control dates or hours, you need to import the datetime feature. The datetime classes in Python are assembled into five major classes. Import web browser-In Python, the web explorer module offers a high-level GUI that helps users to access Web-based documents. The web browser module will be used to open a web browser in a platform-independent manner. Comes with Python and opens a window for a particular website. Requests, please. Downloads files and websites from the Internet. Import Wikipedia—Wikipedia could be a Python library that produces it simple to look at and search Wikipedia data. Wikipedia packages the Media Wiki API in such some way that you just will focus on victimization Wikipedia data, not obtaining it. We can use the Python Wikipedia API to retrieve data from Wikipedia. To decision the strategies of the Python Wikipedia module, we want to import them victimization the subsequent instruction. Installing pyAuido for speech recognition processes PyAudio is additionally obtainable if you decide on to use audio feedback from microphones. If it isn't mounted, the library can still operate, however

the electro-acoustic transducer is going to be vague. Official PyAudio builds tend to be broken on Screens. As a result, you will notice the unofficial PyAudio builds for Windows that truly add the installer folder. Run associate installer that matches your Python version to put in PyAudio. In Debian-based distributions like Ubuntu, you'll sometimes. Install PyAudio by running sudo apt-get upgrading python-audio python3-pyaudio, which is able to install it for each Python two and Python three.

4 Results and Discussions

Encountering with many A.I based devices with our surroundings and environment there being an improvement in smartness and AI process. Many devices are working based on AI and machine learning, voice assistance having a built-in python environment functioning and procedure by using the existing libraries. In future we can improvise our assistance functionalities and quires as by user requirement. This can be changed or upgraded by the developer side by using the required libraries and other coding techniques it is simple and easy to modify the assistance as own choice. So, by using RNN techniques to build the assistance in which usually helps in speech recognition to communicate with devices it would give a request and response to the humans so that we can have one request and response communication between human and a device. By these technologies most of the time will be saved by using these types of gadgets you can do much easier things by virtual assistance. Many assistances in this upgrading world like Alexa, Siri and such devices which are helpful in our daily life. References and sources that are mostly used to collect information and helps in building an assistance moreover this type of devices and gadgets will be used in future as our daily life routine. Forever it will be used in the future for controlling for the home appliances, electronic devices and motor vehicles. Artificial intelligence makes a major change in our future, so that the results of sustainable voice assistance would help us in using of A.I in our daily life for the future.

From Fig. 3 we can see how the voice assistance takes the command from the user it will listen speech from the user side and convert the audio into text format for understanding and it will display the recognized speech on the screen.

5 Conclusions

Modular in design this project makes it more versatile and simpler to incorporate new functions without disrupting the existing framework functionality. Not only does it operate on human instructions, but it also refers to the user based on their quires or terms demanded. Speech by the end user, such as opening tasks and procedures. The way the user is more relaxed and feels free is to greet the user. Interacting with the smart voice assistant. The program should also remove any excessive manual work done by the customer. The whole system operates on the verbal feedback rather than

Fig. 3 Response from the assistance in text format

the text one. And we are having a feature in this model that we can add any features or functionalities in the code we can easily adjust serviceability as user defined with the help of simple code, and there is no of any other devices additional required devices to work. Operations done by this smart system is too easy to handle and user can make this model as a feature updating device because after adding some more functionalities in future this model will work effectively in all applications.

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Medical Report Analysis Using Explainable Ai

Govvala Lokesh, T. Kavya Tejaswy, Y. Sai Meghana, and M. Kameswara Rao

Abstract Nowadays health issues are the most significant causes of mortality in the world today. Prediction of any disease is a difficult challenge in the area of medical data analysis. Machine learning (ML) has been demonstrated to be successful in helping with settling on decisions and predictions from the huge amount of information delivered by the medical services industry. In addition to that explainable AI helps the user knowing more about the results. XAI gives artificial intelligence to expand cognitive abilities and it needs very high-level communication with the user. Also, the deep learning models are an important part of an explainable artificial intelligence approach. We are approaching a method that aims at finding significant features by applying machine learning techniques resulting in improving the accuracy in the prediction of health issues. The prediction model is presented with various blends of highlights and a few known grouping procedures. We produce an upgraded execution level with an accuracy level of 84.61% through the prediction model disease with random forest algorithm. Clinical choices are regularly made dependent on specialist's experience and instinct as opposed to on the information-rich covered up in the information. This prompts blunders and numerous costs that influence the nature of clinical administrations. Utilizing scientific instruments and information displayed can help in upgrading clinical choices. In this way, the objective here is to assemble a web application to help patients with health difficulties of heart, liver, kidney, cancer, diabetes.

Keywords Explainable AI · Machine learning · Diseases prediction

1 Introduction

Clinical choices are regularly made dependent on specialist's experience and instinct as opposed to on the information-rich covered up in the information. This prompts blunders and numerous costs that influence the nature of clinical administrations.

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Utilizing scientific instruments and information displayed can help in upgrading clinical choices. The real problem with implementing explainable AI techniques is that there are major tradeoffs when balancing accuracy and transparency in different types of AI models, more opaque models may be more accurate but fail the explainability test. Other types of models, like decision trees and Bayesian networks, are considered more transparent but are less powerful and complex. In this way, the objective here is to assemble a web application to assist patients with health problems of heart, liver, kidney, cancer, diabetes.

1.1 Explanations Approaches to XAI

Learning Semantic Associations

Semantic association computation is the way toward measuring the strength of a semantic association between two printed units, because of various kinds of semantic relations. Semantic association computation is a critical segment of different applications having a place with a large number of fields, for example, computational linguistics, intellectual brain science, data recovery, and artificial intelligence. The approaches of semantic association computation into two broad categories, based on their utilization of background knowledge sources knowledge-rich and knowledge-lean approaches. Every classification is partitioned further into sub-classifications, as per the kind of fundamental information sources and configuration models of semantic.

Generating Visual Explanations

Visual Explanations can be important because the decision itself explain clearly a rationale for a final user to decide on a classification. Current deep visual recognition methods are typically opaque and do not produce any rationale text, image content may be defined by contemporary vision-language models but do not take into account class-discriminatory image features that explain visual predictions. We suggest a new model that focuses on the observable object's discriminating properties, jointly predicts a class mark, and describes why the predicted label is suitable for the picture. Centered on sampling and reinforcement learning, this model proposes a new loss function that learns to produce sentences that realize a global sentence property, such as class specificity.

Rationalizing Neural Predictions

A prediction has limited applicability without justification. learn to remove as remedy Input pieces, which are short and consistent, and sufficient to make the same prediction, as justifications—rationales. To combine two modular components, generator, and encoder. The model would train to work together well. As candidate rationale, the generator specifies the distribution over data fragments. Passed the prediction

encoder. During training, rationales are never given. To assess the approach Multi-face analysis of feelings against test cases manually annotated. This approach exceeds by a significant margin the focused baseline.

2 Literature Survey

There are numerous researches in the medical field compared to disease prediction systems using several data mining techniques and machine learning algorithms.

To speed up Reinforcement Learning algorithms, combining Case-Based Reasoning (CBR) and Reinforcement Learning (RL) techniques, this approach allows the use of cases in a case base as heuristics. This strategy referred to as Case-Based Heuristically Accelerated Reinforcement Learning (CB-HARL), builds on an emerging technique, Heuristic Accelerated Reinforcement Learning (HARL), in which heuristic information is used to accelerate RL methods. CB-HARL is a subset of RL that, in a Case-Based Reasoning way, makes use of a heuristic function derived from a case base [1, 2].

Gomathi suggested multi-disease prediction using data mining techniques. Nowadays, data mining plays a vital role in predicting multiple diseases. By using data mining techniques, the number of tests can be reduced. This paper mainly concentrates on predicting heart disease, diabetes, and breast cancer [3].

The arrangement strategy that can altogether improve the normal or ordinary techniques will be proposed for use in enormous scope information, bioinformatics, or other general applications in diabetes [4, 5].

A.S. Annesh Kumar, Dr. C. Jothi Venkateswaran has proposed categorization of liver disorder through feature prediction and fuzzy *K*-means classification. Different liver issues likewise share the same property estimations and it needs more exertion to order liver problem type effectively with essential credits. So Fuzzy based grouping gives better execution in these confounding classes and accomplished over 94 rate precision for each kind of liver problem [6].

Dr. S. Vijayarani, Mr. S. Dhayanand has proposed to predict liver diseases using classification algorithms. The calculations utilized in this work are Naïve Bayes and backing vector machine SVM Comparisons of these calculations are done and it depends on the presentation factors characterization precision and execution time. From the outcomes, this work finishes up the SVM classifier is considered as the best characterization calculation in light of its most noteworthy grouping exactness esteems. Then again, while looking at the execution time, the Naïve Bayes classifier needs the least execution time from the usage results it is seen that the SVM is superior [7].

S. Dhamodharan proposes a model of liver disorders that suggesting medical care to doctors for disorders. They foresee three significant liver illnesses like liver malignant growth, cirrhosis, hepatitis with the assistance of particular indications. The essential objective is to foresee the class types from classes like liver malignancy,

cirrhosis, hepatitis, and "no illnesses". In this paper, Naïve Bayes and FT tree calculation exactness are analyzed and the outcome is acquired. The outcome infers that the exactness of the Naïve Bayes calculation is far superior to different calculations [8].

In these papers they recommended different deep learning algorithms like Naive Bayes, Classification Tree, KNN, Logistic Regression, SVM, and ANN for the different diseases for the heart [9–11]. In their perspective, they suggested different algorithms give better accuracy compared with other algorithms.

Combination among electronic health records (EHR) and computer-aided provider order entry (CPOE) schemes are often used in clinical decision support [12, 13]. They can be managed by a desktop, tablet, smartphone, but also by other devices such as biometric and wearable health technology monitoring. Such devices may or may not directly generate outputs on the device or be linked to EHR databases.

In this article, we will be looking at what is medical imaging, the different applications and use-cases of medical imaging, how artificial intelligence and deep learning are aiding the healthcare industry towards early and more accurate diagnosis [14–16].

3 Methodology

This paper is on health problem prediction models of heart, kidney, liver, breast cancer, and diabetes. The trained model will predict by analyzing existing data because we already identifying whether each patient has a particular disease. The trained model is then used to predict if users suffer from a particular disease. Data is split-based training set with 75% and the prediction set with 25%. The training set data is used in the logistic regression component for model training, while the prediction set data is used in the Rationalizing Neural Predictions.

The goal is to develop a model that can at the same rate classify medical data and, via the medical information, provide reasons for such classifications. The model learns to pick concise phrases that are then used to make classification by specifying and training two sub-components, a generator, and an encoder. The model can be easily visualized by utilizing TensorFlow. At each step, the two parts are combined to form a step-by-step strengthening model. In other words, by increasing or decreasing the probability of selection, the generator determines which data should be selected based on the understanding of the encoder to predict a gradation on the selection. In turn, the encoder can predict the correct rating for a given generator medical data. This reinforcement pattern must be balanced to achieve uncompromising learning—too much weight overwhelms both components and the model converges sub-optimally.

Prediction model of breast cancer, kidney, liver, diabetes, heart disease using Machine Learning dataset. Various levels of accuracy should be achieved using several data mining techniques which are explained as follows.

This paper proposed different ML algorithms used for the classification of disease. The research was carried out to study Decision Tree, KNN, and random forest logistic regression algorithms that can be utilized for classification, and their accuracy was

compared. This research concludes that the accuracy obtained by Decision Tree was highest further it was inferred that it can be made efficient by a combination of different techniques and parameter tuning. Data mining techniques along with the MapReduce algorithm. The accuracy obtained according to this paper for the 25 + instances of the testing set was greater than the precision obtained utilizing a conventional artificial neural network. Here, the accuracy of the algorithm used was improved due to the use of dynamic schema. In this research, the accuracy of the Decision Tree, Logistic Regression, Random forest, and KNN classification algorithms were compared. The Random forest algorithm had the highest accuracy (Fig. 1).

Algorithm

Step 1. Load the data set.

Step 2. start with the selection of random samples from a given dataset.

Step 3. Apply the Random Forest Algorithm on the subset of attributes that maximizes classification accuracy.

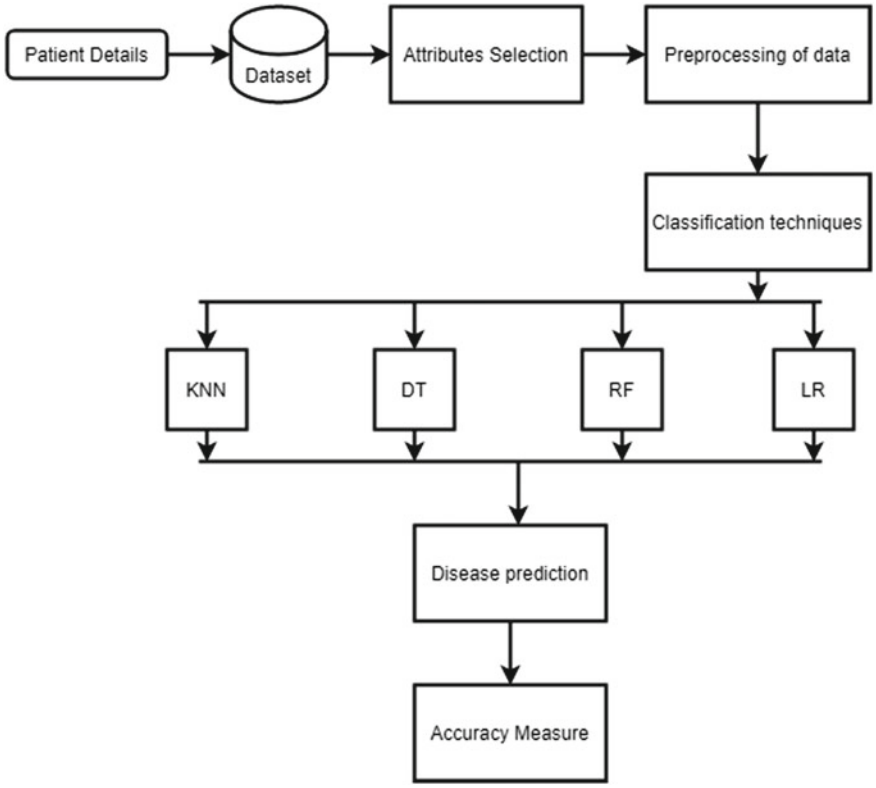

Fig. 1 Implementation of the process behind measuring accuracy

Step 4. Next, this algorithm will construct a decision tree for every sample. Then it will get the prediction result from every decision tree.

Step 5. Voting will be performed for every predicted result and select the most voted prediction result as the final prediction result.

$$\text{Accuracy} = \frac{\text{No. of samples correctly classified in test and trained data}}{\text{Total no. of samples in the test and trained data}}$$

4 Results

This paper is worked on the most accurate techniques of the disease's prediction on heart, liver, kidney, breast cancer, diabetes. Dataset used in this paper only results of heart disease prediction. Accuracy of KNN, decision tree, logistic regression, Random Forest calculated for testing and training model (Fig. 2).

Accuracy of various classifier

Heart diseases prediction accuracy is calculated in the way combination of training accuracy and testing accuracy for the 100%, for the KNN technique accuracy is 58.24%, random forest technique accuracy is 84.61%, decision tree technique accuracy is 75.82%, logistic regression technique accuracy is 82.42% (Table 1).

This paper preferring the most accurate classifier comparing to logistic regression (82.41%), Decision tree (75.82%), KNN (58.24%) classifiers random forest classifier is given more accuracy with 84.61%, so this paper gives the advice to use random forest classifier for heart disease prediction.

age	Sex	C P	Trest bps	chol	F b s	restecg	Thalach	Exang	Old peak	slope	C a	Thal	target
1	63	1	3	145	233	1	0	150	0	2.3	0	0	1
2	37	1	2	130	250	0	1	187	0	3.5	0	0	2
3	41	0	1	130	204	0	0	172	0	1.4	2	0	2
4	56	1	1	120	236	0	1	178	0	0.8	2	0	2
5	57	0	0	120	354	0	1	163	1	0.6	2	0	2

Fig. 2 Sample of 5 patients medical data from a dataset

Table 1 Algorithms used and their accuracy

Algorithm used	KNN	RF	DT	LR
Accuracy (%)	58.24	84.61	75.82	82.42

5 Conclusion

This paper addressed Predicting heart disease through the use of various kinds of machine learning and data mining techniques to predict it. Determine the performance of each algorithm for forecasting and implement the recommended system to the area required. To improve the exact performance of algorithms, use more relevant feature selection methods. If a patient is diagnosed with a specific form of heart disease, there are various treatments available for patients. In conclusion, as identified by the literature survey, only marginal success is achieved in the creation of a predictive model for heart disease. The heart diseases prediction model was implemented with an accuracy of 84.61% by the random forest algorithm so that we are using it to train the model with the random forest algorithm. This approach is finding more accuracy in disease predictions like this preparing more accurate models for liver, kidney, breast cancer, diabetes diseases and train every disease models with the best accuracy classifiers creating a webpage for the user to enter the information about his disease in the web page and by using datasets to refer to the patterns of the disease and find out whether the patient is suffering from the disease or not. For early detection of acute critical disease, and explainable AI early warning score system. Our system explains to the clinician the prediction on which relevant user data is based while maintaining high predictive performance.

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Automated Toll Plaza Using RFID

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Abstract In the present generation, IoT is playing a major role in connecting devices which can be accessed through the internet. Vehicles have been a necessity for everyone, and these increases the traffic, congestion on the road, by which toll gates are been implemented on highways (Balamurugan et al. in International conference on advances in electrical technology for green energy (ICAETGT), Coimbatore, pp 83–87, 2017 [1]). Everyday many vehicles cross many toll gates in every hour. The collection of toll taxes manually is a time taking process as they must form queue lines and wait for a longer time interval. in the present generation, everyone is busy with their own lives and get irritated easily with this system. So, to overcome this problem we have come up with an alternative solution. Earlier these methods have been proposed and some are been implemented. So, the drivers will not pay the cash for getting the token from the toll incharge for crossing the tollplaza. It will cover a suitable range for vehicle on the highways for paying the tax. The system alone says the design by which we can get the help of an individual code which can be used separately for each vehicle by which it will check the required code which will use the database tag and later it will be inserted to the vehicle system. As the vehicle will pass the required amount will be withdraw from the user account, and then the gates will naturally open for the vehicle.

Keywords Automated · RFID · IOT · Toll plaza

1 Introduction

The economy of all our countries usually depends on the transportation system. For getting efficient lifestyle of all people in their respective countries we require efficient transportation system which will usually result in getting social mobility, and freedom

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for a moment which results in higher employment rate level in manufacturing required products [2].

They are basically two methods for gathering the tax which is used presently. So, the first method is a traditional method where the payment is done manually on the highways where a person must be there in toll booth for collecting the cash and the people must wait in line for paying the tax. And second method needs the card payment system for opening the gate where smart cards are used in toll gate system. In this paper, we will admit a way for pay the tax using individual codes which is been accepted naturally by vehicles and subtracts the amount from their own banks. Radio frequency identification(RFID) sensors is nothing but an radio frequency which can be used to identify and tracks the objects isolated [3].

Many types of RFID are available in the world. Basically, RFID comprise of two tags called as passive and active tags. So, the element which is embedded in the tag is reader/writer, antenna. The range of an active tags is very high, and the '90s, toll booths were being manually controlled and people at toll plaza have to operate and use to collect the money from the travelers by recording the date from opening to closing of gates [4]. In the year 1995, the semi-automation technique was been introduced for opening and closing the gates, and that time the information was available in computers and it was operated by only two persons in the booth. Now we will create a toll plaza where no manual work is required. Here the vehicles will be monitored using tags for transmitting and receiving signals [5].

For controlling this system, we will be using different signals like beep sound and this will perform a frequency for smaller range. Whereas passive tags will not require additional power and it can be operated at maximum frequency and can it cover a maximum distance of 1.6 m, but it requires additional watt power for extending it and which will be used in long run and allows us to read the tags for more time [6]. This is less expensive and easily available.

2 Plan Structure

The plan structure is to provide a quick, logical method plan for tax gathering in all the gates which will control the vehicle movements automatically. The main function of this mode is collected automatic taxes, and these can be done by using a single RFID tag which saves the endeavor of carrying cash and records it manually. It's shown in Fig. 1, where the RFID readers which is arranged on the toll booth will notify the entry of the vehicles. These RFID tags are prepaid, and it needs small power supply like a battery but for passive tags does not require an battery and this is the reason for power is being given to the reader by which the range is very low while differentiate to active tags [7].

The RFID reader are usually called an examiner. These readers is been placed in each toll gate by which it collects the data of the user and their vehicles with help of RFID tag [8]. An antenna which are placed generates signals and transmits it to reader and then these signals is been collected by the reader and converts signals to

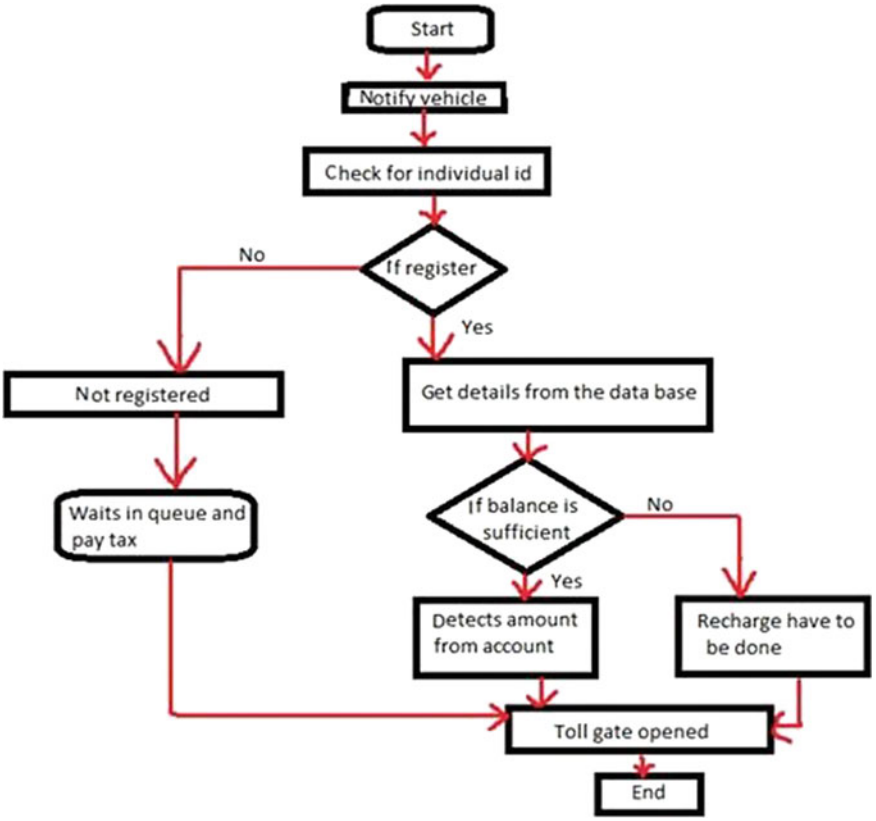

Fig. 1 Flow diagram of toll plaza system

data, later this data is preserved in a database. This data is been send to computer which contains an graphical user interface. Here each tag has individual number which will check the information which is available from the system which helps in detection of the toll taxes. When it matches, the microcontroller will detect the cash which will be shown on the LCD by which the barrier will open and these sensors which are used for closing the gate is a different case.

The plan and action of the system will be totally based on RFID technology where the vehicle toll collection system will work with Arduino. And it will recharge the card balance and it will control the toll gate automatically using a servo motor. The main concept of our project is automation. In other way, automation is nothing but replacing humans from the process of machines. In earlier days around and are fixed on the vehicles with individual Id. A vehicle is not registered, then person as to wait in the queue and pay tax. If the id of their vehicle is registered, then they will get the details from the data, then it will check the balance amount and will automatically deduct from the required account [9]. In case of insufficient balance, it should have to be recharged. Now transaction is done automatically the barrier will be open.

3 Related Work

The main objective of this paper is automation which helps to reduce the manual work for collecting the taxes. This process is done by RFID technology.

4 Components Description

Fig. 2 Arduino nano

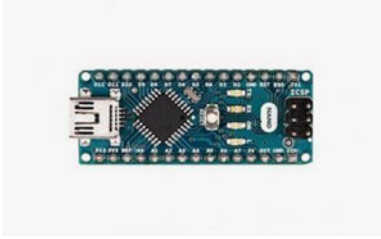

Fig. 3 RFIDReader (MFRC522)

Fig. 4 RFIDTag (13.56 MHz)

Fig. 5 Servo motor

Fig. 6 16*2 LCD display

Fig. 7 4 * 4 keypad

Fig. 8 IRObstacle sensor

Fig. 9 Buzzer

Fig.10 10k potentiometer

Fig.11 330 Ω Resistor

Fig. 12 4.7k Ω resistor

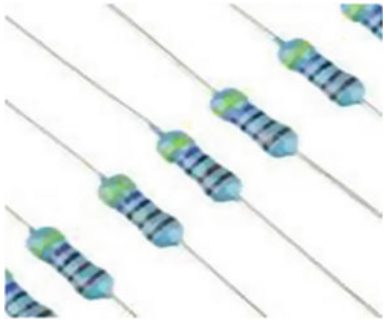

Fig. 13 Jumper wires

S. No.	Component name	Description
1	Figure 2	The surface mount breadboard with an embedded version which is integrated using USB**.** It is tiny, complete and board good which helps in offering some similar connections and specs of Arduino. It is all the required things which are used for analogue inputs pins and +5 V AREF jumper on boards
2	Figure 3	The radio frequency identification reader is a device which is used to gather information from an RFID tag, which allows to track individual objects. This technology allows some items to scan quickly and helps in enabling them with fast identification for a particular product
3	Figure 4	Radio frequency identification is the wireless non-contact used for radiofrequency waves for transferring data [10]. These RFID tags permit users to automatically track or identify the assets required for items
4	Figure 5	This is a rotary/linear actuator which allows controlling the specific angular or linear position, velocity and acceleration. The motor is being coupled to a sensor for getting position feedback
5	Figure 6	It is an electronic display module with a wide range of applications. A 16 * 2 LCD is a basic module and it is often used in various circuits and devices Usually, 16 * 2 LCD means it can display 16 characters per line in 2 lines
6	Figure 7	It is mainly used for giving input in projects. This keypad module is been non-encoded with 16 keys in parallel. These keys form row to the column are been connected through pins from outside. Here pin Y1 to Y4 is used to control rows, and X1 to X4 is used to control columns
7	Figure 8	Infrared obstacle sensor module as built-in IR transmitter and IR receiver that sends IR energy and gets reflected IR energy which is used to detect the presence of an obstacle in front of the sensor module
8	Figure 9	It is an audio signalling device, which can be electromechanical, mechanical or piezoelectric and this can be used in buzzing the alarm devices, timers for confirmation of the input
9	Figure 10	Usually a potentiometer is a three- terminal resistor which is having a sliding or rotating contact which forms an adjustable voltage
10	Figures 11 and 12	It is a device which has electrical resistance, and it is used as an electric circuit for protection, operation and to control the current
11	Figure 13	It is an electrical wire which is grouped into a cable with a connector or pin at each end. These are usually used to interconnect the components on a breadboard, test circuits internally with some other equipment without soldering

5 Experiment Analysis

In this model of automatic toll gate system, this will detect the identities of all the vehicles and helps to perform the whole billing process to implement the identity of vehicles with the required database. If anyone faces any problem while paying the amount such as if they do not have the money in their account, then they can recharge it and solve the problem. If all the requirements are passed, then it will automatically open and closes the gates (Fig. 14).

In this project the RFID plays a major role, this RFID tag will be fixed the windshield of the vehicle and each vehicle will have an individual id. This RFID tag will be read on the toll barrier using an RFID reader which will be there on the toll barrier. This will detect all the necessary information and it will be preserved in data format in the system. If vehicle matches all the requirements, then it will allow the further process. Based on the vehicle type, the cash to be paid and tax is been deducted from their account. If they do not have a sufficient balance in the account, they can recharge it.

After this payment of tax is done the status of the vehicle will be displayed on the LCD and it will allow the gate to be opened. The travelers need not worry about the signal problem because as it is said it is automated so the vehicles need not wait in the queue for this problem because the gate will open automatically once if all the conditions are satisfied.

The tax amount which is to be paid in tollgate differs for the vehicle to vehicle. The vehicle type is deducted at the beginning of the process using the RFID sensors, so the amount is being deducted according to vehicle type.

6 Results

See Figs. 15, 16, 17 and 18.

7 Conclusion

The automated toll plaza system is a new source to lessen obstruction at the toll gates to a high level. This structure allows collecting the toll at highways. This is the very tight and efficient and very cheap structure which will help to reduce the traffic on roads and helps everyone to know the new technology. It as a great tracking power. The main motto of this project is automation which helps to reduce the manual work for collecting the taxes. This process is done by RFID technology. The details of the vehicle are detected by an individual id which is different for all the vehicles.

Here an RFID tag is being fixed on the vehicle then it is passed through the toll barrier and the reader senses the tag, and the vehicle is being identified and it

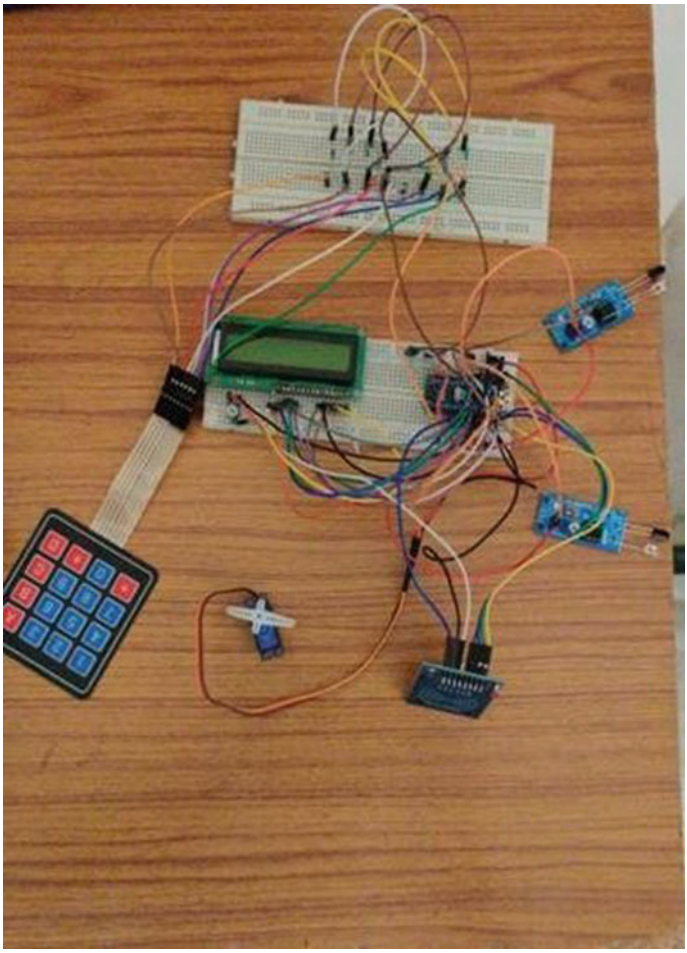

Fig. 14 Hardware connection

recognize the data for further input process. If it passes all the conditions, then the amount be will be deducted and if there is not enough balance then they can recharge it pass the toll gate. The result of that vehicle will be displayed on the LCD screen. This system mainly helps to reduce the problems of traffic and tollgate. It can also be said it the solution for reducing the obstruction and troubles faced while paying the taxes manually near the toll gate.

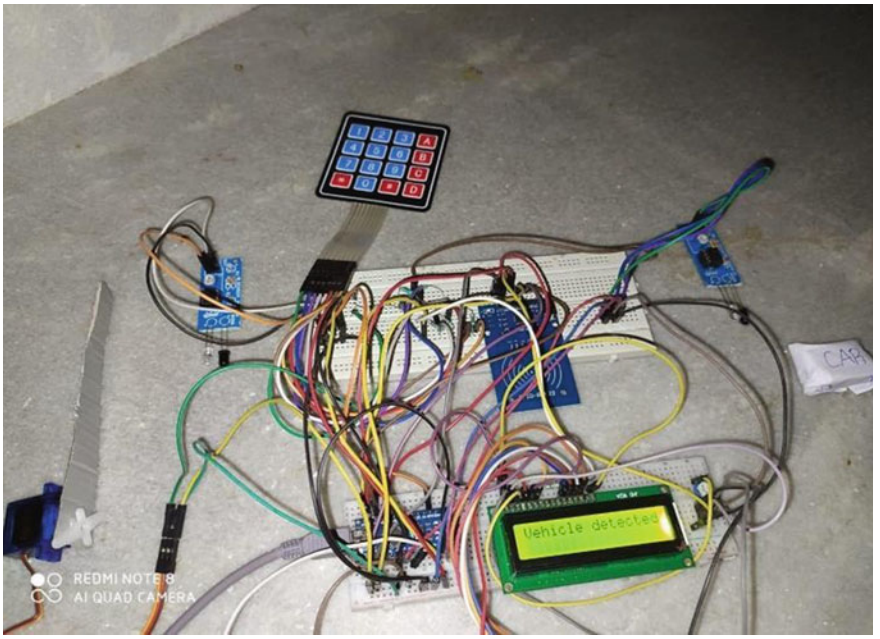

Fig. 15 Vehicle is been detected at toll gate

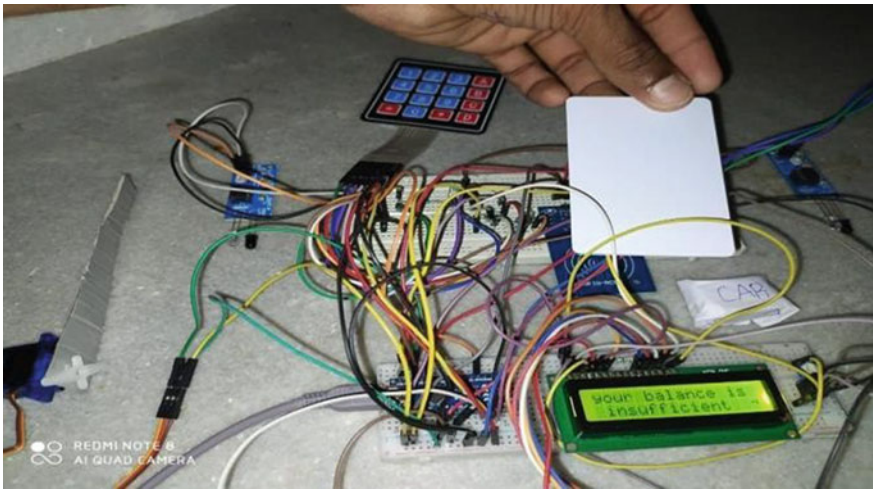

Fig. 16 Uses RFID tag to check the balance

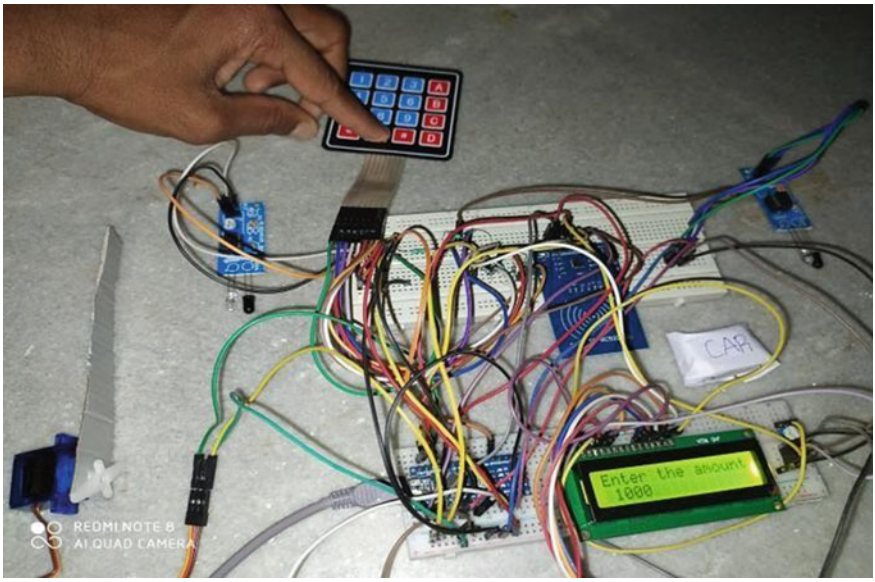

Fig. 17 Recharging their card

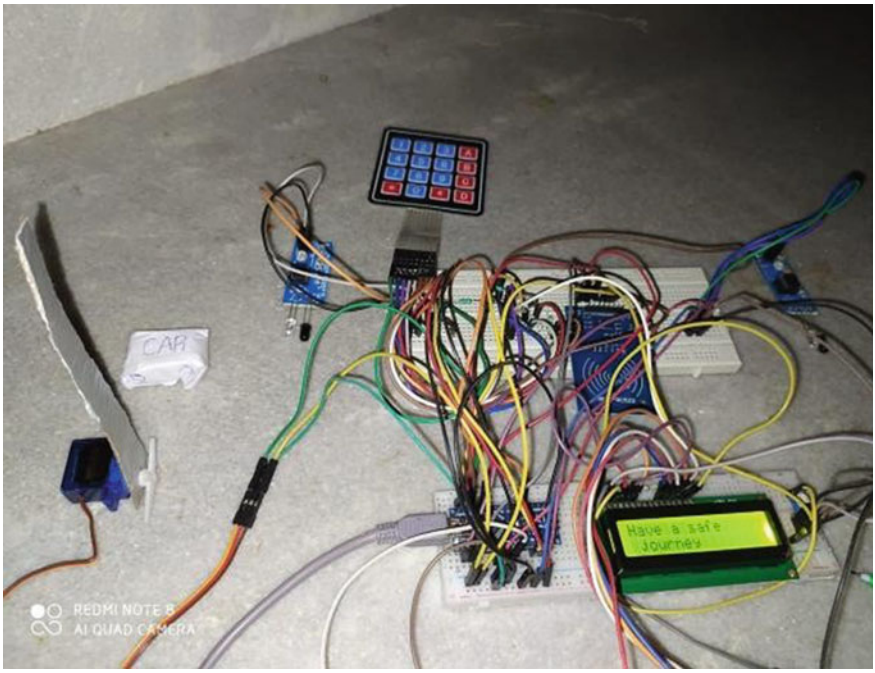

Fig. 18 Wishing them a happy and safe journey

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Predictive Student Performance Analysis Using Machine Learning and Student Assistance System

N. Sai Charan, Md. Ali Hussain, P. Vineela, M. Vamsi Adi Tilak, and T. Chandu Siva Shankar

Abstract In this, we mainly focus on the analysis of the student's performance in academics based not only on external exams, but also taking into consideration the internal marks of each and every student. This work is useful for the users either for just getting an idea on the performance of the student or in situations where the institutions are unable to conduct the examinations and they wanted to promote the students based on their previous performance. We segregate and calculate the performance of students using data (Kaunang and Rotikan, Students academic performance prediction using data mining. IEEE, pp 18–10, 2018 [1]). We then predict the performance of the students who are going to pass and fail based on previous result and also the predicted marks of a student using a new algorithm namely Student Predictive Analysis algorithm (SPA algorithm) with the help of already existing algorithms SVM and linear regression algorithms. These two algorithms are the supervised machine learning algorithms. The support vector classifier is take from the SVM algorithm in order to classify the students as Pass/Fail. In this project, we mainly focus on the analysis of the student's performance and then predict the results through them using training data and then test data of academics not only external exams, but also the overall academic performance of each and every student. In addition to that we have added some more features like student faculty interaction for clarifying doubts or getting faculty assistance, placement prediction and giving suggestions to the to get placed in the companies, OTP login validation and facilitate faculty to give overall feedback on students.

Keywords Student performance analysis · Classification · Prediction system · Doubt and feedback · Pie chart · Dataset

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1 Introduction

Here, we mainly focus on the analysis of the students' performance and then predict the results through them using training data and then test data of academics not only external exams, but also the overall academic performance of each and every student [1]. In a significant number of the universities, when we see the scholastic execution examination is done, however there is no framework that predicts the understudy's exhibition ahead of time [2]. Of which if understudy fizzles in an Exam. Here we consider both inward and outside imprints for examining scholastic execution of an understudy in the school which is investigated utilizing SVM calculation and afterward Linear Regression calculation [2]. The main purpose of this is to provide a system which produces the required data to students and as well as the professors. The required data includes, the students were required to obtain their results of their assignment marks, internal and external examinations. And not only provide access to students to know their results, the lectures are provided a report of how many students are going to pass and fail in the oncoming examinations. By knowing the students' performance the lecturers can assist the dull students to perform better in the coming exams. These predictions are done using the previous results of those students [3]. We also facilitate the students with placement prediction which helps them to improvise their corporate skills if required [4].

2 Literature Survey

Fergie Joanda Kaunang et al., proposes a model for foreseeing the scholarly exhibition of Computer Science students utilizing Data Mining method. The data gathered using polls that contain the students' socioeconomics, previous GPA, and family background data. Two Data Mining models (Decision Tree and Random Forest) are applied to the students' data to make the best student's scholarly presentation expectation model [1].

Deepti Khanna et al., schools and universities in India have an alternate pattern of training students where one can't physically go to classes yet needs to go to classes virtually, here occurs a new problem. Here we will examine a few issues like web availability issues and understanding of concepts explained by faculty in classes [3].

Shana et al., The proposed framework offer a predictive system that can predict the students' outcome in course "TMC1013 System Analysis and Design", which assists the faculty from Information System wing to distinguish students that are predicted to have terrible execution in course "TMC1013 System Analysis and Design" [5].

Yamgming Wang et al., proposes a system for examining and applying faculty student correspondence information. In analysis level, the methodology depends on scene design acquisition and point extraction. The application principally serves before-intercourse and after-intercourse procedures [4].

3 Previous Work

In this paper, a dashboard is created for University Examination Result Analysis System. It determines the post and pre requirements as well as the processes of the University examination system [6]. Depending on the result generated by the university a dashboard is created. In this paper analyze the B. Tech Student details. Data to create dashboard for administrative [7]. This investigation will help the colleges and schools to zero in on basic subject, understudies' exhibition on course astute, and subject insightful. Subject and total subject signs obviously are considered for analysis. It has low degree of granularity having Theory, IA and Practical stamps independently [8]. It only analyses the results of University exams only and not considers about the internal exams held in the institutions. It does not contain any security mechanisms.

4 Proposed Work

We are creating a distributed application in which both internal and external academic performance of a student is considered for analyzing the performance of student. We collect, segregate and perform analysis on the acquired data using data mining techniques. Here we provide access to students to view their results of assignment, internal and external examinations. And the Administrator is given the access to update, delete and add user data and add, update and delete the users and generate report which can be viewed by users and professors. In order to predict the performance, we use classification techniques. The Doubt and explanation given by the faculty should be visible to all the students. Mail OTP login for enhanced security. This feature adds more security to the student information because the details of students are very sensitive. Student to student interaction provides the students to interact with any other fellow student in the institution. Prediction of student placement using previous student's results and skills comparison by checking the student's academic skills and soft skills with the previously graduated students, we will predict whether the student gets a job or not. After prediction giving suggestions on what skills are to be improved to get a placement. Based on comparison, students will get a suggestion to improve the skills that they are lacking in. An option to address the issues faced by the students. The complaints or suggestions or requests from the students are posted to the management. Enabling faculty to provide the overall feedback of student including academics, behavior and extra circular activities etc. These details will be given to the companies or other organizations that are seeking student information or recommendation. This proposed system comes handy in this present Covid situations and any other pandemics.

In Fig. 1, the framework of the proposed model is demonstrated which includes various users linked to each other and the controller of the model.

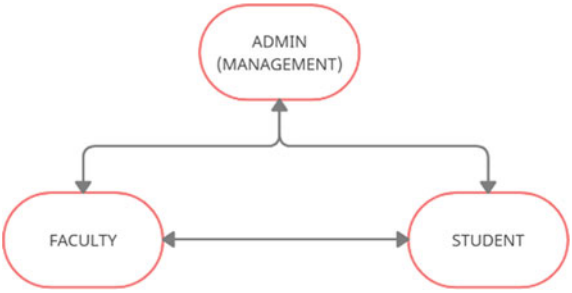

Fig. 1 Framework of the proposed model

5 System Analysis

In this system, admin has got to login with valid username and password. After login successful he can do some operations such as add faculty, view faculty, add students, view students. Adding faculty includes the details of the faculty such as name, email, phone number, gender, subject, address. Likewise adding student includes student roll number, name and email password, course, gender and year. Admin also creates the login credentials for the students and faculty. The faculty has to login with valid username and password. After login successful he can do some operations such as add marks, view marks, predict marks. Adding marks includes the details of the student and their subject marks respectively. In prediction we have two parts view pass prediction and view marks prediction. View pass prediction will show whether a student gets pass or fail and view marks prediction will predict the approximate marks of a student in the exams. In addition to that we also provide the faculty with an opportunity to give the students overall feedback. Here the student can only view his marks with his respective username and password and then they get the grade to their marks, then have better knowledge on how to improve in subjects. In student portal there are some other additional features such as interacting with faculty, placement prediction and suggestion, raising complaints, giving suggestions and student to student interaction etc. The graphical analysis of the Merit of the students is done by transferring the data into a csv file and in that csv file we create a pie chart that is imported into the website for pictorial analysis of merit of students. This importing is done using CSS.

In Fig. 2, the flow chart of the proposed model is demonstrated which includes the component like Admin, Faculty and Student.

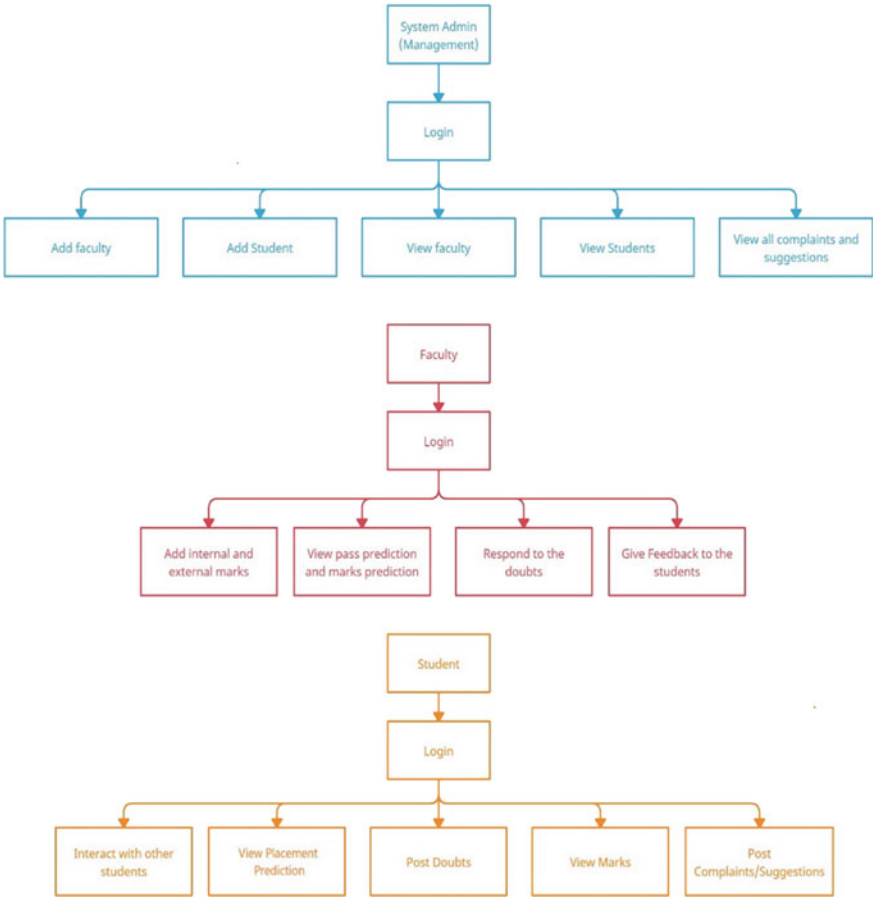

Fig. 2 Flowchart of the proposed work

6 SPA (Student Predictive Analysis) Algorithm

Step 1: Import pandas, numpy, sklearn and math modules.

Step 2: Reading the data from dataset or database.

If the required data exists them Goto STEP 3.

Step 3: The marks obtained will be passed through the function:

marksPredict():

read a CSV file or connect to database
variable1=variable1_split(df,test_size=0.2)

list1=train[list2].values.tolist()

list3=train['External marks'].values.tolist( )

Here list2 contains internal marks and attendance

Step 4: Now import linearRegression from sklearn and pass the data

from sklearn.linear_model import LinearRegression

model = LinearRegression()

model.fit(list1, list4)

Return the model.

Now for Pass evaluation Goto STEP 5.

Step 5: The Pass/Fail Classification will be obtained from the function:

read a CSV file or connect to database

train,test=train_test_split(df,test_size=0.2)

train_labels=[Internal marks in Subject1, Internal marks in Subject2,….., Attendance]

list1=train[train_labels].values.tolist()

list1=train['PASS/FAIL'].values.tolist()

Step 6: Now import Support Vector Classifier(SVC)

from sklearn.svm import SVC

classifier=SVC(kernel='rbf',random_state=1)

classifier.fit(list1,list2)

return classifier

Step 7: These obtained lists will be stored in CSV file or Database.

Step 8: From the csv file, obtain the pie chart as per our requirement that is to be displayed in the web page.

Step 9: End.

Here this algorithm is developed based on the existing algorithms SVM and Linear Regression. They are implemented based on our requirement for prediction and

classification. It is an AI count subject to controlled learning. It plays out a backslide task. It is used to survey certified taking into account relentless variable(s). Here, we set up association among free and ward factors by fitting a best line. This best fit line is known as backslide line and addressed by a straight condition [9, 10].

Preceding arrangement what direct backslide is, let us get ourselves adjusted with backslide. Backslide is a system for exhibiting a target worth reliant on free pointers. This methodology is for the most part used for spreading and finding conditions and sensible outcomes association between factors. Backslide techniques by and large shift subject to the amount of self-ruling components. In Fig. 1 it is very clear how the linear regression algorithm will work.

It is a coordinated AI computation which may be used for both course of action or backslide challenges. Regardless, it is by and large used all together issues. In the SVM count, we plot each data thing as some degree in N Dimensional space with the assessment of every particle being the assessment of a specific organize. By then, we perform request by finding the hyper-plane that isolates the two classes very well (look at the underneath review) [11–13].

In Fig. 3, the pie chart that shows the percentage of different categories of students based on their Merit i.e. the overall marks in all the submits that they have in their curriculum. Firstly, the data is loaded into the csv file using the write function and then the data is rendered and based on our criteria it gets divided into three categories of students as show in the Fig. 2. From that classification, we will generate a pie chart. The pie chart obtained from the csv file is then imported into the webpage. The pie in css and pie class in html is used for featuring the Pie chart in the website.

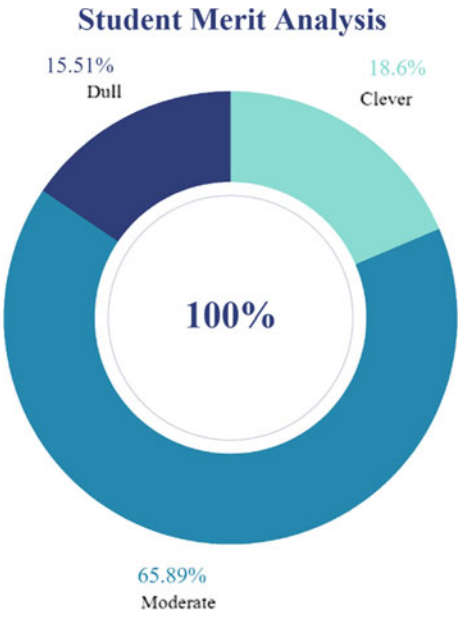

Fig. 3 Student merit analysis

7 Conclusion

This expectation calculation fills in as a decent benchmark to screen the movement of understudy's exhibition in higher organization. It additionally upgrades the dynamic by scholastic educators to screen the competitor's presentation semester by semester by enhancing the future scholarly outcomes in the after effect scholarly meeting. Subsequently with the assistance of this Prediction calculation the educators build up a decent comprehension of how well or how inadequately the understudies in their classes will perform so teachers can take proactive measures to improve learning.

8 Future Enhancement

Hence, the system has been implemented as per the requirement of the end user. However it can be extended to few more variables to predict the student's performance. It can conducts principle component analysis by considering 16 variables and our work is completely a desktop application so in future it has to be developed as android application by sending the reports to the mobile so that parents can know the performance of their children.

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Design of Low Power Area Efficient 7:3 Counter

G. Rakesh Chowdary, P. Srikantṇh Reddy, B. Hemanth Kumar Reddy, and M. Prudhvi Tharaka Rami Reddy

Abstract Implementation of a counter which is designed and simulated by using a 6:3 counter, which will be better in speed and lesser in the no of Look Up Tables (LUTs). Moreover, it's going to bring down the power usage of the proposed 7:3 counter when compared to the normal stack-based counter. This counter can be used in digital systems in terms of doing multiplications of higher-order bits, where these proposed counters are used to bring down the internal products generated from the multiplier in to lower no of stages when compared to the normal conventional multipliers. These counters are fast because of not using any XOR gates in the circuit implementation of the counter.

Keywords Stack · Counter · Multiplier · Digital system

1 Introduction

Counters as the name intimates they are used to count the physical and digital entities in our day to day life. They are actually build by using flip-flops They are nothing but memory elements which are used to store and transfer single bit of data in circuits [1]. Generally, counters are used to count the numbers from 0 to required number, for this they need to be triggered by a clock pulse and then the states of the counter changes accordingly with apply of clock pulse. Then they start counting from 0 to the desired number which is n. Counters are implemented in many ways like up counter which counts from 0 to required number and down counter which counts from a number to 0 [2].

Counters are two types, the main difference was in counters was in applying clock signal. If all the counters are connected by using a single clock then they are called synchronous counters [3]. Which means the internal circuitry is in a sync manner and the whole counter has only one clock which is used to triggers the flip-flop one then

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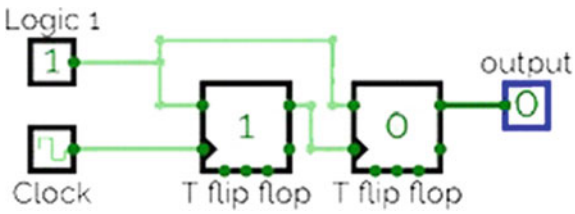


Fig. 1 Circuit diagram of an asynchronous 2-bit counter

based on the applied inputs the states of the other flip-flops change according to the desired truth table [4]. Then in asynchronous counters the clock is not connected for every flip-flops they need to be triggered individually as the name suggests the clock for the flip-flops was not in sync manner [5]. So separate clock signal is applied from the previous flip-flops result as the clock to the next flip-flops clock input. This has to be same for all flip-flops which are connected as counter. However both counters are capable of counting 0 to particular number and number to 0 based on the necessity of our circuit [6].

Asynchronous or ripple counters: The counters which are having individual clocks are called as asynchronous counter. In these counters the clocks are not connected as a single clock they are separate for every flip-flop. In Fig. 1 we can analyse an asynchronous 2-bit counter which is having 2 flip-flops, here we can analyse that the clock for first flip-flops and second flip-flops was not connected [7, 8]. The end result of the first flip-flop can be used to trigger the clock of the second flip-flop based on the present and further states of the flip-flops.

Parallel counters: The counters which are having single clock for every flip-flops in its circuit are called as synchronous counters, Here the clock is in sync manner therefore all the clocks are triggered at once. The circuit shows the counter diagram of a 2 bit synchronous counter [9]. Here we can find the similar clock connection the 2 flip-flops are connected with the single clock pulse therefore there should be a minimum delay which is also called as propagation delay it is caused by the propagation of clock from one flip to another flip-flops in synchronous counters the flip-flops are not dependent on each other for clock signal they are all triggered at once with a single clock pulse and generate the outputs according to the truth table [10]. These counters are easy to implement and to use in digital systems because due to less delay there should be increase in performance when these counters are used in some digital systems like multipliers to count the sum of the products which are generate in between a multiplication operation [11].

Here we can observe the below 2-bit counter circuit diagram it is implemented by using two j-k flip-flops, the inputs j and k of the flip-flops are connected to the input 1 and the clock of the 2 flip-flops are connected to an external clock source. Therefore the both triggered at once with a minimum latency [12]. At first clock the result of the flip-flops was 0 1 and for the second clock pulse the result was 1 0 for third clock pulse it was 1 1 and after the last trigger pulse the counter comes to the starting state which is 0 0 and again the cycle repeats to reach the output. If we want

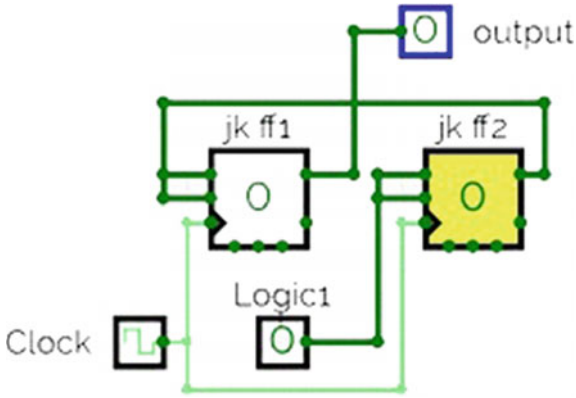


Fig. 2 Circuit diagram of synchronous counter

to build an n bit counter then we need n flip-flops connected in sequential manner that's why counters are called as sequential circuits.

These synchronous counters have better advantage over non synchronous counters because these are manageable to use and also the sequence of the next state can be controlled by using logic gates whenever we needed and also due similar clock these are triggered at once therefore these counters are used in alarm clock and cameras [13]. In cameras we can observe that a counter is set to take a photo after some amount of time it is also one of the use of these synchronous counters, here the clock is not needed to propagate for the next flip-flops hence speed is more this makes the synchronous counters better as asynchronous (Fig. 2).

Now we can observe how the timing of the synchronous counter and observe how the clocks set for every clock set. Initially the clocks result QaQb was on 00 when we give the first clock pulse the flip-flops one will triggered and the output Qa = 1 but the next flip-flops will not triggered and therefore the second flip-flops output Qb = 0 therefore the state after the first clock pulse is 01 which is QbQa. When the next clock signal is applied the state of the flip-flop one is changes from 1 to 0 then the other flip-flops state changes from 0 to 1 then the output after second clock pulse was 10. For the next clock signal again the state of the first flip-flops changes from 0 to1 therefore previously second flip-flops state is also 1 then the result is 11 after this for the final clock pulse the first flip-flops converts its state from 1 to 0 then other flip-flops whose state is 1 previously now triggered and changes to 0 so the output after the final clock result is 00 hence the counter comes to the starting state of the counting sequence.

Up/Down counters: These counters can capable of count up, means increasing sequence and down means decreasing sequence it is possible by using a mode to control the counter. If the mode m = 1 that tells the counter is in decreasing sequence mode and it starts counting from down to up from a number to 0. And if the mode m = 0 it infers that the counter was in increasing sequence mode which counts from 0 to number as a counting order both can be selected by using a mode control called up counter.

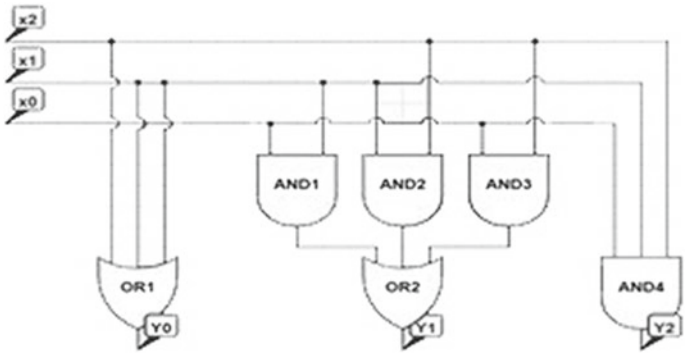


Fig. 3 Circuit diagram of 3-bit stacker

Stack-Based Counter: Stacking means grouping of ones together which can also be used as a technique to implement counters like other sorts of counters are binary counters supported symmetric stacking during which the stacking technique was used to formulate the ultimate carry and sum. Stacking means grouping all ones and zeros to the one end. These counters also are utilized in multipliers to scale back the internal products, but these counters were complex and need more Lookup tables, Input, and Output pads, and consumes more power in comparison to the proposed 7:3 counters. The proposed counter requires a smaller number of look-up tables (Fig. 3).

The 6-bit stack-based counter was implemented by using 3-bit stacker circuits and by using the intermediate vectors H, I, J, K, computed final Carry2, carry1, Sum of the 6 bit counter by using the Fig. 4 stacking circuit.

2 Proposed Design of 7-bit Counter

The proposed 7:3 counter was implemented by using a 6:3 stack-based counter and fast adder as shown in Fig. 5. The carry2, carry1, sum of the 6-bit counter and additional 1 more bit is then added by the carry look-ahead adder, instead of using multiplexes, it can be implemented by using this methodology. So, the complexity of the circuit is reduced and the number of lookups tables required are going to decrease and hence consume less power when compared to the stack-based 7-bit counter.

Figure 6 shows the 6-bit stack-based counter and the final states of Carry2, Carry1, Sum, here a 7-bit counter is designed using a 6-bit counter. For the 7-bit counter, the number of inputs is X0 to X6 total of 7 inputs. Here first 6-bit counter was implemented and then by using a carry look-ahead adder it's going to add the remaining 7th bit which is X6 with the Carry2, Carry1, Sum, and then final Carry, Sum1, and Sum0 is generated. Here C2 represents Carry2, C1 represents Carry1 and S represents Sum and X6 is the 7th bit of the 7-bit counter.

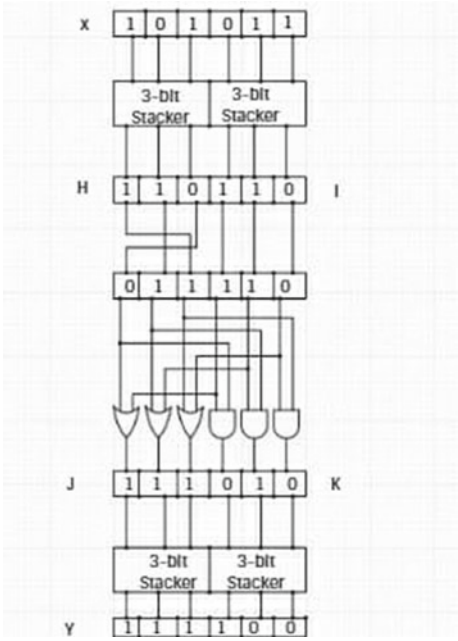


Fig. 4 Circuit diagram of 6-bit stacker

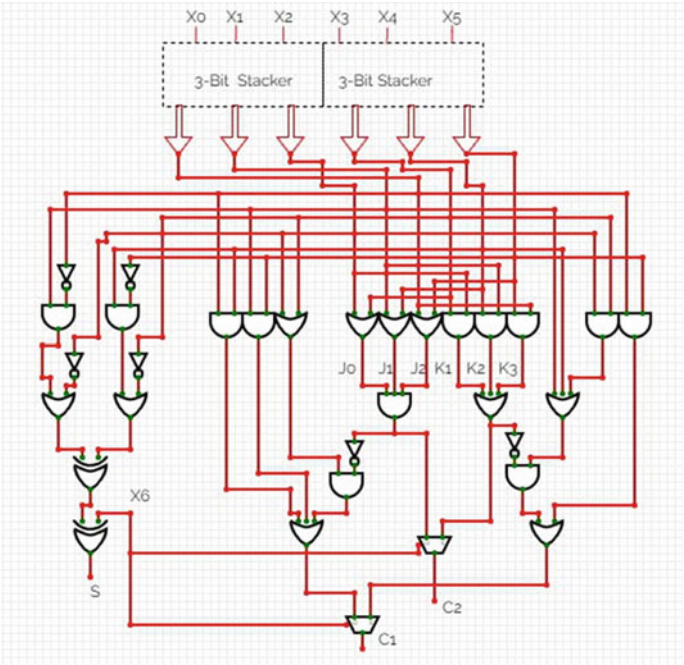


Fig. 5 7:3 Stack-based Counter

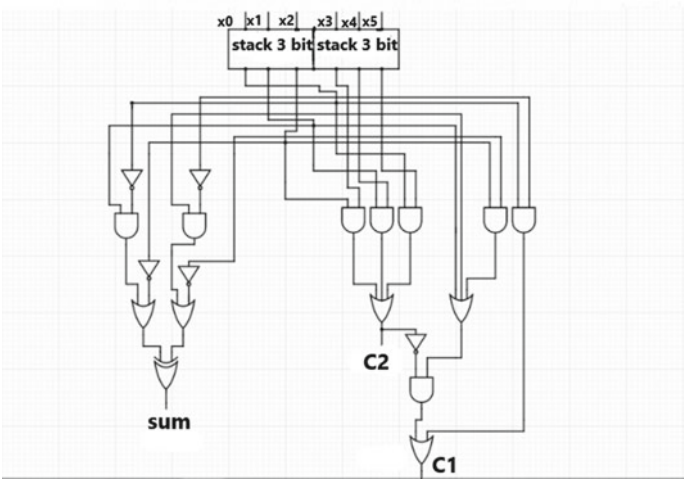


Fig. 6 Circuit diagram of 6-bit counter

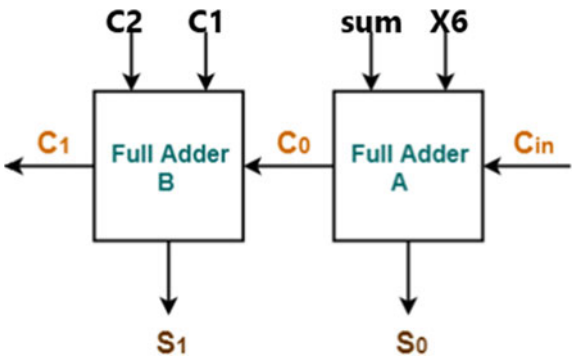
Here in the above 6-bit stack-based counter, the final output as C2, C1, Sum then convert this counter to a 7-bit counter by using a carry look-ahead adder. Which takes inputs as C2, C1, Sum, and X6. Here the proposed counter is 7 bit that's why one more additional bit X6 is taken. Figure 7 shows the 2bit carry look-ahead adder.

Here 6-bit counter and fast adder which was shown in Fig. 7 is combined and implemented as a 7-bit counter. Here the final Carry, S1 and S0 are computed by using the following equations.

$$p0 = (s\hat{}x6)$$

$$g0 = (s\&x6)$$

Fig. 7 2-bit fast adder



Here pi means propagation of carry and gi means generation of carry and hence s0 is sum0, s1 is sum1 and c1 is the final carry after compressing all the inputs from X0 to X6.

$$s0 = (p0 \hat{} cin)$$

$$c0 = (g0)|(p0\&cin)$$

$$p1 = (c2 \hat{} c1)$$

$$g1 = (c2\&c1)$$

$$s1 = (p1 \hat{} c0)$$

$$c1 = (c0\&p1)|(g1)$$

Therefore, the final output of the proposed 7 bit counter is C1, S1, S0 which was the same output as the stack-based counter, but this counter is less complex and more efficient in terms of power and look-up tables count.

3 Results and Discussions

Here, proposed 7-bit counter is implemented by using the Verilog programming language. The suggested counter was simulated and observed that it consumes 37% less power compared to the stack-based 7:3 counter and the no of lookup tables count is reduced by 33.3%.

When implemented and checked the stack-based 7-bit counter is found that it utilized more look-up tables around 18 tables and also takes 29 IO's and 17 percent more than the proposed counter. Table 1 shows the utilization of resources.

Therefore, Table 2 shows the utilization of look-up tables for the proposed 7-bit counter which was implemented by using the carry look-ahead adder.

The stack-based counter takes more on-chip power which is 9.185 W when compared to our proposed counter and utilizes more look-up tables. The Table 3 shows the on-chip power consumption of the stack-based counter.

Table 1 Look up tables utilization of stack based 7-bit counter

Resource	Utilization	Available	Utilization%
LUT	18	53,200	0.03
IO	29	200	14.50

Table 2 Look up tables utilization of proposed 7-bit counter

Resource	Utilization	Available	Utilization%
LUT	13	53,200	0.02
IO	24	200	12.00

Table 3 Total on-chip power consumption of stack-based counter

Total on-chip power	9.185 W (Junction temp exceeded!)
Junction temperature	125.0 °C
Heat margin	−45.9 °C (−3.2 W)
Essential JA	11.5 °C/W
Usage of power by off-chip devices	0 W
Confidence level	Low

Table 4 Total on-chip power consumption of proposed counter

Total On-Chip Power	5.74 W (Junction temp exceeded!)
Junction temperature	91.2 °C
Heat margin	−6.2 °C (−0.4 W)
Essential JA	11.5 °C/W
Usage of power by off-chip devices	0 W
Confidence level	Low

The proposed counter-power consumption also lower when compared to the stack-based counter. The proposed counter's on-chip power was 5.74 W which is 37% less than the stack-based counter. Table 4 shows the on-chip power consumption of the proposed counter.

When RTL analysis of the stack-based counter done, it's observed that it takes more cells, I/O ports, and nets. Figure 8 shows the elaborated design of the stack-based counter.

After doing the Register transfer logic (RTL) Analysis for the proposed counter as shown in Fig. 9 it's observed that it takes fewer nets, I/O ports, and cells when compared to the stack-based counter.

After doing power analysis and based up on the netlists are generated the below values of look up tables and cells are observed.

Table 5 and Fig. 10 shows the analysis of parameters among the stacking counter and the proposed fast adder based counter. So, it's found that the proposed adder-based counter shows good performance in power usage, no. of cells, nets, and I/O ports.

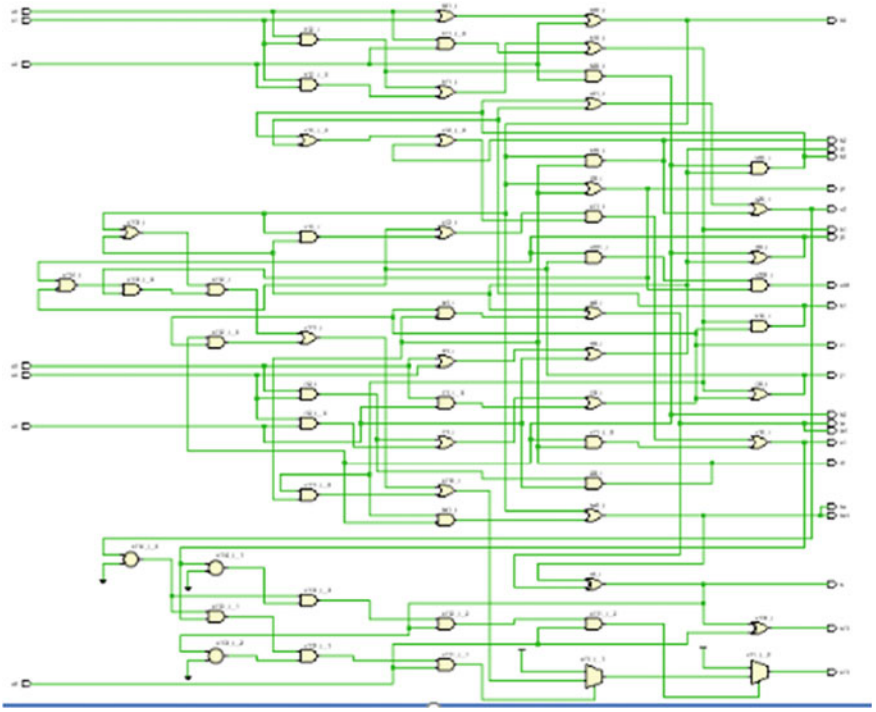


Fig. 8 Elaborated design of stack-based counter

4 Conclusion

From the implemented design it concludes that the proposed counter was more efficient in terms of power and LUT's. Therefore, this counter can be used in digital systems like multipliers to reduce the partial products instead of normal conventional adders and counters. Thereby a chance to increase the efficiency of the multipliers.

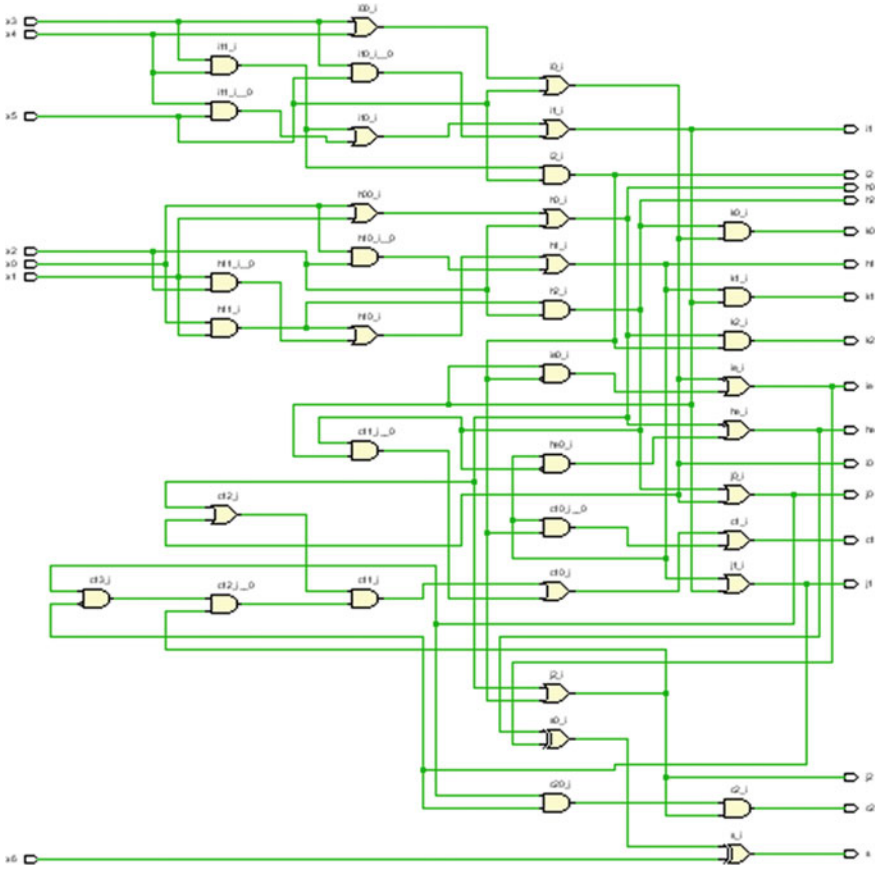


Fig. 9 Elaborated design of the proposed

Table 5 Analysis of parameters between proposed and stack counter

Counters	7:3 Stack counter	Proposed counter
LUT	18	13
Power	9.185 W	5.74 W
Cells	58	38
Nets	67	45
I/O Ports	29	24
Latency	1.8	1.5

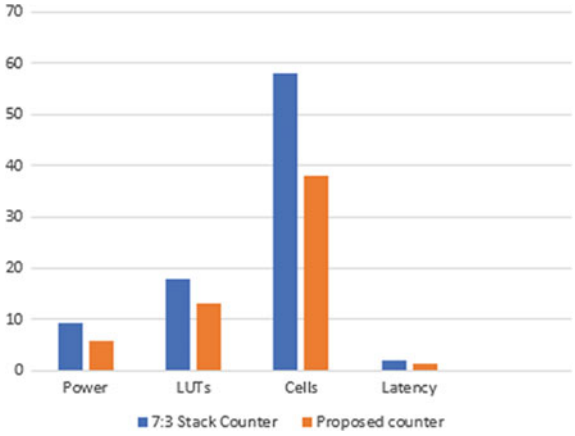


Fig. 10 Comparison of 7:3 stack counter and proposed counter

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Detection of Cyber Threats in Application Platforms

Krishnaveni Kommuri, Vamsee Krishna Allam, Ritika Allam, Vanapalli Geethika, and Boyapati Vyshnavi

Abstract Illicit behavior on application platform, the gadget's popular social platform, promotes misuse of 'search rankings' and the spread of malware. The evidence that has been left by the scammers is detected by Fraud rank detector. It detects vulnerable malware and application to hunt for malware manipulation. A Pseudo Clique Finder, program is proposed which tracks the behavior of deceiver enlisted to download/rate a technology is suitably to advertise those rating with comparably less interval of time or download the app using symmetric key. The server needs to permit the key to access the secret key as referred to PCF takes the input as set of downloads of an app in and a threshold value u ($u = 3$). Whenever the threshold limit exceeds by downloading the application more than the u times the user is said to be fraudster.

Keywords Cyber threat · Fraud detection · Malware · Anomaly detector · Cyber intelligence · Malicious event · Social media · Rank finder

1 Introduction

Cyber Security govern the data up-strings. Commercial rate of social websites includes the motive that they need an approach to make exact assets for dereliction. Deceitful designers use portable stockpile purpose of ransom ware. Upon awareness produce by their clients also effects online services and gives better field to impact the citizens thinking. Performance of electronic devices appeal in trade depends upon a search rank such as Google Play. Mostly low-ranking apps are fixed and also produce more remuneration from promotions.

A Pseudo Clique Finder, program is proposed which tracks the behavior of deceiver recruit to analysis/download/rate an application is such as to advertise those evaluation/rating in less interval of duration or download the app using symmetric key. The server needs to permit the key to access the secret key as referred to Table 1.

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Table 1 Symmetric key permission

ID	User name	File name	Permission
1	Ritika	WhatsApp	Permitted
2	Geethika	Facebook	Permit
3	Vyshnavi	EasyTaskLazySwipe	Permitted

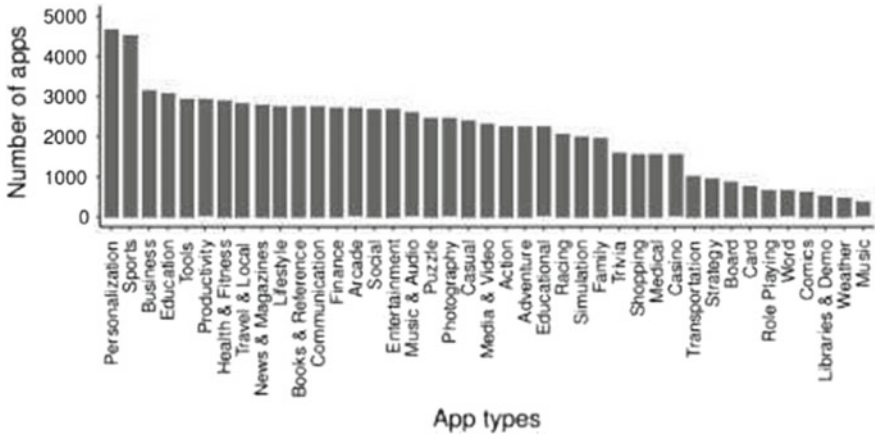

Fig. 1 App types (to create an app search optimization (ASO) submarket)

PCF takes the input as set of downloads of an app and limit value (u = 3).Whenever the threshold limit exceeds by downloading the application more than the u times the user is said to be fraudster as showed in Fig. 5.

There is a most usual view that high ranking users support the latest applications to bring out high search grades. The best aim for users is to advertise their own implementations to create an App Search Optimization submarket as showed in Fig. 1. A process advancement approach will combine implementation examine cases and enlargement plans to a efficiently-defined number of steps are key to program development establishment. The analyst works on this issue of finding mislead violation to classify the data. This analyst gives detail report about the outcome and analysis of it using artificial data as showed in Fig. 2.

2 Literature Survey

ML' programs can be effectively employed for modeling and developing autonomous vehicle systems [1]. SVC and Naïve Bayes algorithms have been found to be quite suitable for modeling autonomous vehicle systems. Naïve byes algorithm has been proved to be the nest choice due to increased accuracy, less prediction time and training time [2] DDOS attack detection models generate a large set of patterns (or

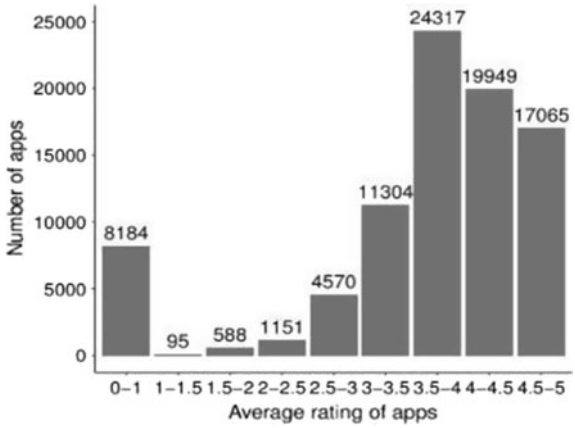

Fig. 2 Average rating of apps versus number of apps

signatures) in which most of them are inaccurate due to high false alarm rate. Traditional packet correlation approaches need several network packets beside knowledgeable information to forestall complicated DDOS attacks. Also, detection and anticipation of dynamic DDOS attacks are difficult in the real-time distributed LAN/WLAN networks [3]. A examiner present in IDS is used to carry out deep packet' examination [4]. Cyber threats are increasing and one of the common aspects of all attacks has a commonality, which is a malware [5]. In learning dynamic malware analysis its future scope can be further extend to static malware analysis where we completely try to unpack and learn the working principle of a malware, further approach can be to reverse engineer it, from this paper user gets a proper understanding about dynamic analysis approach [6]. Dynamic analysis of a malware can predict the behavior of malware and we can plan the strategy to take down the malware [7]. In dynamic analysis as soon as various organization can benefit from dynamic analysis of malware forensics, because at certain point in life of a network administrator he/she has to encounter the type of malware affected and should take necessary steps to counter it [8]. This paper explains various spam located in various actors in everyday life.

3 Search Security Shield Tracking Technology

Basically, a shield jaunt software would permit workplace employees to put digital inspect by the side of a defend scouting. Inspect points are utterly organized through the workplace people with agile monitoring gadget, it prompts robotically when a protector comes to a definite place throughout their scouting. Like the forte is examined for that reason permit the gathering of unique facts. Later getting into inspection, protector can scan barcodes and QR codes with their app. The laptop routinely trace when a soldier test in at a precise spot, define the information is

efficiently convey even though the protector's laptop temporarily based on moment's it will lose service.

4 Proposed Methodology

The suggested task develops [9–11] proving the centre view outlines of client survey associations. The manufacture PCF, which is a compelling heuristic for perceive in no time restricted, centre vision foremost pops set up by the commentators when the with impressively crossing centre view occasions across brief timeframe entry-ways. The utilizing momentary components of remark time survey to characterize the suspect investigation floods bought by applications. As show that a common need to post at any rate certain criticism to counterbalance for an antagonistic audit, for an appeal which has a result. The regularly order appeals with "shaky" means examination, positioning, and establishment, [12, 13] just as applications with the slopes for asking acknowledgment. This work depends on then the thought that they ill-conceived and deceitful practices on application stages leaving the conspicuous signs aside discussed in [14–20].

Misrepresentation Rank Finder Fig. 3 carries out over 97% exactness in the discovery of malignant and the asking programs, and the 95% over the rightness the distinguishing proof of malware and generous usage.

Authentic exploit-influenced clients will record unfavorable the remarks have information. Fraud Rank Detector espies thousands of spiteful applications as showed in Fig. 3. In contrast to existing arrangements, the proposed framework builds up its exploration onto the discovering which illicit and destructive exercises on combine

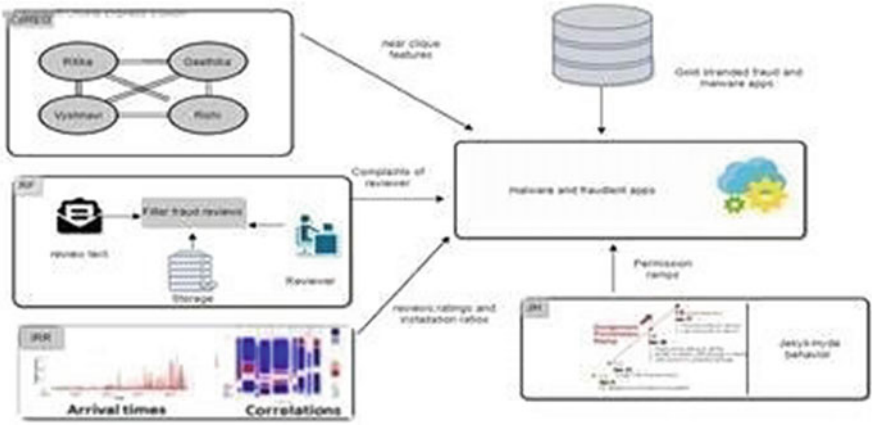

Fig. 3 Behavior of apps (different frames which are used to detects thousands of malicious reviews and ratings)

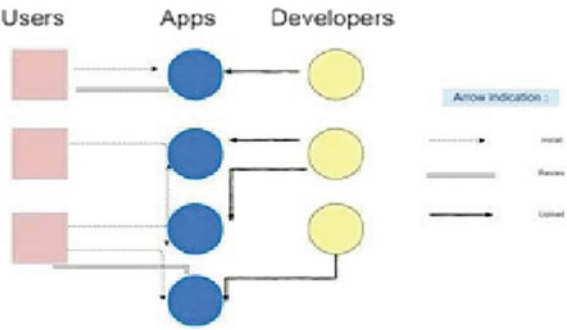

Fig. 4 System architecture

the versatile areas left away admonition actions. Which is a suggested framework reveals these terrible works by choosing these tracks.

5 Interface Architecture

1. Login or Register
2. Outline your account.
3. Explore applications and recommendations, by likes, given ranking 5, 4, 3 or 2
4. Appeal for symmetric key for application to download.
5. To download application symmetric key status should be permitted as shown in Table 1.
6. Steps executed by users, developers on apps as referred in Fig. 4.

6 PCF Algorithm Pseudocode

i. **Start**: for d: = 0' 'd < days.Size();d++
ii. Graph' 'PC: = new Graph();
iii. 'bestNearClique(PC, days[d])'
iv. c: = 1; n: = PC.size()';
v. for nd: = d + 1;d < days.size()& c = 1; d++'
vi. bestNearClique(PC,days[nd])'
vii. .c: =(PC.size() > n);endfor'
viii if (PC.size() > 2)'
ix. allCliques: = allCliques.add(PC); endfor'
x. return.
xi. functionbestNearClique(Graph PC, Set revs)'
xii. if (PC.size() = 0)'
xiii. .for root: = 0; root < revs.size();root++'
xiv. GraphcandClique: = newGraph();'

xv. candClique.addNode(revs[root].getUser());'
xvi docandNode: = getMaxDensityGain(revs);'
xvii. if (density(candClique{candNode}))'
xviii. candClique.addNode(candNode);'
xix. while(candNode! = null);'
xx. if (candClique.density() > maxRho)'
xxi. maxRho: = candClique.density();'
xxii. PC: = candClique;endfor'
xxiii. elseif(PC.size() > 0)'
xxiv. docandNode: = getMaxDensityGain(revs);'
xxv. if (density(candClique[candNode)))'
xxvi. PC.addNode(candNode);'
xxvii. while(candNode ! = null);'
xxviii. return
xxix. Stop.

In this mechanism, the Database server will check the current devices which have authenticated login details. Administrators can change privacy settings, access all personal files, and install the OS. Other than the administrators, management can also make changes to other accounts. Apps are added by the administrator during the portion. If the user tries to feature the app, the user should type application followed by the register toggle. Within website, the specifics are going to be found. Once when get through the performance of the application then view the details of the implementation device, consumers, the portal category, depiction. When admin tries for defraud those details will also effect on performance ID, Ethernet address (fraud), app name, mobile, program name. It repudiates or concedes user from connecting to another computer and networks.

7 Results and Discussion

To detect spam feedback, the paper introduces the classification criteria of a series of opinion spam detection based on the spammer's behavioral characteristics. Related reviews and related feedback from all reviews are then suggested to be remembered by two algorithms. This is highly perfect and had features of a effect: Increased accuracy in classifying fraud applications, the fraud classification detector achieves an accuracy of over 97%, thus more than 95 million validity in identifying fraud and harmless applications. Actual impact: Prove malware and provocations. Play store finds many fake applications. Consequently, to spot and recognize more kinds of malware, it is imperative to assemble a lot of performance that adds other wicked parts. Even though electronic device malware recognition stays tremendous challenge (Fig. 5).

Fig. 5 Fraud Detection Status (Status after blocking the user when he/she exceeds threshold limit)

8 Conclusion

This paper is proposed to acknowledge the malicious behavior such as misrepresentation in the application and make their rating/search rank zero. It also improves the performance by detecting the malware application and placing he apps with authorization. By Using the list that makes an interesting improvement in insurance if the malicious applications are hindered in the underlying download and evaluation phase.

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Image Security Algorithms—Proposed Methods and Critical Performance Analysis for the Best Fit

K. V. Anusuya and N. Navindran

Abstract In the modern age, most data transfers involve a variety of images. From social media to defense applications, the transfer of images plays a vital role. The characteristics such as the massive amount of data, high redundancy, and a strong correlation between every pixel in all directions demand image security, resulting in image encryption. The paper aims to improve the performance of AES by proposing a modified AES algorithm and improving the performance of ECC through a hybrid algorithm that combines ECC with an RGB pixel displacement algorithm. This paper critically analyzes the comparative performance of the proposed algorithms against the standard encryption algorithms such as RSA, ECC, AES, and PDA. The Root Mean Square Error, Peak Signal to Noise Ratio, Histogram analysis, Information entropy, rate of change of the number of pixels, Unified average intensity, correlation coefficient, Resistance to Noise attack analysis, and the encryption time analysis are the metrics used to analyze the performance of image encryption.

Keywords AES · ECC · Image encryption · PDA · RGB · RSA · Performance analysis

1 Introduction

In the era of modern communication systems, the demand for secured image transfer is expanded. Cryptography is proven to be an appropriate solution for secured electronic image transactions using efficient encryption techniques. The best-fit algorithm for image encryption needs to be finalized through performance analysis. In this paper, a modified Advanced Encryption Standard (AES) algorithm and a hybrid algorithm using Elliptic Curve Cryptography (ECC) and RGB Pixel Displacement Algorithm (PDA) are proposed and their performance is compared against Rivest

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Shamir & Adleman (RSA), ECC, AES, and PDA algorithms. The metrics such as Encryption time analysis, UACI, PSNR, RMSE, Shannon's entropy, and Correlation coefficient are used for critical performance analysis.

It is known that the ECC suffers from low resistance to noise attack and this is resolved by the hybrid technique of ECC with RGB-PDA algorithm. RGB Pixel Displacement Algorithm (RGB-PDA) is a symmetric key algorithm that uses the image as a key and hence the key size increases multi fold times, denying easy intrusion at the cost of enlarged encryption time. The hybrid encryption technique is tested for better efficiency in image security. Also, a modified AES algorithm using the Linear Congruential Generator (LCG) for random number generation for the seed value is proposed. Here, the keys used in all the rounds are made random and are not user-specified and hence the efficiency is significantly improved.

2 Literature Review

Paper [1] compares the performance of AES and RSA algorithms by testing the image encryption quality and analyzing through histogram, entropy, and correlation. The results of more converged columns in the histogram indicate the better encryption quality of AES over RSA. The Dynamic AES algorithm that makes use of a Dynamic S-Box is proposed [2] and it analyzes the gray-scale and color images. The operation of ECC is elaborately discussed in [3]. Its implementation incorporates a digital signature to ensure the authenticity and integrity of the received message. Paper [4] focuses on the RGB-PDA algorithm which is better suited for 3D/Color image-based applications. To ensure the confidentiality of 3D images during transmission on unsecured networks and at the storage, a Reality-Preserving Multiple-Parameter Fractional Hartley Transform (RPMPFRHT) technique is proposed in paper [5]. The simulations demonstrate its robustness against various attacks. Paper [6] makes use of AES in Cipher Block Chain (CBC) mode to control the image encryption time using the lookup table technique. Here, fast image encryption is assured.

Paper [7] exhibits an algorithm for generating pseudo-random number arrays, which has good cryptographic performance and application potential in block and stream encryption systems. The proposed compound Logistic-Tent system yields wider chaotic behavior. In Paper [8], the author analyzed the applications of elliptic curves in pseudo- random number generator, digital signature, and key agreement along with the merits and demerits of each application. In paper [9], the author proposed a digital image encryption technology based on the AES algorithm and performed the digital image processing, obtained the data that can use the AES encryption algorithm.

In paper [10], the author designed a cryptographically secured pseudo-random number generator that involves a permutation of the internal state. The author has performed several statistical tests with the permutation and proved that the statistical quality is increasing. In paper [11], a new pseudo-random number generator algorithm that uses a dynamic system clock converted to Epoch Timestamp as PRNG seed

is developed. The algorithm uses a Linear Congruential Generator (LCG) algorithm that produces a sequence of pseudo-randomized numbers that performs mathematical operations to transform numbers that can be used as seeds.

In Paper [12], the author proposed a color medical image encryption algorithm. This algorithm consisted of an image pixel shuffling step and an image pixel replacement step. The security of the proposed algorithm is stronger and the key space is also very large. In paper [13] three experiments are developed to examine the execution time of the processes of encryption and decryption and comparing the results together to elicit the improved points. In paper [14] author discussed a bidirectional diffusion-based image encryption-then-compression scheme and has got superior features over other existing schemes. The scheme offers enhanced security while transmitting images over an untrusted channel.

In Paper [15] author proposed a color image encryption algorithm based on 2D-CIMM chaotic map with higher security. The 2D-CIMMmap simulation outcomes show that it has a wide range of chaos.

3 Proposed Algorithms

The proposed algorithms (i) Hybrid encryption ECC-PDA algorithm and (ii) AES-LCG Algorithm, are compared with RSA, AES, ECC, and PDA algorithms.

Hybrid Encryption algorithm using ECC-PDA

In ECC, the elliptic curves principle is used to construct the keys that are generated through the elliptic curve Eq. (1), as the product of substantial prime numbers. Figure 1 shows the encryption-decryption process. Initially, the sender and the receiver are agreed upon elliptic curve E(a, b), whose points satisfying the Eq. (1) is generated and followed by the Diffie-Helman key exchange narrated in [8].

$$y^2 = x^3 + ax + b \tag{1}$$

The R, G, B components of the plain image and the key image are separated and the XOR operation is carried out. The resultant R, G, B components are combined to get the intermediate cipher and are further encrypted by ECC, using Eq. (2). Here P*m* is the prime image. In the encryption, User A utilizes the Public key of B, and the image is scrambled to obtain the resultant cipher image.

$$C_m = \{KG, P_m + kP_B\} \tag{2}$$

In the decryption process, the cipher image is unscrambled and then decrypted using Eq. (3), where M is equal to an intermediate cipher.

$$M = (P_m + kP_B) - (KG \times n_B) \tag{3}$$

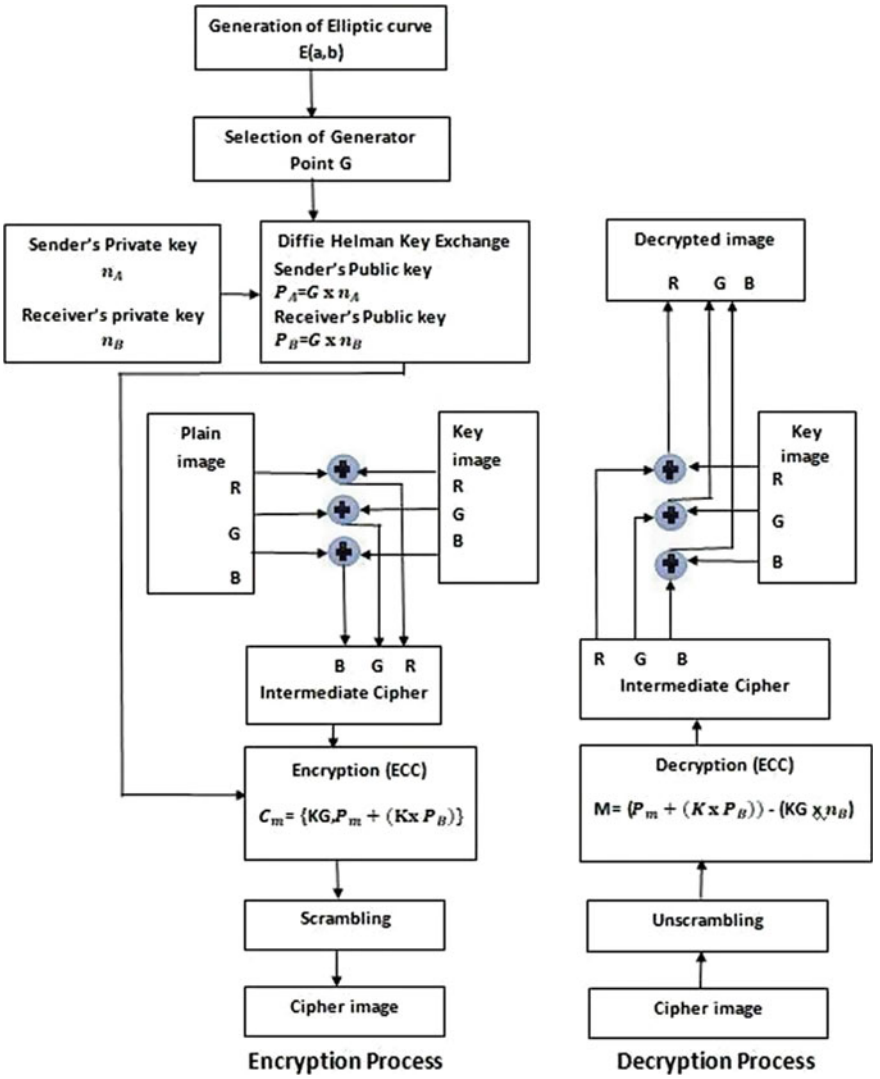

Fig. 1 Hybrid encryption algorithm: ECC with PDA

R, G, B components of M and the Key images are separated and XOR operation is performed. The resultant R, G, B components are combined to get the decrypted image.

AES-LCG Algorithm

AES encrypts the block of size 128 bits [6]. To improve the encryption efficiency, the Linear Congruential Generator (LCG) technique is incorporated to generate the Pseudo Random Number (PRN) in the proposed algorithm. The technique converts

the dynamic system clock into the Epoch timestamp and is used as the seed value. It mathematically translates the seed into deterministic random numbers, which are unrelated to the seed [11]. The updated features are compared with AES and shown in Fig. 2. X_n is the Dynamic Date and time converted into Epoch Time Code.

$$X_n + 1 = (aXn + c) \bmod m \tag{4}$$

Linear Congruential Generator. Random number generators are widely used in cryptography [7] and LCG is a technique that yields the sequence of Pseudo-random numbers. This method generates a sequence of integers X_1, X_2, X_3 between zero and m-1 [10], according to the recursive relationship given in Eq. (4).

$$X_{n+1} + 1 = ({}_aX_n + c) \bmod m \tag{5}$$

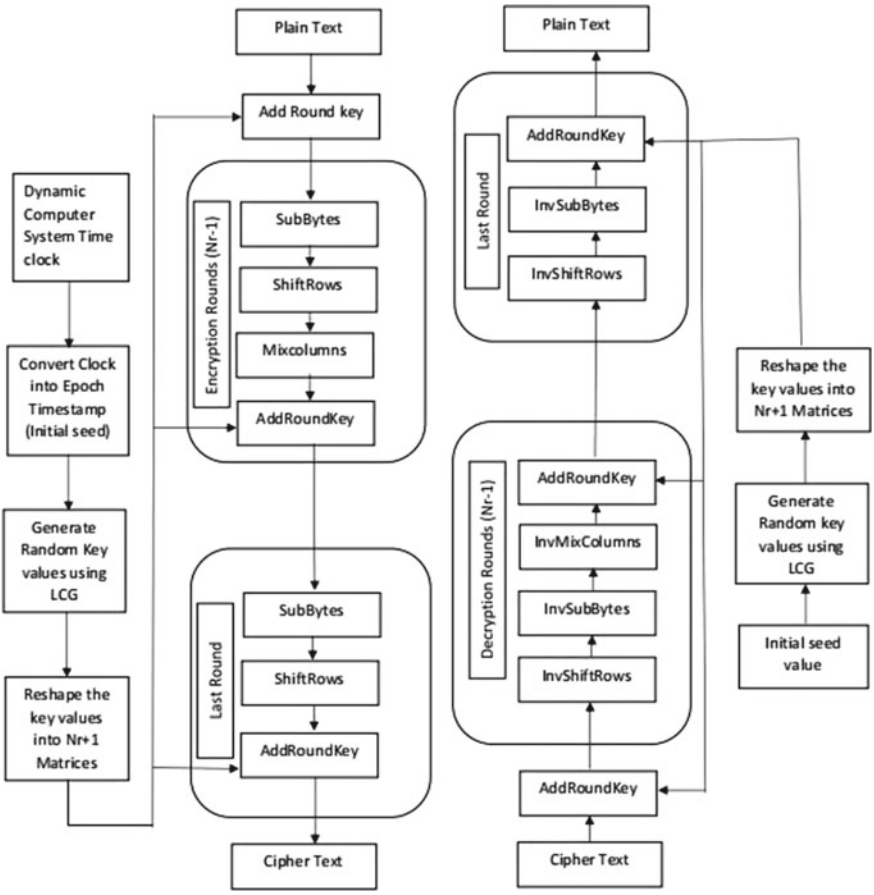

Fig. 2 AES Algorithm Vs AES-LCG algorithm

where,

Seed = Initial value of X_n

a = Constant multiplier

c = An incremental value and m = Modulus

The operation at the sender and receiver of the proposed AES-LCG algorithm is given below.

AES-LCG Algorithm
Transmitter
1.Convert the system time clock into Epoch time stamp and assign it as the Seed Value
2.Assign the size of a round key as 128 bits (Nrrounds of AES require Nr + 1r ound keys)
3.Assign each round key as a 4 × 4 matrix
4.Calculate xn + 1from Eq. (4)
5.Iterate Eq. (4) into 176 times and obtain 176 Random values
6.Reshape the random values into 11 matrices of size 4 × 4
7.Assign each matrix with 16 random values and each number occupying 8 bits
8.Assign each round key with the size of 128 bits and each element value ranging from 0 to 255
9.Make use of the round keys in the round operations of AES
10.Perform the operations—Add round key, Byte substitution, Shift row, and Mix column and obtain the resultant Cipher image
11.Transmit the Cipher Image along with the Seed value
Receiver
1.Generate the random key value using LCG and then reshape them into round keys
2.Repeat steps from 4 to 9
3.Perform the operations—Add round key, Inverse shift rows, Inverse substitution bytes, Inverse Mix column operations and obtain the decrypted, original image

In this algorithm, the Seed X_n is an Epoch time derived from the dynamic date and time. The m and c values dictate the output quality. For the value of a = c = 1, a simple modulo-m counter having a non-random, long period is generated. To generate the random sequence, the three requirements, referred to as the Hull-Dobell theorem is followed.

Epoch Timestamp. The Epoch timestamp is the number of seconds that have elapsed since 1st January 1970 (midnight UTC/GMT), without counting the leap seconds. Epoch/Unix Time Timestamp: 1,611,462,911 in time zone IST is equivalent to human readable date and Time: Wednesday, January 24, 2021, at 10:05:11 am [11].

4 Implementation and Performance Analysis

The tool used for implementation is MATLAB 2020b. The computing systems used for encryption time analysis have the following configuration.

System A: 2.5 GHz CPU, 4 GB RAM with Windows 10 OS.

System B: 3.4 GHz CPU, 8 GB RAM with Windows 10 OS.

Samples

Four samples are considered as plain images and are shown in Fig. 3 with their features illustrated in Table 1.

Performance metrics

The algorithms coded in MATLAB consider the sample images as input and the encrypted images as output. The performance of the algorithms is analyzed using the following quality metrics.

Root Mean Squared Error (RMSE). RMSE indicates the difference (contrast/error) between the plain and cipher images. It notifies the extent to which the image is altered due to the change in information and is calculated as per Eqs. 6 and 7. Here, S and C values refer to plain and cipher images. And, N and M values hold the resolution of these images.

$$MSE = 1/MN \sum_{x=1}^{M} \sum_{y=1}^{N} (S_{xy} - C_{xy})^2 \tag{6}$$

$$RMSE = \sqrt{MSE} \tag{7}$$

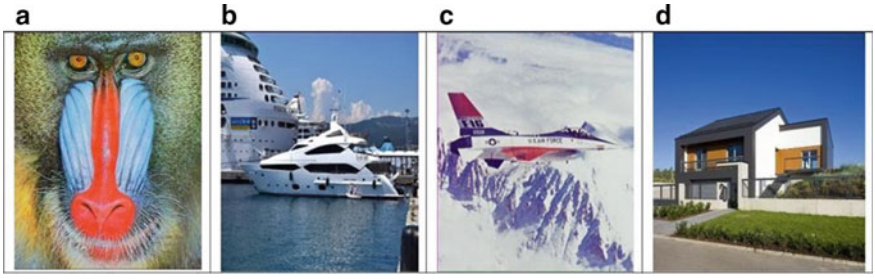

Fig. 3 Sample images: **a** Mandrill, **b** Ship, **c** Airplane, **d** modern home

Table 1 Feature comparison of input sample images

Features	Sample 1 Mandrill	Sample 2 Ship	Sample3 Airplane	Sample 4 Modern home
Input dimension	512 × 512 × 3	800 × 1200 × 3	512 × 512 × 3	800 × 800 × 3
Size in bytes	786,432	2,880,000	786,432	1.920,000
Image format	JPG	JPG	PNG	JPG
Data type	Unsigned integer	Unsigned integer	Unsigned integer	Unsigned integer
Bits per pixel	8 Bits	8 Bits	8 Bits	8 Bits

Peak Signal to Noise Ratio (PSNR). PSNR is a function of the highest pixel value in both plain and encrypted images. It measures the distortion in the image after encryption and is given in Eq. (8).

$$PSNR = 10\log_{10}\left(C^2_{\max}/MSE\right) \tag{8}$$

Correlation Coefficient (CC). The correlation coefficient determines the relationship of two adjacent pixel values in an image. The value $+1$ or -1 ensures a very close, linear relationship between the pixels of plain and cipher images [2].

Information Entropy. Shannon's Information entropy reflects the uncertainty of pixel values. It identifies the diversity that exists among the adjacent pixels of an image [2]. The entropy values of cipher images are slightly more than that of plain images (almost close to 8).

Number of Pixels Change Rate (NPCR). NPCR is the change rate of the cipher image pixels when the image changes a pixel in the encryption process [2]. The higher the value, the stronger is the encryption algorithm and has a high resistance to plaintext attack. It is calculated as per Eq. (9).

$$NPCR = \sum_{(i,j)}(D(i,j)/(M * N)) \times 100 \tag{9}$$

where,

$$D(i,j) = 0, \quad if \quad S(i,j) = C(i,j)$$
$$D(i,j) = 1, \quad if \quad S(i,j) \neq C(i,j)$$

S(i, j) and C(i, j) refer to the plain image and cipher image respectively.

Unified Average Changing Intensity (UACI). UACI is the change rate of the average strength of the original image and the encrypted image [2]. The higher value insists upon a stronger encryption algorithm and offers high resistance to differential attacks. It is guided by Eq. (10).

$$UACI = 1/M * N\left(\sum_{(i,j)}((S(i,j) - C(i,j))/255)\right) \times 100 \tag{10}$$

5 Results Analysis

Tables 2, 3, 4, and 5 demonstrate the comparative results of RSA, ECC, AES, PDA, with the proposed algorithms—AES-LCG and ECC-PDA techniques.

Table 2 Comparative performance of algorithms for Sample 1

Parameters	RSA	ECC	AES	PDA	AES-LCG	ECC-PDA
RMSE	25.5748	10.667	5.2265	5.3509	5.2277	4.8767
PSNR (dB)	6.931	9.7341	21.921	21.972	21.972	23.979
Shannon's Entropy	7.7563 (P)	7.7563 (P)	7.7563 (P)	7.7563 (P)	7.7563 (P)	7.7563 (P)
	5.0443 (C)	7.7032 (C)	7.3519 (C)	7.9930 (C)	7.9931 (C)	7.8691 (C)
UACI (%)	0.0448	23.827	27.2125	28.2284	32.151	29.3263
NPCR (%)	99.9481	99.945	99.3992	99.4026	99.407	99.8160
CC	0.004749	1	0.0027	0.0171	0.0012865	0.00053
Time (s)	A: 0 0.06319	A: 0.1327	A: 4.9321	A: 0.410915	A: 4.893100	A: 0.539812
	B: 0.04820	B: 0.0942	B: 3.9543	B: 0.392153	B: 3.76913	B: 0.443571

Table 3 Comparative performance of algorithms for Sample 2

Parameters	RSA	ECC	AES	PDA	AES-LCG	ECC-PDA
RMSE	24.9648	11.743	7.8455	7.7778	7.8359	3.7191
PSNR (dB)	7.031	15.762	23.3863	23.863	13.863	23.979
Shannon's entropy	6.6639 (P)	6.6639 (P)	6.6639 (P)	6.6639 (P)	6.6639 (P)	6.6639 (P)
	5.0529 (C)	6.9529 (C)	6.6035 (C)	7.9083 (C)	7.998 (C)	6.7025 (C)
UACI (%)	4.1423	26.213	28.138	23.7234	32.237	23.3863
NPCR (%)	100	99.605	99.544	99.599	99.6445	99.994
CC	0.0072	1	0.084	−0.0094	0.001838	0.0121
Time (s)	A: 0.20542	A: 4.86223	A:0.38665	A: 4.71386	A: 0.467480	A: 0.07274
	B: 0.05342	B: 0.19452	B: 2.56783	B:0.25034	B: 4.12841	B: 0.391425

Table 4 Comparative performance of algorithms for Sample 3

Parameters	RSA	ECC	AES	PDA	AES-LCG	ECC-PDA
RMSE	19.1984	12.764	4.9335	4.8761	4.9751	4.0673
PSNR (dB)	7.78	21.592	23.026	23.979	23.026	25.098
Shannon's entropy	7.7070 (P)	7.7070 (P)	7.7070 (P)	7.7070 (P)	7.7070 (P)	7.7070 (P)
	5.0376 (C)	7.8376 (C)	7.4494 (C)	7.9705 (C)	7.8521 (C)	7.9465(C)
UACI (%)	10.33	21.24	29.554	29.3240	28.653	32.632
NPCR (%)	99.706	100	99.468	99.639	99.471	99.9176
CC	0.0480	1	0.09	-0.0063	0.0017419	−0.5344
Time (s)	A: 0.01634	A: 0.1569	A: 5.4569	A: 0.6156 B	A: 6.19340	A: 0.59654
	B: 0.00943	B: 0.1176	B: 4.9672	: 0.6012	B: 4.90512	B: 0.50812

Table 5 Comparative performance of algorithms for Sample 4

Parameters	RSA	ECC	AES	PDA	AES-LCG	ECC-PDA
RMSE	23.6719	18.1362	4.4560	4.8720	4.4518	4.3896
PSNR (dB)	10.986	7.8213	25.649	23.979	25.649	25.649
Shannon's entropy	7.8317 (P)	7.8317 (P)	7.8317 (P)	7.8317 (P)	7.8317 (P)	7.8317 (P)
	5.0406 (C)	7.8521 (C)	7.3937 (C)	7.9866 (C)	7.9972 (C)	7.9391 (C)
UACI (%)	13.3082	22.1498	27.7868	29.3082	28.316	28.5564
NPCR (%)	99.8231	100	99.2231	99.5541	99.481	99.4891
CC	−0.0561	1.000	0.0921	−0.0128	0.00049325	−0.2548
Time (s)	A: 0.01716	A: 0.09275	A: 4.09275	A: 0.55383	A: 5.91863	A: 0.568658
	B: 0.01167	B: 0.09443	B: 2.94591	B: 0.49109	B: 4.98031	B: 0.448019

6 Inference

From the results, it is observed that the RSA algorithm yields better performance in encryption time, correlation coefficient analysis, and NPCR. It takes very little time for a randomly taken plain image (ship) which is 0.01634 s. But it suffers from low resistance to Noise attack analysis. For the sample 'Air plane', the percentage of change after decryption of noise added image is 34.55% and is the demerit for real-time communication. By attaining 100% NPCR, the ECC confirms that it modifies all the pixel values of the plain image. The Correlation coefficient as 1 indicates the positive correlation between the plain and encrypted images and a value close to 0 indicates the linear relationship among them. PDA algorithm attains a negligible percentage of difference among the decrypted image and its noise added version. Hence, it is suitable for real-time communication. A very low percentage of 0.015% is obtained for the ship image. Further, a greater value of entropy is provided for cipher images. Ideally, the entropy of the encrypted image is 7.9930 for the 'Mandrill' image and is the maximum among all other input images. Also, its value of UACI is found to be more than 20. But it consumes with little longer encryption time.

However, the ECC-PDA has improved the UACI value for all sample images and the encryption time is a little longer (0.59654 s) for sample 3 image. For the AES algorithm, the entropy value remains almost the same. However, it yields better results for RMSE, PSNR, NPCR, and UACI for all four samples. The UACI value of the AES- LCG algorithm has tremendously achieved 32.151% for sample 1 and 32.237% for sample 2.

7 Conclusion

The simulation and performance analysis of the proposed image encryptionalgorithms AES-LCG and ECC-PDA against the existing cryptographic algorithms—RSA, ECC, AES, and PDA are carried out using MATLAB. The quality metrics used for the evaluation of algorithms are RMSE, PSNR, UACI, NPCR, Correlation coefficient, information entropy, and Encryption time with four sample images. The algorithms are critically analyzed and the results are tabulated and inferred. The improvement in metrics could be planned in future experiments and with further analysis.

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Impact of Contextual Segments in the Prediction of Overall User Gratification in Asian and European Continental Hotel Tourism Sector

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Abstract User overall gratification is vital and is considered a vital objective in the tourism sector. Context-aware recommender systems are one of the power sources to find a user's gratification most simply among all recommender systems. The role of contextual segments plays a significant portion in predicting a user's future gratification in hotel sector tourism based on hotel classes and trip-types. The weight of each context tells about the importance of overall gratification. This paper explores the significant contexts that cause the overall gratification in Asian and European continental hotels also predicts user's gratification levels upon user stays.

Keywords Context-aware recommender systems · Gratification · Hotel class · Overall gratification · Trip-type

1 Introduction

The tourism and travel sector transformed into a new study with vast web information [1]. Online booking platforms and travel web domains are the primary sources for information gathering before making a trip [2]. Reviews and ratings of various tourism services provided by the user community are valuable information sources before planning a trip. In contrast to many e-commerce domains that allow users to rate objects, recent travel platforms capture users' post-trip feedback on hotel accommodation in multiple dimensions in a more fine-granular approach using multi-criteria recommender systems [3, 4]. These systems permit the user to know the pros and cons of a specific hotel in a simple fashion, not to spend much time reading about text reviews before making a trip. The information extracted from a user is a valuable source to recommend hotels in the hotel sector tourism. The hotels in the continents of Asia and Europe have a significant role in e-tourism by offering various tourism packages around the clock. After the unexpected CORONA pandemic, the

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hotel sector business on its knees, specifically in these two continents. Attracting and recommend the hotels to the users is now in these problematic situations is a big hurdle for the travel platforms. Users are not bothered about all the conceptual segments and seek some of the things at feedback times. This study identifies those contexts in which the user is interested and leads to high overall satisfaction levels upon different hotel class segments and trip-types. This work also helpful for the travel segments to identify future user gratification.

The multi-facet opinion of a single user is predominant for other users' perspectives; also, travel providers use this to exploit several concerns. First, the rating dimensions concerning the relative significance of different hotel-classes, trip-types on the overall user gratification at the continent level can be analyzed. These results help traveler providers forecast overall ratings, identify the dimensions that significantly impact users' overall satisfaction, and meet their target users' expectations to better their service on different views or service changes.

Many e-commerce domains include recommender systems that help online users find relevant and interesting things within an extensive large assortment of products [5]. These systems use rating information to rank the options after filtering from a large repository automatically. Collaborative filtering is a popular class of recommenders, making recommendations to the user upon the unseen items by finding relevance from the larger user community's items' ratings. With multi-criteria recommenders, current tourism and travel platforms have more detailed information on a user's preferences, which is useful in the recommendation process than only single overall ratings [6, 7].

This paper starts with a verifiable survey of data gathered from a popular travel website, giving us a new perception of relative dissimilar rating criteria' importance. This paper also presents a new approach in predicting the overall gratification of a user better manner. Earlier studies limit few segments in finding traditional user behavior on hotel accommodation [2, 8].

This study first analyzes multiple contextual segment ratings and digs more in-depth to find user interests and forecast user overall satisfaction level with available quality factors using the TripAdvisor dataset on different hotel-categories and trip-types both in Asian and European continental tourism cities. These results exhibit notable variations among the contextual segments, useful for future studies of the tourism offerings in adopting segment-wise travel or tourism information systems.

Our approach significantly estimates user- and item-specific importance weights and figures out significant features, useful for forecasting user gratification levels from different quality factors through linear regression with the item-item collaborative filtering approach. These assessments help traveler platforms for adopting new recommendation techniques serve better in user view.

Organization of paper

1. Introduction
2. Analysis of contexts
3. Results
4. Conclusion
5. Future work

2 Analysis of Satisfaction Contexts

This section will identify particular quality dimensions that impact the overall assessment of different individual customer groups with TripAdvisor's Dataset [9, 10].

2.1 Data Set Extraction and Customer Segments

This study analysis was on the TripAdvisor platform's information carries a rating, demographic information, and contextual segments, including user trips. The Dataset was Collected from 59 global tourism city hotels, from 38 cities in Asia, and 21 from Europe through web crawling, which encompasses ratings of 30,405 users of recent reviews.

Users on TripAdvisor.com can rate six different hotel dimensions: cleanliness, location, a value within budget, quality of rooms, sleep, and services about overall quality. A uni-dimensional rating also provides by a user for a rating of a hotel about overall satisfaction.

2.2 Feedback Recommendation with Multidimensional Rating

This paper's theme is not limited to finding potential contexts but predicts future overall gratification based on item-specific weights in the following manner.

In this study, overall user rating is the dependent variable and the contexts service, value, rooms, location, cleanliness, and sleep-quality as predictors among the Dataset's contextual segments. Here, the first Analysis of Variance was applied between the Depend and Independent variables to find significant mean differences; also, Variance Impact Factor was checked among predictors to find any autocorrelation. Fortunately, all of our predictors do not exhibit any multi-collinearity [11, 12]—the ordinary least squares (O.L.S) method used to estimate significant contexts item weights.

3 Results

From Tables 1, 2, 3, 4, 5 and 6, the contextual segment weights differ with hotel classes and trip-types both in Asian and European continental cities. Therefore, this study concludes that all contextual segments do not play an equal role in the user's overall gratification.

Table 1 A-priori segments of hotel classes-5 and 4 in Asia

A-priori segments	Segment 1: Class 5 overall			Segment 2: Class 4 overall		
Quality domains	Beta	T-value	V.I.F (Variance Impact Factor)	Beta	T-value	V.I.F (Variance Impact Factor)
Cleanliness	0.1704	10.197	**1.515375**	0.1155	8.077	**1.4918007**
Location	0.1207	7.463	**1.392366**	0.105	7.67	**1.282241**
Value	0.1936	12.202	**1.45519**	0.1817	13.294	**1.47066**
Rooms	0.1492	9.258	**1.506433**	0.1726	12.185	**1.464342**
Service	0.2983	20.167	**1.517058**	0.3343	25.714	**1.637763**
Sleep_quality	0.1466	8.888	**1.404399**	0.1581	11.385	**1.424456**

Table 2 A-priori segments of hotel classes-3 and 2 in Asia

A-priori segments	Segment 3: Class 3 overall			Segment 4: Class2 overall		
Quality domains	Beta	T-value	V.I.F (Variance Impact factor)	Beta	T-value	V.I.F (Variance Impact Factor)
Cleanliness	0.1405	8.698	**1.412385**	0.133	3.515	**1.360076**
Location	0.0876	5.499	**1.230745**	0.128	3.577	**1.137103**
Value	0.1579	10.164	**1.39009**	0.1379	3.856	**1.227967**
Rooms	0.148	8.932	**1.365751**	0.2301	6.433	**1.354576**
Service	0.357	26.183	**1.62957**	0.2685	8.185	**1.81633**
Sleep_quality	0.1662	10.322	**1.334783**	0.2244	5.93	**1.195082**

Table 3 A-priori segments of hotel classes-5 and 4 in Europe

A-priori segments	Segment 1: Class 5 overall			Segment 2: Class 4 overall		
Quality domains	Beta	T-value	V.I.F	Beta	T-value	V.I.F
Cleanliness	0.1333	4.045	1.394109	0.0937	6.186	1.355089
Location	0.1368	4.191	1.382018	0.1264	8.989	1.213363
Value	0.0721	2.297	1.322176	0.1855	12.835	1.417427
Rooms	0.0749	2.285	1.344205	0.1592	10.746	1.43251
Service	0.3333	11.221	1.548008	0.3489	28.553	1.578125
Sleep_quality	0.1685	5.174	1.368021	0.1441	10	1.347188

Table 4 A-priori segments of hotel classes-3 and 2 in Europe

A-priori segments	Segment 3: Class 3 overall			Segment 4: Class 2 overall		
Quality domains	Beta	T-Value	V.I.F	Beta	T-Value	V.I.F
Cleanliness	0.0897	7.375	1.31831	0.0492	2.222	1.338902
Location	0.0944	7.964	1.195623	0.0724	3.151	1.194118
Value	0.1518	12.963	1.427314	0.1051	5.065	1.51772
Rooms	0.1952	16.613	1.427107	0.2674	12.997	1.477411
Service	0.4544	43.949	1.649291	0.4895	25.322	1.710997
Sleep_quality	0.1782	15.909	1.361469	0.2301	10.913	1.351807

Table 5 A-priori segments of Business Trips in hotel classes 5 and 4 in Asia

A-priori segments	Segment 1: Class 5 Business			Segment 2: Class 4 Business		
Quality domains	Beta	T-value	V.I.F	Beta	T-value	V.I.F
Cleanliness	0.1955	7.19	1.656546	0.1504	4.845	1.536968
Location	0.1366	5.006	1.342008	0.0744	2.516	1.314359
Value	0.2054	8.033	1.576162	0.2333	8.078	1.558339
Rooms	0.1388	5.062	1.636147	0.1502	4.74	1.614619
Service	0.3473	14.537	1.528422	0.3238	11.542	1.569944
Sleep_quality	0.1842	6.874	1.482831	0.1703	5.46	1.593478

Table 6 A-priori segments of Business Trips in hotel classes 5 and 4 in Europe

A-priori segments	Segment 1: Class 5 Business			Segment 2: Class 4 Business		
Quality domains	Beta	T-Value	V.I.F	Beta	T-Value	V.I.F
Cleanliness	–	–	1.327052	0.1888	4.412	1.398615
Location	–	–	1.396314	0.1495	3.69	1.351421
Value	2007	2.129	1.505284	0.1076	2.821	1.442576
Rooms	–	–	1.417012	0.1739	4.478	1.429228
Service	0.3184	3.491	1.375338	0.3962	11.888	1.446472
Sleep_quality	0.2621	2.822	1.273297	0.1831	4.782	1.37395

Tables 7 and 8 show the predicted overall rating of the business sector in Asian and European hotel class-2 upon significant context weights (Figs. 1 and 2).

Table 7 The predicted overall rating of business class-2 in Asia

S. No.	Actual overall rating	Predicted overall rating
1	5	5
2	5	4
3	5	5
4	5	4
5	5	3
6	5	5
7	5	5
8	4	4
9	5	4
10	5	5

Table 8 The predicted overall rating of hotel class-2 in Asia

S. No.	Actual overall rating	Predicted overall rating
1	4	5
2	4	3
3	4	5
4	5	5
5	5	5
6	2	3
7	4	3
8	5	5
9	5	5
10	4	5

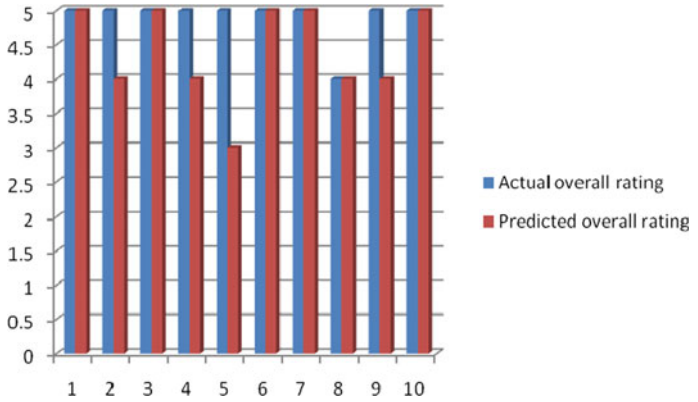

Fig. 1 The predicted overall rating of business class-2 in Asia

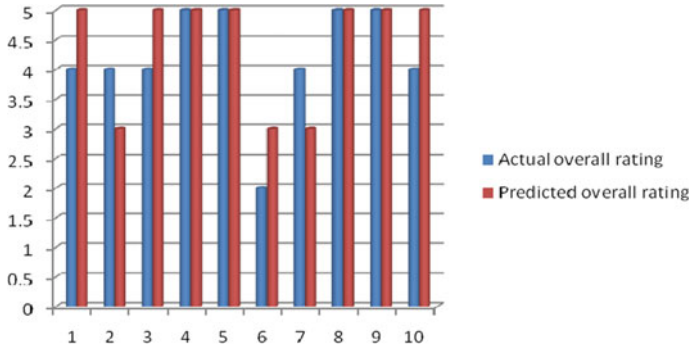

Fig. 2 The predicted overall rating of Hotel class-2 in Asia

4 Conclusion

The role of traveler recommender systems is vital now after this post-COVID-19 pandemic since user expectations change from location to location. This study concentrates on the importance of contextual segments that cause the high overall gratification in hotel sector tourism in hotel classes and trip-types both in Asian and European continental tourism cities. Our study indicates that the role of a contextual segment changes not only based on hotel class but also trip-types.

5 Future Work

This study limits to focus on only Asian and European continents. In the future, some other continental hotel sector contextual segments should be analyzed to find their role in overall user gratification.

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Heart Disease Prediction with Machine Learning Approaches

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Abstract Heart is the most imperative or integral component of our body. Heart is used to preserve and conjugate blood in our body. There are a lot of instances in the world associated to coronary heart diseases. People are main to dying due to coronary heart disease. Various signs like chest pain, fasting of heartbeat and so on are mentioned. The fitness care industries located a massive quantity of data. This paper offers the notion of predicting coronary heart disorder the use of laptop gaining knowledge of algorithms. Here, we will use quite a number computer mastering algorithms such as aid vector classifier, random forest, KNN, Naïve-Bayes, selection tree and logistic regression. The algorithms are used on the foundation of elements and for predicting the coronary heart disease. This paper makes use of distinct computing device studying algorithms for evaluating the accuracy amongst them.

Keywords Coronary artery disease · Decision tree · K nearest neighbour · Machine learning · Support vector · Accuracy · Logistic regression · Naïve Bayes

1 Introduction

Heart sickness is a time period that damages our fitness badly. Every 12 months too many humans are demise due to coronary heart disease. Due to the weakening of coronary heart muscle, coronary heart disorder can be occur. The coronary heart ailment can be described as the breaking of coronary heart to pump the blood [1]. Coronary artery disorder or Coronary coronary heart sickness is the some other time period for coronary heart disease. (Coronary artery disease) CAD can occur due to inadequate blood furnish to arteries.

Most frequent symptoms of coronary heart assault are:

- Chest pain.
- Shortness of breath.
- Sweating and Fatigue.

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- Nausea, Indigestion, Heartburn, or Stomach pain.
- Pressure in the higher again ache that spreads to an arm.

Types of coronary heart ailment are:

- Coronary artery sickness (CAD).
- Angina pectoris.
- Congestive coronary heart failure.
- Cardiomyopathy.
- Congenital coronary heart disease.

On the groundwork of above factors, this paper offers the exceptional attempt to predict the threat of coronary heart disease. Related to coronary heart ailment prediction, a big quantity of work has been finished the usage of computing device gaining knowledge of algorithms through many authors. The purpose of this paper is to attain higher accuracy so that it can predict the possibilities of coronary heart attack. The affected person hazard stage is categorized the use of information mining methods such as K nearest neighbour, Decision tree, Random forest, Support vector classifier, Logistic Regression and Naïve Bayes. Some hazard elements are: Age, Sex, Blood pressure, Cholestrol, Chest Pain, Heart charge and so on.

In this paper, the supervised desktop mastering idea is used for making the predictions. The number computing device getting to know algorithms such as knn, random forest, aid vector machine, choice tree, Naïve Bayes, and logistic regression are used to make the predictions the use of coronary heart disorder dataset [2].

2 Related Work

Amandeep Kaur [3] it's a contrast study done on synthetic neural network, Tree, K-nearest neighbour, Naïve-Bayes and Support Vector computing device on coronary heart disorder prediction. Thomas and Theresa Princy [4] proposed a study on K nearest neighbour algorithm, Decision Tree, neural network, Naïve-Bayes and selection tree for coronary heart disease prediction. They used records mining methods to realize the coronary heart disorder hazard rate. Monika Gandhi et al. [5] used Naïve- Bayes, DT and neural community algorithms and analyzed the clinical dataset. There are a big wide variety of points involved. So, there are certain points and limits to be used for limiting variety of features. This can be achieved with the aid of characteristic selection. On doing this, they say that time is reduced. Kaur and Prabhsharn Kaur [6] have confirmed that the coronary heart disorder information includes unnecessary, reproduction information. This has to be pre-processed. Nikhar et al. [7] has proposed a work on Heart attack and Heart Disease Prediction Using Machine Learning Algorithms the use of selection tree classifier and Naïve Bayes methods. Santhana Krishnan et al. [8] has written paper that predicts coronary heart sickness for male affected person the usage of classification techniques. Chaim et al. [1] proposed a feature extraction mining technique, which will improve

the predication rate of CVD in combination of various classifier for early detection of heart attacks. Swathi et al. [9] devised a distribution method to classify unbalanced raw dataset which are applied for samples, SVM and sampling techniques are used for prediction of heart disease. Benjamin et al. [2], proposed an automated system of prediction of heart attack on real time dataset. This work is based on big data analytics. Amin et al. [10] aim of their work is to propose predication type of models, which combines various combinational features of 4 classifiers, which will improve the prediction accuracy of CVD.

3 Methodology

In this paper, we have used our dataset for making use of unique computer mastering algorithms for figuring out if a character has coronary heart disorder or not. Then, we will take care of the lacking values in the dataset, visualize the dataset and examine the accuracy received by using extraordinary computer studying algorithms. The laptop mastering algorithms used are described below.

Data Collection

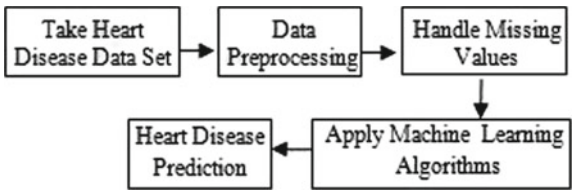
We have collected datasets from various source as well as, the dataset are lively obtained from the Cleveland Heart Disease database at UCI Repository. There are 14 attributes in the dataset.

The description of dataset is given as follows:

1. Age: describes the age of a person.
2. Sex: describes the intercourse of a person; 1 for male, zero for female.
3. Cp: describes the chest ache kind in a individual (1 for angina, two for a ordinary angina, three for non-angina, four for asymptomatic).
4. Trestbps: describes the resting blood pressure.
5. Chol: describes the serum cholesterol.
6. FBS: describes the Fasting Blood Sugar (1 for genuine and zero for false).
7. Restecg: describes the resting electro-graphic results (zero for normal, 1 for ST-T wave abnormality, two for left ventricular hypertrophy).
8. Thalach: describes the most coronary heart rate.
9. Exang: describes the exercising brought about angina
10. Oldpeak: describes the melancholy raised via exercising relative to rest.
11. Slope: describes the slope of the top workout ST section (1 for up sloping, two for flat, three for down sloping).
12. Ca: describes the wide variety of blood vessels.
13. Thal: describes thal characteristic (3 for normal, 6 for constant defect, 7 for reversible effect).
14. Target: describes the goal classification (0 for no coronary heart disease, 1 two three four for having coronary heart disease).

Data overview
Detect and remove outliers
Detect and impute missing data
Data enhancement using random number generators
Applying suitable normalization techniques
}
Step 2: Model Selection
{
Understanding data value (classes)
Machine learning model selection
}.
Step 3: Model Implementation using Rapid Miner
{
Import Data
Implementing all models together using Rapid Miner
}
Step 4: Performance Measurement
{
Calculate Accuracy using "Performance" operator
Analyzing the result through Confusion Matrix
}
Step 5: Result Comparison
{
Comparing the accuracy among all models
Comparing the result with previous work
Calculate final output
}

Flow Diagram



4 Results and Discussion

Correlation Matrix

Let's see the correlation matrix of features. From this graph, we can have a look at that some elements are exceptionally correlated and some are not (Fig. 1).

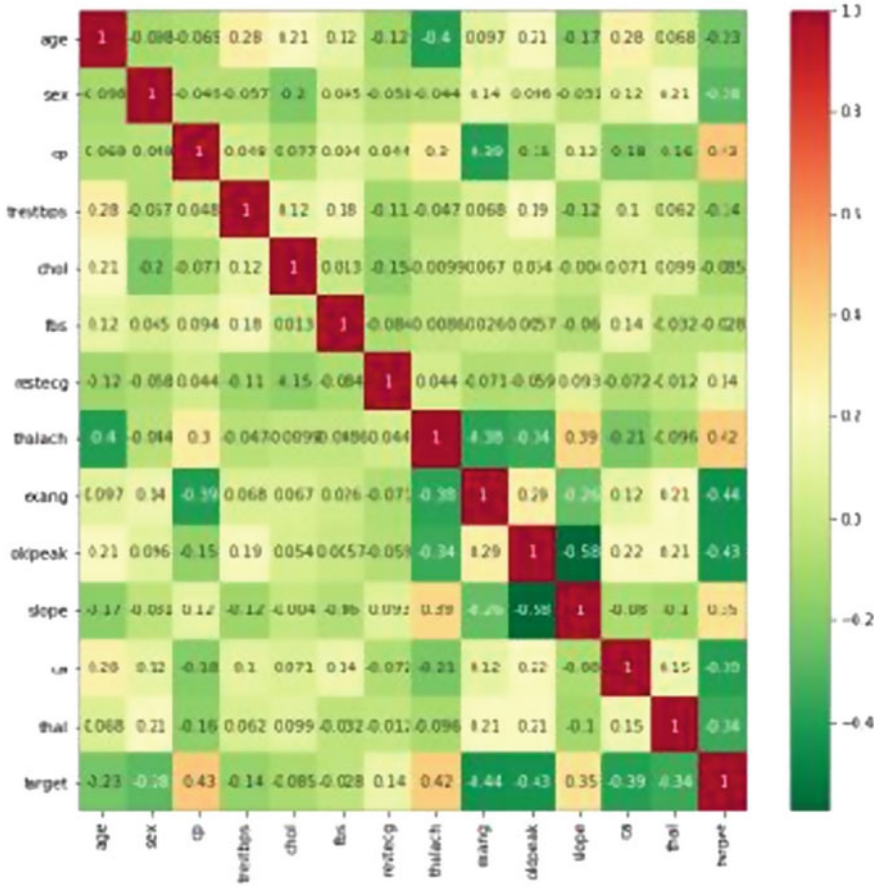


Fig. 1 This figure shows the correlation matrix

Histogram

The histogram is quality and effortless way to visualize the records due to the fact it solely takes a single line of code to make the plots. Let's take a seem at the plots. Before making use of any laptop getting to know algorithms we will have to seem to be for specific variables. The goal category is used for describing whether or not a man or woman is having coronary heart sickness or not [11–15] (Fig. 2).

Exploratory Data Analysis

Exploratory Data Analysis (EDA) is a strategy to analyze the records units to describe their predominant highlights the use of visible methods. There are many one-of-a-kind techniques to conducting exploratory statistics evaluation out there, so it can be challenging to understand what evaluation to function and how to do it properly. EDA, characteristic selection, and function engineering are regularly tied collectively and are necessary steps in the computer getting to know journey.

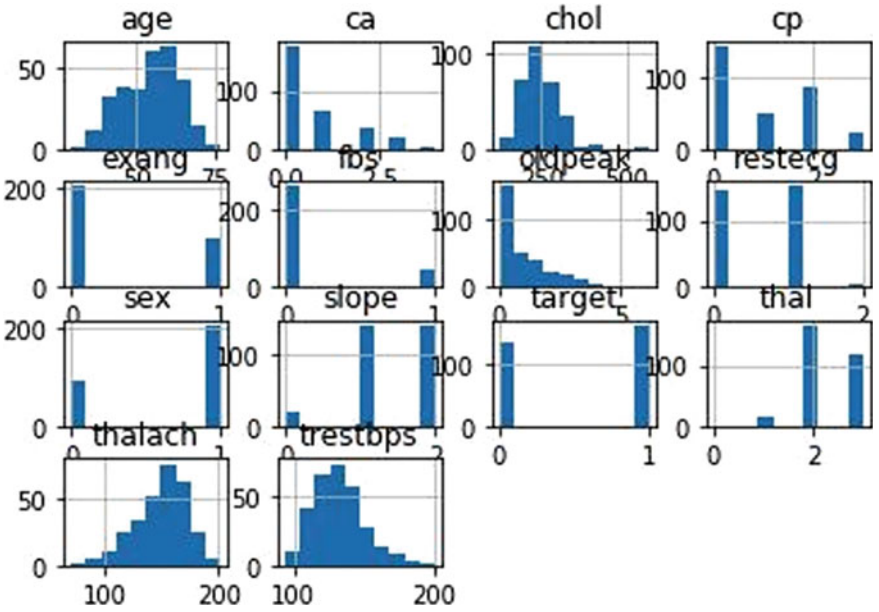


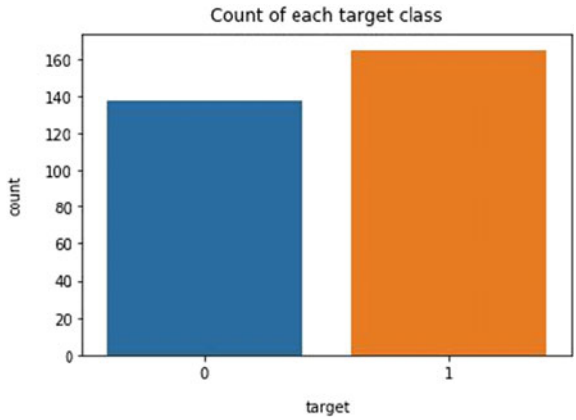
Fig. 2 This figure shows the histogram

Bar plot for goal classification with specific features

It is very necessary that the dataset we are the use of need to be pre-processed and cleaned. This layout suggests the depend of every goal class (Fig. 3).

The above graph shows the distribution of target versus count class that is used to identify or predict the total number or type of state in heart disease whether someone has heart- disease or not (0 = no heart disease, 1 = having heart disease) (Figs. 4, 5, 6, 7, 8 and 9).

Fig. 3 Target versus count feature



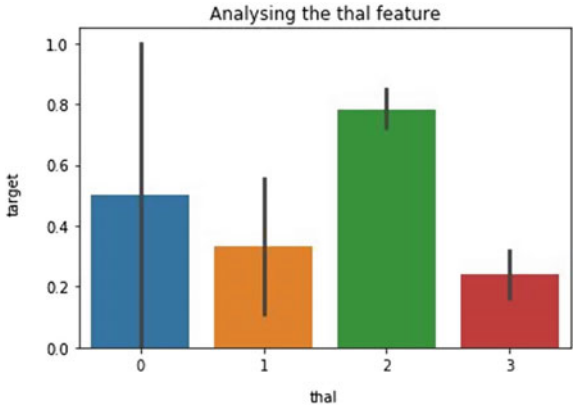


Fig. 4 Target versus Thal feature

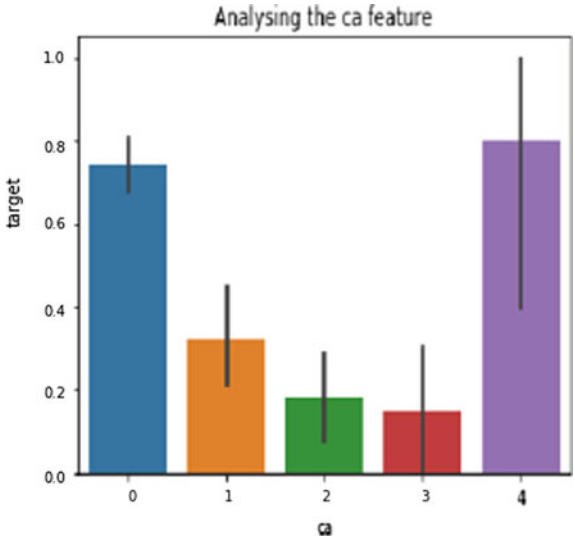


Fig. 5 Target versus Ca feature

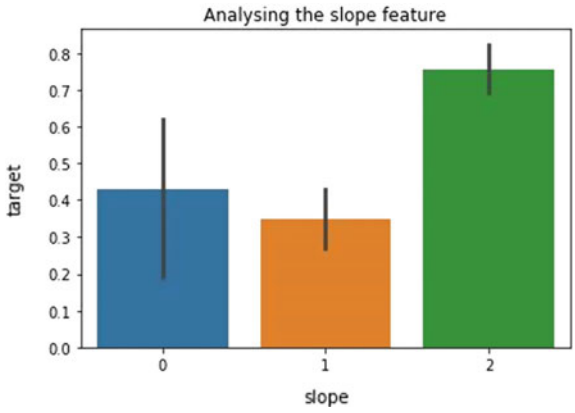


Fig. 6 Target versus Slope feature

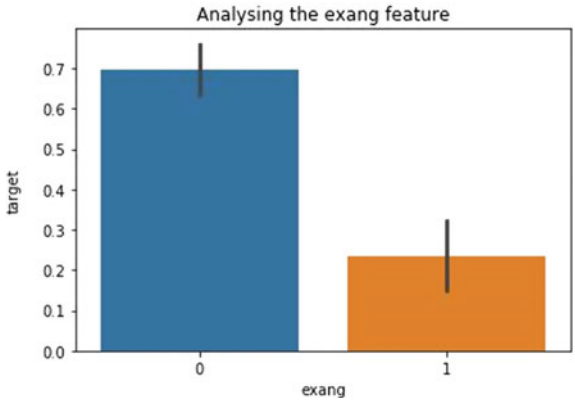


Fig. 7 Target versus Hexing feature

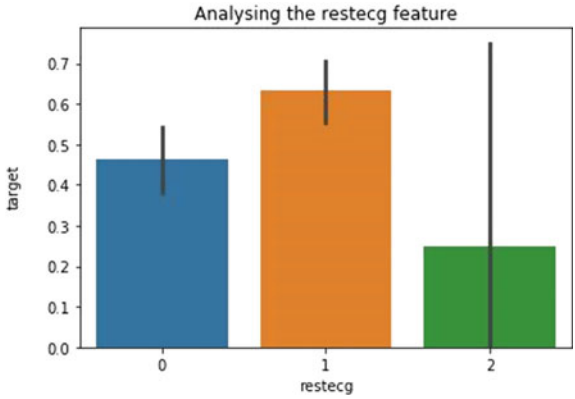


Fig. 8 Target versus Restecg feature

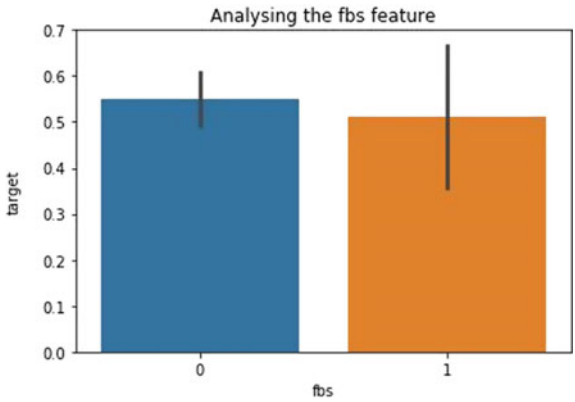


Fig. 9 Target versus Fbs feature

Data Analysis

Logistic Regression

Logistic regression a supervised getting to know algorithm which is focused to predict the binary structure of a goal variable. Logistic regression is better and easiest algorithm used in computing device gaining knowledge of that can be used for a variety of troubles such as sickness prediction, most cancers detection and so on. In this paper, we carried out the accuracy of 84% via the usage of this model.

Naïve-Bayes Classifier

Naïve- Bayes is a statistical classifier. It is based mainly on Bayes' theorem. A naïve Bayesian classifier, has same overall performance with choice tree and different chosen classifiers. The computation speed can be decreased greatly. It is handy to implement. In this paper, we completed the accuracy of 80% by using the use of this classifier [11].

K Nearest Neighbors Classifier

K Nearest Neighbors is a non parametric technique used for classification. It is lazy getting to know algorithm the place all computation is deferred till classification [12]. It is additionally an occasion primarily based studying algorithm, the place the characteristic is approximated locally. This algorithm is used when the quantity of facts is giant and there are non-linear choice boundaries between classes. KNN explains a express fee the use of the majority votes of nearest neighbors. Not solely for classification, KNN can be used for characteristic approximation problem (Fig. 10).

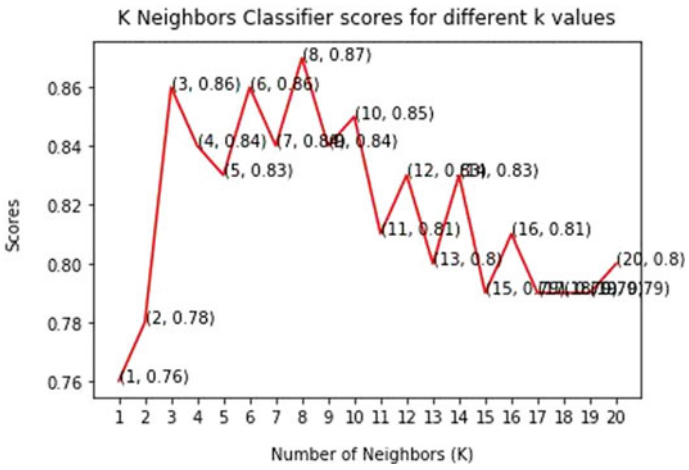


Fig. 10 This figure shows the K Neighbors classifier scores

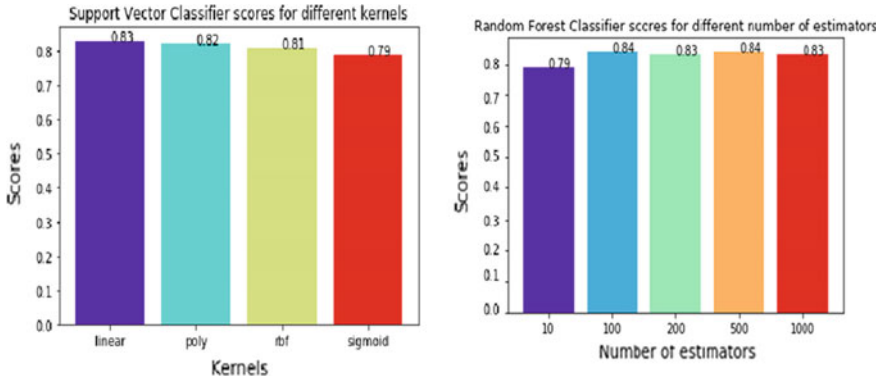


Fig. 11 This figure shows the Support Vector Classifier scores

This graph indicates that the most accuracy done by using K neighbors classifier is 87%.

Support Vector Classifier

SVM (Support Vector Machine) is a supervised desktop getting to know algorithm that is useful for classification and regression troubles as aid vector classification (SVC) and assist vector regression (SVR). This classifier separates records factors the use of a hyper aircraft with the biggest quantity of margin. Support vectors are the statistics factors which are closest to the hyper plane [14]. There are various kernels on which the hyper aircraft can be decided. This paper normally focuses on 4 kernels specifically linear, polynomial (poly), radial groundwork characteristic (rbf) and sigmoid. This kind of classifier makes use of much less reminiscence due to the fact they use a subset of coaching factors in the choice phase (Fig. 11).

This figure suggests that the linear kernel is having the best accuracy of 83% with the aid of the use of this dataset.

Decision Tree Classifier

This classifier falls beneath the class of supervised learning. It can be used to resolve regression and classification problems. We can use this algorithm for problems the place we have non-stop however additionally specific enter and goal features [14]. It is the most superb computing device gaining knowledge related algorithm used for describing the bushes in a graphical manner (Fig. 12).

This diagram indicates the line format from which we determined that the most accuracy is 79% and is received by means of wide variety of most facets (2, 4, 18).

Random Forest Classifier

Random woodland is a supervised getting to know algorithm. The algorithm will be using here for classification and regression which is very and handy for implementation. A wooded area is comprised of trees. This classifier creates choice timber on randomly chosen statistics samples, receives prediction from every tree and selects

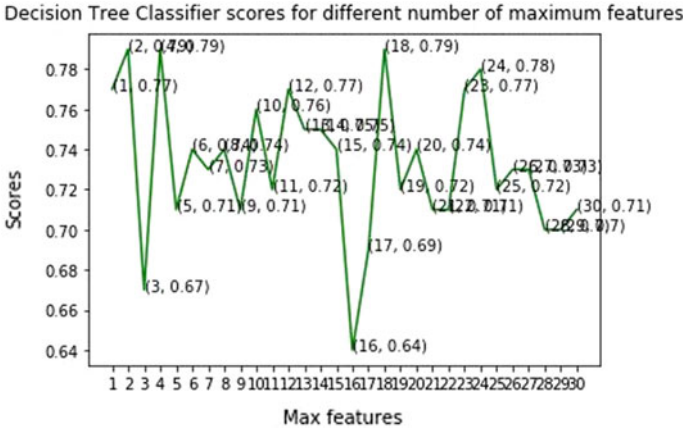


Fig. 12 This figure shows the Decision Tree Classifier scores

Table 1 Accuracy values

Algorithms	Accuracy (%)
Logistic Regression	84
Naïve Bayes Classifier	80
K Nearest Neighbors Classifier	87
Decision Tree Classifier	79
Support Vector Classifier	83
Random Forest Classifier	84

the first-rate answer by way of ability of voting. The random wooded area composed of more than one selection trees. It creates a wooded area of trees.

Table 1 indicates that K Nearest Neighbors Classifier offers the excellent accuracy with 87% in assessment with the different desktop getting to know algorithms used in this paper. Because KNN algorithm is primarily based on characteristic similarity and is one of the most well-known classification algorithms as of now in the enterprise honestly due to its simplicity and accuracy. K Nearest Neighbors is a easy algorithm that shops all the handy instances and classifies new instances primarily based on a similarity measure.

5 Conclusion

This paper includes prediction of the coronary heart ailment dataset with desirable information processing and implementation of computing device studying algorithms. In this paper, we make use of six computing device mastering algorithms for prediction.

Among all the computer gaining knowledge of algorithms used in this paper, the best possible accuracy is completed by means of K Nearest Neighbors Classifier with 87%. This paper indicates that the computing device getting to know algorithms can be used to predict the coronary heart disorder without problems with unique parameters and models. Machine studying is very beneficial in prediction, fixing troubles and different areas. Machine getting to know is an advantageous way to remedy the troubles in distinct areas too.

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Spam and Ham Classification by Multinomial Naïve Bayes Classification in Text Data

J. K. R. Sastry, P. Harika, Trisha Dubey, and Y. Vijay Ditya

Abstract Attacking Mobile phones is increasingly alarming especially infringing through many applications. Attacking is being done through clicking hyperlinks, which are transmitted through messaging systems as content. The Mobile phones literally are being made un-operational through these kinds of cyber-attacks. This project aims to build machine learning model that learns to detect the attacking through malware caused within messaging that contains different kinds of sources that include text, video and audio. The model aims to learn the attacking caused through malware and then trigger an action that counter the attack based on its type.

Keywords Cyber security · Malware · Spam messages

1 Introduction

Spamming is the practise of delivering unsolicited advertisements to vast groups of people for the purpose of commercial, non-commercial proselytising, or some other forbidden purpose. Although email spam is well-known, such as instant message spam, web online classified advertising, cell phone messaging spam, spam on the Internet forum, social spam, Smartphone spam sports, TV ads, and spam file sharing.

Spamming has been focused of legislation. A individual who produces spam is called a spammer. Most email spam messages are commercial in nature. Many are not only irritating, but also harmful, whether commercial or not, since they can include links that lead to malware hosting phishing websites or sites—or have malware as file attachments. Email addresses from chat rooms and blogs etc. that steal address books from users are obtained by spammers. Often, these obtained email addresses are marketed to other spammers as well [1–10].

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2 Related Work

2.1 Multinomial Naïve Bayes

Naïve says that features in the dataset are mutually independent. The Naïve Bayes will outperform the most potent choices for small sample sizes. It is used in many different fields, being relatively stable, simple to implement, fast, and precise. For Example, Spam filtering in messages

$$Posterior\ Probabilty = \frac{Conditional\ Probability * Prior\ Probability}{Predictor\ Prior\ Probability}$$

2.2 Stemming and Lemmatization

We want to screen out spam messages using a multinomial Nave Bayes Classifier. Initially, we consider eight normal messages and four spam messages (Fig. 1).

The histogram used to measure the probability of seeing each word, provided that it was a regular message (Fig. 2).

Probability (Dear|Normal) = 8/17 = 0.47.

Similarly, the probability of word Friend is

Probability (Friend/Normal) = 5/17 = 0.29.
Probability (Lunch/Normal) = 3/17 = 0.18.
Probability (Money/Normal) = 1/17 = 0.06.

The possibility of the word dear we saw in the spam message given is

Probability (Dear|Spam) = 2/7 = 0.29.

Similarly, the probability of word Friend is

Probability (Friend/Spam) = 1/ 7 = 0.14.
Probability (Lunch/Spam) = 0/7 = 0.00.

Fig. 1 Multinomial Naïve Bayes Classifier

Fig. 2 Histogram of words in spam

Probability (Money/Spam) = 4/ 7 = 0.57.

Calculate probabilities of discrete words and not probability continuous like weight or height. These Probabilities are also called **Likelihoods.** Now, let's say we have received a normal message as **Dear Friend** and we want to find out if it's a normal message or spam. We start with an initial guess that any message is a Normal Message. From our initial assumptions of 8 Normal messages and 4 Spam messages, out of 12, 8 messages are normal messages. The prior probability, in these cases, will be:

Probability (Normal) = 8/ (8 + 4) = 0.67.

We multiply this prior with probabilities of **Dear Friend** that we have calculated earlier.

0.67 * 0.47 * 0.29 = 0.09.

0.09 is the probability score considering **Dear Friend** is a normal message.

Alternatively, let's say that any message is a Spam.

4 out of 12 messages are Spam. The prior probability in these cases will be:

Probability (Normal) = 4/(8 + 4) = 0.33.

We multiply the prior probability values with probabilities of **Dear Friend** that we have calculated earlier.

0.33 * 0.29 * 0.14 = 0.01.

0.01 is the probability score considering **Dear Friend** is a Spam. The probability score of **Dear Friend** being a normal message is greater than the probability score of **Dear Friend** being spam. We can conclude that **Dear Friend** is a normal message. Naive Bayes treats all words equally regardless of how they are placed because it's difficult to keep track of every single reasonable phrase in a language.

Fig. 3 DataFrame

	Country	Age	Salary	Purchased
0	France	44.0	72000.000000	No
1	Spain	27.0	48000.000000	Yes
2	Germany	30.0	54000.000000	No
3	Spain	38.0	61000.000000	No
4	Germany	40.0	63777.777778	Yes

3 Implementation of the Project

3.1 Holding Null Values

Any real-world dataset includes a few null values. We must intervene for no paradigm can handle these NULL or NaN values on its own. First and foremost, we must determine if our dataset contains any null values..

3.2 Standardization

This is another step of integral pre processing (Fig. 3).

Formula for Standardization

$$z = \frac{x_i - \mu}{\sigma}$$

3.3 Tokenizing

Splitting down words into single elements.

For Example:

every	country	has	its	own	uniqueness

3.4 Training Dataset

The sample of knowledge used to fit the model. The real dataset we use to train the model. From this data, the model sees and learns.

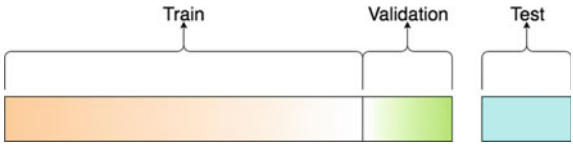

Fig. 4 A visualization of split

3.5 Validation Dataset

For evaluating a given model, the validation collection is used, but this is for regular assessment. We use the outcomes of the validation collection, and update higher level hyper parameters. Thus, a model is influenced by the validation package, but only indirectly. It known as the Dev packager or it can be known as Production set, the validation set. It is in "development" stage of the model, this dataset assists.

3.6 Test Dataset

Gold standard referred to testing the model is given by the test dataset. It is workers after a model is fully educated (using the train and validation sets). What Generally, the test collection is well selected. It includes carefully sampled data that, when used in the real world, spans the different groups encountered by the model (Fig. 4).

3.7 Apply Multinomial Naive Bayes Algorithm

For classification of discrete characteristics, Naive Bayes is appropriate.

For class j, word I at the frequency of the word f:

$$\Pr(j) \propto \pi_j \prod_{i=1}^{|V|} \Pr(i|j)^{fi}$$

The sum of logs in order to prevent underflow:

$$\Pr(j) = \log \pi_j + \sum_{i=1}^{|V|} f_i \log(t_i \Pr(i|j))$$

$$\Pr(j) \propto \log\left(\pi_j \prod_{i=1}^{|V|} \Pr(i|j)^{fi}\right)$$

$$\Pr(j) = \log \pi_j + \sum_{j=1} f_i \log(\Pr(i|j))$$

One problem is that the likelihood of it happening again increases if a term appears again. We take the log of the frequency to smooth this:

$$\Pr(j) = \log \pi_j + \sum_{i=1}^{|V|} \log(1 + f_i) \log(\Pr(i|j))$$

Apply (IDF) weight on each word to take account stop terms.:

$$t_i = \log \left(\frac{\sum_{n=1}^{N} doc_n}{doc_i} \right)$$

$$\Pr(j) = \log \pi_j + \sum_{i=1}^{|V|} f_i \log(t_i \Pr(i|j))$$

Although the stop words have already has been set to 0 for this particular use case, to generalize the feature, IDF implementation is being added.

4 Results

This particular section provides experimental outcomes of the proposed method. First, the details of the dataset are provided. Then, predicted the performance of the proposed model that detects if a text is spam and ham. The model is solved with the help of confusion matrix, ROC AUC (Fig. 5).

4.1 Uncertainty Matrix

It can be used to compute Precision, Sensitivity (aka recall), Specificity and accuracy (Fig. 6).

We compute make use of the specified formulae to explain the accuracy for Offered model.

Accuracy is the ability to determine the correctness or closeness of personality categorization. The formula for accuracy can be given by

Fig. 5 Healthy message indication

```
In [26]: y_pred = model.predict(messages)
         y_pred
Out[26]: array(['ham'], dtype='<U4')
```

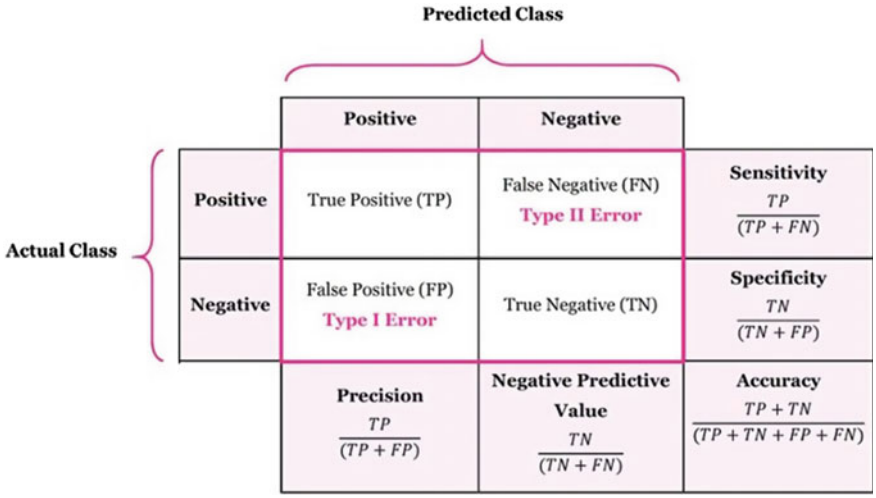

Fig. 6 Uncertainty matrix

Fig. 7 Accuracy of the developed model

```
In [17]: model = MultinomialNB()
         model.fit(X_train, y_train)
         model.score(X_test, y_test)

Out[17]: 0.977705274605764
```

$$\text{Accuracy} = (\text{TP} + \text{TN})/(\text{TP} + \text{TN} + \text{FP} + \text{FN})$$

Precision mention to the correctness of more than two values (Fig. 7).

$$\text{Precision} = \text{TP}/(\text{TP} + \text{FP})$$

Specificity is classified as percentage of negatives that are specifically identified in a binary classification test and can be calculated by

$$\text{Specificity} = \text{TN}/(\text{TN} + \text{FP})$$

Accuracy of the model that says the text is spam or ham is 97% (Fig. 8).

The AUC of the model of multinomial naive bayes is 0.98, which is closer to 1. Based on the ROC-AUC curve, it is clear that the AUC of the model of multinomial naive bayes is 0.98, which is closer to 1.

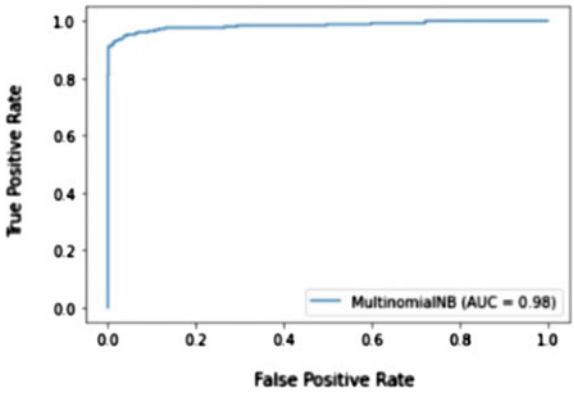

Fig. 8 ROC AUC Bend

5 Conclusion

In this paper shows a simple machine learning method and created an output assessment for it using the Spam Base dataset. The results with the hypothetical power, as well as the limitations of every technique, are also precise. The ability of individual classifiers to accurate identify text message as spam, ham is an interesting extension of this working. When constructed using the Multinomial Nave Bayes classifier, our model had a 97% precision, a 0.98 ROC AUC curve, and a 0.96 GINI coefficient rating.

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Smart Helmet—An Intelligent Key for Safety Management System

S. Arvind, S. V. Devika, Abhishek Dani, Vashisht Goud, and Naga Sai Teja

Abstract Bike riding is a lot of fun, but accidents happen. An accident is a unexpected, unusual and unintended external action which occurs in a particular time and place, with no apparent and deliberate cause but with marked effects. India is one of the busiest countries in the world in terms of road traffic. The Indian road network, spanning over 5 million kilometers, carried almost 90% of the country's passenger traffic and about 65% of the goods. India in 2019, an average of 414 a day or 17 an hour, according to the transport research wing of the ministry of road transport and highways. People choose motorbikes over car as it is much cheaper to run, easier to park and flexible in traffic. In India, 37 million people are owning two wheelers and 17 million units were sold in 2020. Since usage is high, accident percentage of two wheelers are also high compared to four wheelers. Motorcycles have high rate of fatal accidents than four wheelers. The impacts of these accidents are more dangerous when the driver involves in a high-speed accident without wearing helmet. So, wearing a helmet can reduce this number of accidents and may save the life. We have simple yet ready to use smart helmet system. A module affixed in the helmet, such that, the module will sync with the module affixed on bike and will also ensure that biker has worn Helmet. Additional feature of alcohol detection module will be installed on the helmet.

Keywords Smart helmet · Intelligent key · Safety management system · Bike riding · Accident

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1 Introduction

As of now we have no system for alerting the driver and to immobilize in case subject is not wearing a helmet or if subject is under the influence of alcohol at the time of riding the two-wheeler [1]. Because of this negligence, there may be a chance for getting accidents, which costs man lives. To avoid this, we are developing this proposed system, which alerts the driver and lets the vehicle to continue to stay in immobilized state. In the proposed system, we are going to let the vehicle stay in the immobilize state when the helmet is not being worn by the driver or if the alcohol sensor is positive. In either of the case as above, there is an alert that comes in the form of buzzer sound. Which kills the power to the vehicle immediately and also, in this paper, the data of the positive sensor will be collected for future safety. It can be sent to the database of the authorities for immediate action in case of emergency situations [2]. This paper presents the detailed components used in the design of the smart helmet which is intelligent in nature to save human life.

2 Working Principle

The Design of this Helmet needs Hardware and Software for product model. Hardware consists of Arduino Nano Board, Arduino Uno Board, Power Split Board, Click Switch, Alcohol Sensor, RF Transmitter, RF Receiver, Buzzer, 9.9 V battery.

Software used to write the program is Arduino IDE 1.8.13 running on Windows 10 and this design has two modules.

1. Helmet Module
2. The Bike Module

2.1 The Helmet Module

In the Helmet module, Arduino Nano Board is used due to its size, which is just 1/4th size of the Arduino Uno Board, which is easy to be placed inside a helmet with a battery pack and also doesn't increase the weight of the helmet by much (comparing to helmet that already exist which are brought in Indian market).

A Power Split Board is being used to split the power between the

1. RF Transmitter
2. Alcohol Sensor
3. Arduino Nano Board

Alcohol Sensor detects the presence of the alcohol in the air (or on the breath of the subject, who's wearing the helmet), RF Transmitter has to transmit the output data of the Arduino Nano Board to the RF Receiver of the Bike Module [3].

2.2 The Bike Module

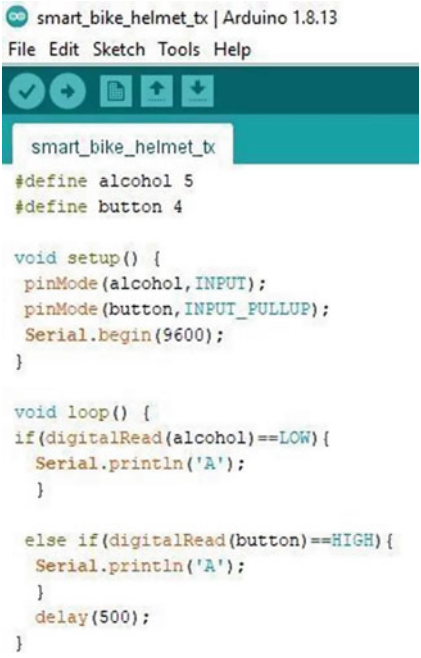
In the bike module, Arduino Uno Board is used as it is bigger in size and cannot be used in the helmet module. Also, the other advantages of using this is Arduino Uno Board has a DC power input which can be taken from the bike it-self without interfering it with an electric plug converter.

RF Receiver is the next component connected to the Arduino Uno Board which receives the Output 'A' from the Rf Transmitter that is connected to the Arduino Nano Board in the Helmet Module. Buzzer is the last component connected to the Arduino Uno Board and it has to buzz when the Arduino Uno Board gives output, when it gets input of 'A'.

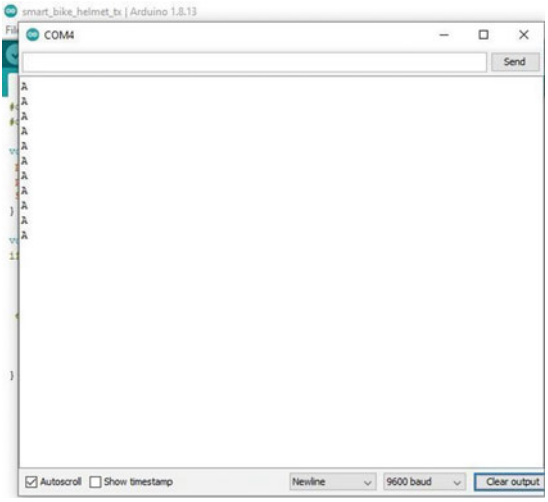
The program states that whenever the button is sensing any pressure or the alcohol sensor detects any positive signature, its output has to be 'A' (which is understood by the program in the Arduino in the Bike Module).

3 Program Code

3.1 The Helmet Module



3.2 Output



3.3 The Bike Module

smart_helmet_bike_rx | Arduino 1.8.13

File Edit Sketch Tools Help

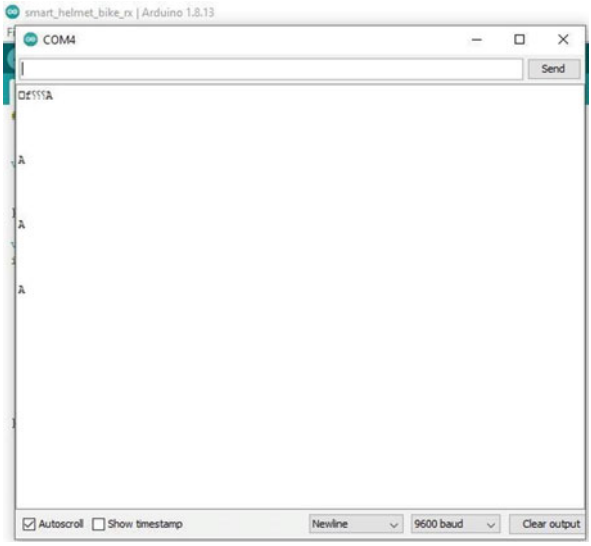
smart_helmet_bike_rx

```
#define buzz 5


void setup() {
 pinMode(buzz,OUTPUT);
 Serial.begin(9600);
}

void loop() {
if(Serial.available()){
  char data = Serial.read();
  Serial.println(data);
  if(data == 'A'){
    digitalWrite(buzz,HIGH);
    delay(100);
    digitalWrite(buzz,LOW);
    delay(100);
    }
  }
}
```

3.4 Output



4 Result

Basically, when the subject is wearing the helmet—the switch is being press due to the weight of the helmet against the head, also the alcohol sensor should give a negative reading for the alcohol contain in the air then it is positive sign for the engine to keep running.

5 Conclusion

The main aim of the project is for the people to at least wear a helmet while riding the two-wheeler so that the main part of a body i.e. Brain is the well protected and the fatalities can be decrease if there is any mishap. We hope the working bodies of the government to take up this project and include it in the rules, which will be beneficial to everyone.

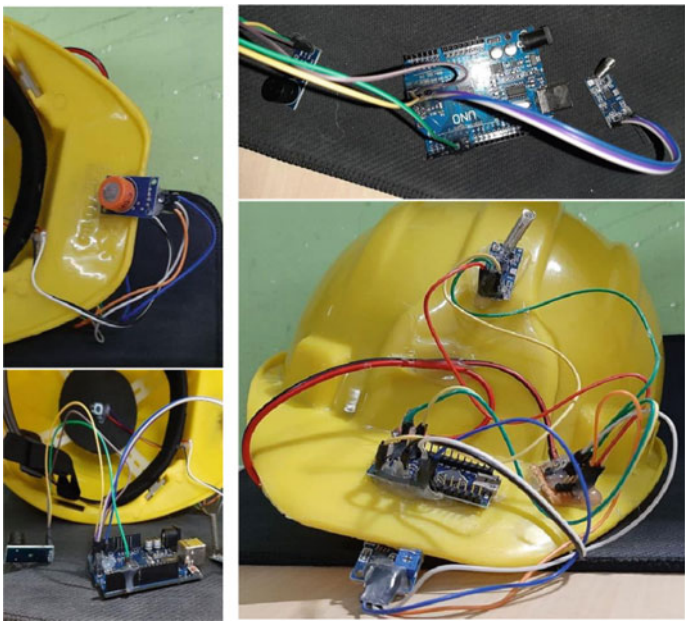


Fig. 1 Prototype pictures of smart helmet

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Vertical Farming—An Agriculture Management and Controlling System

S. V. Devika, S. Arvind, Gogadi Kavya, Harshitha Akkineni, and Himan Varma

Abstract Farming is one of our country's important sources of income. But, how successful has it been over the last few years? This is one of the most debatable topics in the present scenario. We all know the importance of farming and we are also very well aware of threats that it has due to today's changes in environment, new crop production and industrialization. It is predicted by the United Nations that by the year 2050, the world will not have enough livestock and food. What are we doing to contribute to the industry of food production? What are the ways we increase the food production and make sure we have year-round crop production, all of this and more can be attained by Vertical Farming. A lot of farming practices based on vertical farming have proved that, it is one of the most effective ways of producing the crops with more favourable outcomes. This is possible because of controlling environment in which the crops are growing and providing supplants to them accordingly. In order to do so, we control factors like humidity, nutrition to the plants, the amount of light it receives naturally and through other external resources. In this way, we tend to create an artificial environment to the plants and ensure the year-round cultivation which ultimately results in better crop production (Li et al. in International conference on information systems and computer aided education (ICISCAE), 2019 [1]). Thus, increase in the crop production which leads to betterment in the farming practices. Additionally, we also use various types of sensors in order to ensure that plants receive full nutrition and proper supplants through man made sources which yields in the better outcome.

Keywords Vertical Farming · Sensors · Food production

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1 Introduction

What exactly is the concept of Vertical Farming, and why do we even need to adapt it? It can be explained as an agricultural practice with controllable environmental conditions that promotes the growth the of the crop better than the conventional method. To be more precise, why do we use air conditioners in summer? and warm clothing in the winters? To make ourselves comfortable right? Similarly, to promote the better growth of the crop we provide with some favourable conditions. This should ensure some quality and quantity improvements over a short scale of farming. This project helps in controlling the environment around the crops. The humidity, moisture, etc. can all Initially set or can be manually controlled with the help of a remote [2]. Also, in this method a large number of crops can be cultivated over a small area when compared with the conventional method. This should interest even the common people to start vertical farming over a small scale and help the society with good health in this scenario.

2 Working

The working model of this farming technique mainly involves the usage of the following components: 1. Arduino (ATMEGA 328P), 2. Humidity sensor (DHT11), 3. Soil moisture sensor, 4. Relay module (5 V), 5. DC motor, 6. LCD: 16 * 2, 7. IR receiver, 8. IR remote, 12 V adapter, jumper wires.

Software used to write this program is Arduino IDE 1.8.13 running on Windows 10 operating system.

The working is not very complex and can be easily achieved by anyone who is practicing farming. The temperature sensor turns on the fan if the temperature is greater than the requires temperature by the plants. And similarly, it turns on the heater if the temperature is below the required level. Moreover, it turns of the cooling fan if the required temperature is attained and similarly turns of the heater as well. We use pulse modulation techniques for the above sensors to work accordingly. Moving on to the soil moisture sensor, it measure the percentage of moisture in the plants and its main function is to turn on the pumps if the moisture content is less than the required and turns the pumps off once it reaches the required level. A very similar working is taken place in the humidity sensor, but it works with the exhaust fan and switches it on if the humidity is more than the regular required rate and turns it off otherwise. The program that we implemented for the sensors to work are mentioned below in detail.

3 Code

3.1 Defining of Parameters

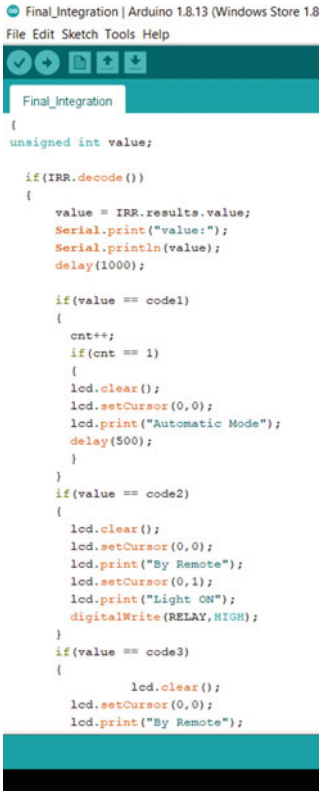
Final_Integration | Arduino 1.8.13 (Windows Store 1.8.42.0)

File Edit Sketch Tools Help

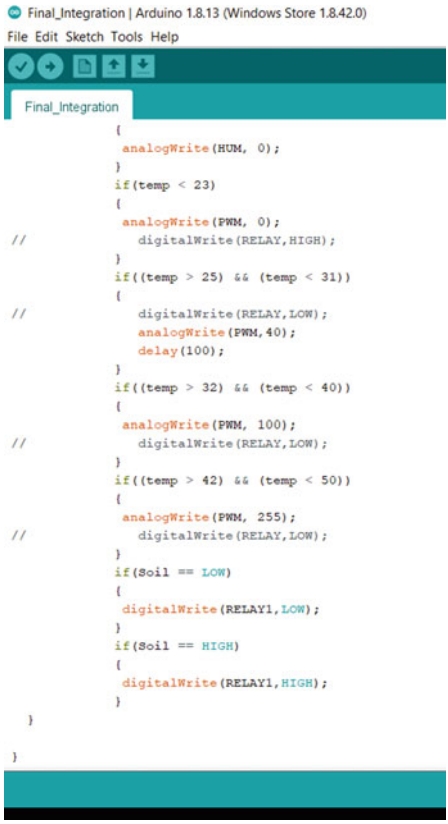
Final_Integration

```
#include <LiquidCrystal.h>
#include <IRremote.h>
int input_pin = 2;
IRrecv IRR(input_pin);
#include "DHT.h"
#define DHTPIN 6
#define DHTTYPE DHT11

#define SOIL 3
#define RELAY 4
#define RELAY1 A0
#define TEMP A1
#define HUM A2
int PWM = 5;

#define code1 18615 //15328
#define code2 20655 //15330
#define code3 55335 //15314
#define code4 63495 //15346
#define code5 12495 //15306
#define code6 45135
#define code7 28815

const int rs = 12, en = 11, d4 = 10, d5 = 9, d6 = 8, d7 = 7;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

DHT dht(DHTPIN, DHTTYPE);
int cnt,cnt1;
float vout;
float temp;

void setup()
{
  Serial.begin(9600);
  lcd.begin(16,2);
```

3.2 LCD Interfacing



3.3 Temperature Sensor Interfacing



3.4 Final Integration of All the Components

4 Result

Ultimately, our main aim for this project is help the growth of the farming sectors. The usage of various types of sensors has shown a positive result when tested. This project can be used in any indoor areas provided with right equipment. We have also observed that this project can be easily put into use as most of the farmers are already aware of the functioning of exhaust fans and pump as well as the functioning of the motors (Figs. 1 and 2).

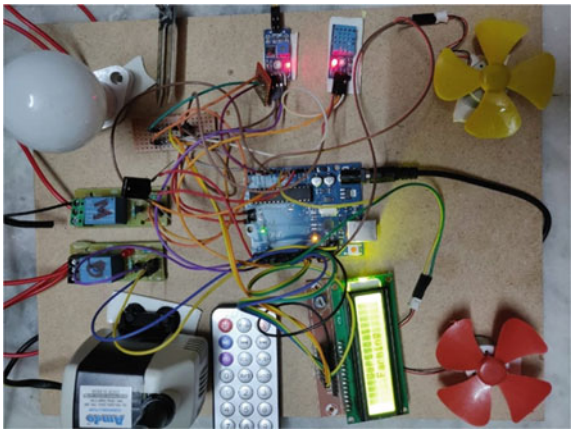


Fig. 1 Demo of the interfacing

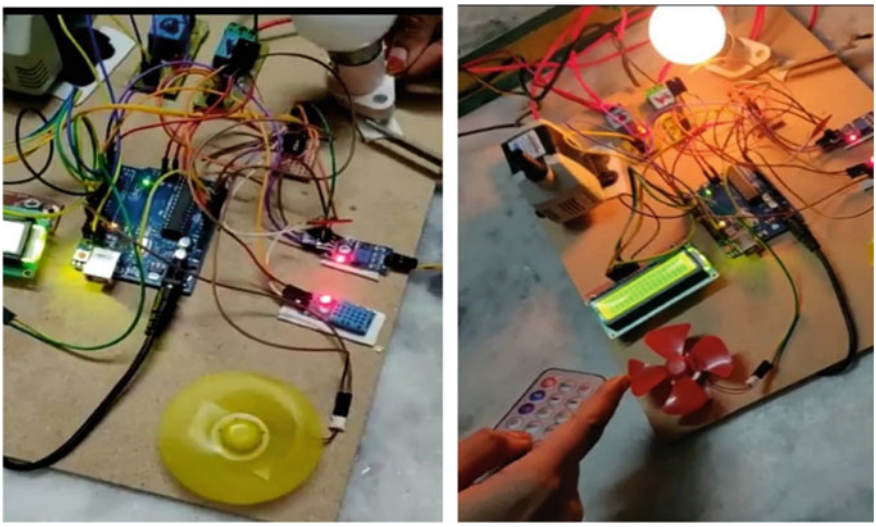


Fig. 2 Working of the fan in accordance to the temperature

5 Conclusion

The concept of vertical Farming is of great advantage and when implemented on a large scale it can be of great use to the farming sector. The combination of farming using the current technology is where we believe the future of the farming sector lies in [3]. This method when put to usage can show extremely good results as it mainly functions on controlling the environment in which the plants grow and ensures the proper functioning of plants. All of this and some more can be attained and we can

see the increase of growth of many rare crops using this emerging technique. We certainly believe, this project can bring the change in the farming practices. This project's ultimate goal is to increase the food production and increase the growth of the crops in the off season as well along with the growth in the rare breed crops when horizontally we cannot grow. This farming is trending now a days due to unavailability of land space due to more residential occupancy in India.

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Impact of Covid-19 on Education

P. Sunitha, Naeem Ahmad, Rejaul Karim Barbhuiya, Vinit Kumar Gunjan, and Mohd Dilshad Ansari

Abstract The world is reeling in the midst of the novel corona virus pandemic with fear of rising toll due to the deadly virus. This situation caused complete lockdown in many countries thus posing one of the biggest challenges to educational institutions and academicians to continue the teaching learning process involving students. E-learning system is very important to ensure successful delivery, effective use, and positive impacts on learners. In order to engage learners while at home as well as to utilise their time and complete syllabi, the process of teaching-learning and assessment need to be streamlined. However, while doing so, the institution should keep in mind various skills related as well as infrastructure related constraints on the part of school, teacher, student and parents. But, in reality, majority of the institutions are conducting online classes in urgency regardless of skill and experiences of concerned teachers and students. It is even more challenging when teachers and academicians alike are not well trained at technological tools for virtual/online classes. Students at large are also not acquainted with technologies and much help can't be expected from their parents in this regard. The goal of this chapter is to investigate students' opinions for virtual classes focusing on their learning and behaviour during COVID-19. The said study is validated through the student satisfaction survey involving directly students from different institutions.

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Keywords E-learning · Online class · Virtual classes · COVID-19 · Education

1 Introduction

As we all know the world is struggling in dealing with the novel Corona virus called Covid-19 outbreak, which forced most Governments to close the educational institutions by enforcing lockdown and social-distancing measures, temporarily. According to UNESCO [14], this shutdown has impacted around 72% students of the world's student population. Although it is a relatively short-term disruption, many families around the world are worried about children's social life and learning as there are continuous extensions of lockdowns, with no sign of vaccine in sight. Physical presence of students in school, colleges and other institutions, that is, the face-to-face mode is one of the traditional and successful methods to impart skills and knowledge among students. In such places students can have fun, can improve their social skills, ability and awareness. The students can acquire them in a relatively short time [2, 5], and in a joyful manner while interacting with their peers and teachers. Missing these places of activities for a significantly longer period can have consequences for overall cognitive growth of learners. People are expecting that this severity will be for short time [15]. But, the reality is that we cannot very precisely estimate how long it may take to get rid of this COVID-19 pandemic and return to normalcy.

Lockdown not only affects the teaching-learning for educators and students, it also interrupts another key component that is continuous formative and summative assessments, thus posing exam postponement or cancellation. Internal assessment is one of the key factors to check the performance of students and also provide the information about the child's progress for families and teachers, on a regular basis. Delaying or missing this information may delay in the recognition of potential learners [13], and necessary personalised intervention could not be provided to overcome learning gaps. At the same time, other national level entrance examinations in India (e.g. JEE, NEET, GATE, NET, JAM conducted by Indian Educational Bodies) required to be cleared to get admission into higher education institutions, have been postponed or cancelled for entire student population [16]. In order to mitigate the impact of this immediate closure, several institutions from different countries have implemented the online or virtual class paradigm, and providing e-learning resources and other means of additional learning remotely. This paradigm shifting is on an untested and unprecedented scale. The assessment procedure is also moving, which is uncertain for students and tutors thus causing assessment cancellation. Further these interruptions can have long-term effect on the learners.

On one hand educators are looking at online solution to mitigate the effect of lockdown on education. On the other hand, educators should also observe the behaviour of students towards the online tools and e-learning resources. This is because one of the limitations of this online teaching-learning is Internet bandwidth and limited data for users. Sometimes, students are not having enough resources in terms of laptops/desktops, earphones, regular electricity or a noise free room. Moreover, students

cannot afford bad services getting from the institutions or lack of teachers' experience in online teaching. The goal of this chapter is to investigate the students' opinions for virtual classes focusing on their learning and behaviour during COVID-19. The said study is validated through the student satisfaction survey involving directly students from different institutions.

2 Previous Studies

Online education is gradually expanding with the advancement in the technology and affordability of computing devices and Internet to access the online resources using devices such as PCs, laptops, tablets and smart phones. Also it is observed that the traditional system of education and collaboration is restricted to limited students and mostly confined within the same classroom [4]. Today, information technology has made available learning resources in many formats such as text, images, audio, videos interactive, simulations and various multimedia formats, primarily through the Internet. It has removed barriers of geographical boundaries by providing online teaching-learning, to anyone, at any time and that too as per the convenience of the user. Additionally, it is creating more opportunities for educators, researchers and policy makers to collaborate and communicate with experts from other geographical institutions and students through wikis, forums, chat and peer-to-peer activities.

Numerous studies [3, 6, 9] have been done from time to time to find out the effectiveness of digital mediums in education as well as learner's perception about those mediums. The Report Card of online education shows that more than 70% academic leaders believe online instruction as the same or superior to face-to-face instruction [1]. Earlier, online education was viewed as a revolutionary solution to diverse educational problems and to address the issue of inequality [11]. It was argued long back that the primary aim of online education should be to make authentic accessibility of contents and to provide opportunities to the disadvantaged groups, rather than creating social divide by providing additional opportunities for those who already have access to quality education [12].

In recent years there have been a sudden rise in availability of video conferencing tools which are easy to use and have many interactive features. The case study based on one such popular tool Zoom shows the benefits a teacher can avail using this tool [17]. Another detailed review shows how these relatively inexpensive video meeting and collaboration tools can create a virtual classroom where teacher can encourage participation of students from the comfort of their home [6]. Impact of video conferencing on student's achievements [10] showed positive outcome. Another important digital medium is the social networking sites such as Facebook, twitter, LinkedIn, etc., that have got visible presence in higher education [18]. Studies showing statistics about Facebook usage [8, 18], found that 94% of college students were users of Facebook spending an average of 10–30 min on the site and having 150–200 friends. Effectiveness of different Web 2.0 tools such as Wikis, Blogs, Podcasts, and Social Networks in online education have been extensively covered [3, 10, 18].

3 Students Behaviour Towards Online Teaching-Leaning During Lockdown

Online classroom software tool is the booming technology and is being used all over the country for learning more feasible to everyone. As the part of our survey we interacted with students from different institutions of various regions and various background experiences. They have been satisfied by the teaching-learning during this COVID-19 lockdown period. They have given us the moderate result i.e., 60–70% for the learning experience. There are many application platforms where learning is more comfortable and easier to the students and parents. These applications act as a carrier transmitting the knowledge from faculty to student even in this heavy pandemic period some of the applications are Microsoft-Team, Zoom, Google Meet, Google-Hangouts, Adobe-connect etc.

To make the students feel inventive and exciting the institutions preferably chosen the most appropriate application i.e., Microsoft Teams application which is mostly downloaded from the Appstore during this lockdown period. It helps the faculty do maintain the learning easier to the students with this application in this pandemic period. They prefer Microsoft Teams due to its Overall features and the Excellent Streaming of Audio/Video and it also provides monitoring of students to both faculty and parents. Another salient feature of Teams Application is scheduling of classes and modifying the timing that can be shared to students and the parents that helps the students to be attentive to the classes. Students has given different reasons for their selection. Institutions are developing a skill based subjects to increase the potentiality of the students. In our survey we came to know that institutions go with the students need and they discussed with the faculty and the students mostly prefer "4 classes /5 classes" based on the need of their learning per. In some regions the classes are modified. The students arranged themselves to the virtual classes through their own mobile data connection. In some cases, they used the Borrowing mobile data connection i.e., Hotspot and sometimes they prefer the Wireless-Frequency (Wi-Fi) for the virtual classes learning.

In India we being digitalized choosing the virtual classes during this lockdown all the institutes around the globe prefers the virtual classes to make students near to the academics and building closer relationship between the faculty and students through being interactive with the parents by the virtual classes for the learners. The institute serves the learners to get the best-to-best learning experience to enhance their learning skills and practical knowledge by offering videos and online compilers applications for getting practical learning. Virtual classes provide learning to the learners even they are far away from the institutes and faculty. Students are satisfied having virtual classes during lockdown to some extent. Students found a new way of gaining learning experience through staying home and make usage of the learning by the virtual classes. They likely choose the usage of virtual classes to be carried forward even after the lockdown period. The students are more comfortable by gaining the knowledge through being practical and physical with the presence of the faculty rather than being in virtual classes.

Virtual class is a new way of learning the things around the world by being on intensive role helps the students and faculty to learn new things by this medium. Students are more comfortable by getting the knowledge through a new way and makes usage of this period to build healthy relationships between the student and the faculty as well as parents. Everyone is obedient to learn new things from any medium if wants to be a learner such online classes help the students to be active learners. Virtual class are new technique for the faculty and students to gain knowledge.

4 Utilizing Available Resources During Lockdown

Lockdown situation is demanding that learners and educators needs to attend online classes at short notice to continue the education. In such situations, it is very important immediately arrange and manage the online tools, learning resources and keep in touch with all faculties and students. Both faculty and students should go through the different available online classroom tools to decide best one and train them to use online and digital platforms. It is also important for faculty while delivering the lecture, goal of learning should meet with the learning modules at all times. Online tutorial is also changing the way of teaching and learning around world. These changes in education were very slow and transformational before the Covid-19 outbreak. Most of the institutions worldwide are now adapting these changes rapidly to continue education delivery model although educators, administrators and policy-makers has created interest among students towards available resources. For example, students are being asked to opt one Massive Open Online Courses (MOOCs) courses in graduate courses [3].

Apart from these approaches, educators can utilize email or WhatsApp platforms to inform students about the time and topic of the online class. Also tutorial links or assignments can be shared on these digital media by creating group chats and group mails. For these options, email addresses and contact information can be obtained from system admin of the college. Both faculty and students should remember and follow the guidelines provided by the institutions and digital platform providers. For example, faculty should prepare the lecture well and must be ready with necessities like laptop, earphones, camera etc. before the class. For smooth functioning of tools streaming, students should mute their mics and hide their camera.

In addition to this, families also play a central role to have major inputs into a child's learning as detailed in [7]. It is likely to be positive and effective approach to extend in home schooling, which is always considered as complement to the input from school. For example, parents' attention on learning of child's mathematics knowledge by practicing exercises tuned with daily life problems or illuminate history lesson by making online virtual tours of important monuments or museums. With this approach of learning, student community can continue their learning at home. However, the situation is not same for every student as sketched here.

5 Conclusion

World is facing the lockdown situation due to Covid-19 outbreak, which has much affected our education system. It has posed the serious issues of continuing classes for the students in short notice. Now the educators and learners are moving to online classes without having any previous experience. In this situation, institutions are providing commercial and non-commercial online classroom software tools. This chapter presents a brief study of students' behavior towards using online classroom software tools and difficulties faced by the students. Moreover, authors highlighted the points how to utilize the available resources and improve the education delivery model for the students.

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Innovation and Entrepreneurship in the Technical Education

Ekbal Rashid, Mohd. Dilshad Ansari, and Vinit Kumar Gunjan

Abstract This paper deals with the possibilities related to technical students according to the demands of the market. Briefly explain the most popular programming languages and software technologies help of data from software repositories. The paper discusses the possibility of fusing a section of academia with industry experts to create cutting edge for effective training purposes. Blocks in general about the entrepreneurship possibilities and the areas from which revenue may be collected in order to fulfil requirements of such training.

Keywords Innovation · Entrepreneurship · Technical education · Training · Technologies

1 Introduction

The curriculum of technical education in general and of computer science in particular in technical institutes is repute with a myriad of materials that are not quite considered to be modern and updated. This results in our technical graduates often garnering the idea that in all probability the curriculum furnished to them is not in accordance with the needs of the market. Especially in computer science with and ever evolving and ever emerging arena of technical understanding and skillset, we are posed with the question whether it is sufficient for our emerging technocrats to respond to the demands of the market having simply these curricular materials at their disposal. This paper therefore deals with the possibilities and ways to tackle the situation. That is how our technical education can be made more and more conformal to the needs of the market. This paper also discusses about the needs of the market and what are the emerging trends, what should be catered to the students and how they should be

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equipped and trained. This paper is also about the entrepreneurship possibility in this field and how people with ample experience and adequate skills can club together to garner returns from the market. Also worth mentioning is the fact that many big players have shown interest in this field by dishing out classes related to coding for even school kids [1–4]. Although the practically of such classes has been widely and naturally debated loud and long, we may understand one important fact from this new phenomenon. The matter of fact which comes as an inference to this recent craze of coding for school kids is that the situation is ripe and does not need much persuasion and involved attempts to convince the people at large and specially students to opt for extracurricular computer related education and training to augment their careers [5–7]. Another important thing that may be inferred from this is the urge before technical students to know and study about the hot topics of the day because they feel that doing so will help them to fare better in interviews and exam when people from the industry would come to recruit freshers. Everyone wants to remain one step ahead of the rest and hence there is little doubt about the fact that demand of such training is sufficiently high and the supply chain is more or less on the wanting side. Nevertheless, this paper therefore tries to deal with this demand and supply situation and explore for efficient entrepreneurship [8–10].

2 Market Demands

In order to be more specific and make things sufficiently concrete and precise, there is a need to take a look at the need of the day, at the emerging trends and at the recent developments in the arena of software development since we are sticking to exactly that domain in this deliberation. The GitHub repositories remain an interesting place to explore and draw conclusions in this matter [6–9]. 2020 has been a time of extraordinary developments so far as the world of software development is concerned. With governments urging citizens to remain at home and work from home, the GitHub has seen a huge surge of activity inspiring developers from all over the globe to collaborate and get involved in innovation in the search for connections and the attempts to dig for solutions to problems. The GitHub publishes the ‘State of Octoverse’ each year outlining interesting facts and figures [6]. As per the document presented for the year 2020, there are more than fifty six million developers with more than 60 million repositories created just in the year 2020. To get the idea of what are the most popular languages that were used in software development in the few years we can again look at the data from the document. Right from 2014 to 2020, JavaScript has dominated the top most position without any signing of losing importance and the top slot in the years to come. Java was in the second spot till 2018 and then it gave way to Python which left Java with the third position in the list. The document also shows that the languages such as Typescript, PHP, C#, C++, C and Ruby also rule the world of programming This gives an interesting idea about the languages to be taught and the nature of training to be given to our technical students. The training should invariably include these languages and also the idea modern tools and IDEs that help

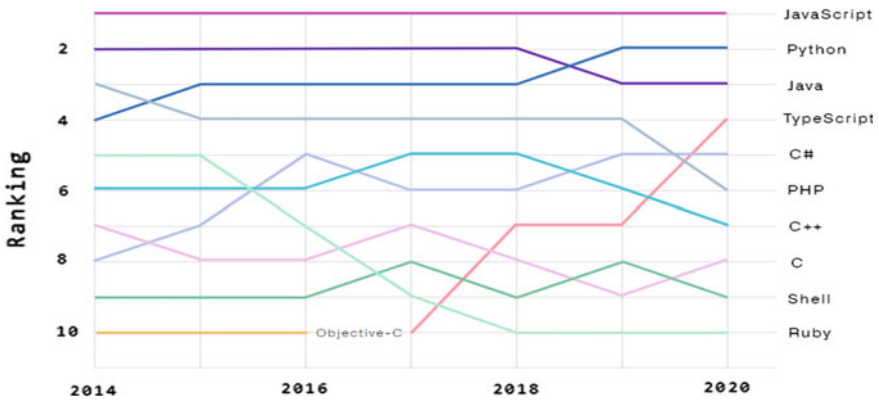

Fig. 1 Top languages over the years[1]

us to program better in these languages. Besides, it is also necessary to make our students well versed. By this we mean that we should train our students on a one to one correspondence basis between the nature of applications and the languages used to develop these applications. Most of our courses teach programming languages from the syntax and data structural point of view. But along with that the course of language training should also include the understanding of the domain which the language has been successfully applied to. JavaScript is increasingly being used to develop mobile applications and also other web applications. Python is being increasingly used in data science and machine learning. Keeping such things in mind while training people in these languages will help develop a greater sense of programming and also the technique to chose a particular language for a particular purpose. This has to be an integral part of the training (Fig. 1).

3 Training of Software Technologies

Another aspect of this training should be the stress upon the most popular technologies. Again, going through GitHub repositories gives us a good insight about this. Among the first twenty projects on GitHub feature Bootstrap, React, React Native, Angular, jQuery, Linux, etc. This list is not exhaustive, but it does give an idea about what people are thinking today. Bootstrap is a very popular HTML, CSS and JS framework for developing useful web projects that are responsive in nature. Angular and React are basically JS frameworks. React is quite new and very popular. It is on e of the most popular frameworks that people want to learn nowadays. Training our technical students to handle React will make them largely market ready and also fit for freelance work. Linux is not so new but is is increasingly replacing Windows in the use of servers and also desktop OS due to its open source, robust and secure features. It goes without saying that a sound knowledge about the Linux OS will help

technical students to respond in a much better manner to the needs of the industry. Another name in this about React Native which is great for both Android and IOS mobile app development. All of us shall definitely appreciate the increased importance of mobile applications in not only trade and commerce but also in other aspects of human life. We look towards mobile apps in almost every facet of our works and activities. This has helped developers come to the forefront as entrepreneurs. Many new software firms dealing in mobile apps are successfully operating nowadays. React Native is the technology and a thorough knowledge of React Native would help students reap maximum benefits from the market. Many tools such as GitHub tools[3] can be used and many forums such as GitHub classrooms[4] may be employed.

4 Industry and Academia Together

This training has to be a fusion of the academia and people from the industry. We hardly have institutions that formally involve people from both academics and industry working in tandem. We are open to the opportunities of creating one such organization. Such an organization which may be more of the form of a company rather than a college or university may forge together theoretical experts dealing proficiently with the base understandings that go into the building of quality software, people who can train about algorithms, complexities, language syntax and software engineering practices and also experts from the industry are very well versed with the need of the day. A concrete roadmap may be chalked out to outline a program of study and training so that things develop systematically and definite goals are covered in specific intervals of time. The training must be a combination of both online and offline activities, of both theoretical works and rigorous work on the machines themselves. A benchmark may be decided so as to help the evaluation of those getting trained. Based on this benchmark, the candidate may be considered to be fit to work in a particular project. This organization or company would also involve undergraduates and graduates in live projects with the technologies at hand and other skillset mentioned here in this deliberation and otherwise.

5 Entrepreneurship Training

The revenue needed for such a kind of training activity may be from different kinds of resources. One may be from the direct funds provided by the beneficiaries in the form of fee for training provided to them. Another method may be making good use of available funds in universities and also in industry which are supposed to be utilized for useful and explicit training. A third method may be the use of governmental resources made available directly or indirectly for training purposes. There are an increasing panorama of governmental schemes and planning for skill development. Although most of such plans and utilities hover around basic skillset development

and corresponding employment generation, efforts can be made of convince people in government circles to release funds for adequate training of technocrats as that will ultimately contribute to building of national human asset and economy at large. The funds generated thus may be sufficient to fuel the core team and also all those involved in such training work. Over and above there is also every possibility of generating surplus and thus inviting investors to take interest in this direction.

6 Conclusion

In this way we have presented in the current deliberation before this learned audience an outline of the need for proper and systematic training of technical students and the possibilities of entrepreneurship involved in such an exercise. It is very much possible to create entrepreneurship opportunities to deal with the demand for effective technical training of technical students. For this, one has to understand the needs of the market like which are the most popular programming languages and which are the most important technologies that are controlling the market. Once that is done there is a need of creating team of academic and industrial professionals, chalking out a time bound program or a roadmap and then deciding suitable benchmarks to evaluate the person receiving the training. It is necessary explore the different avenues for funding this endeavour and finally to forge all these ideas and activities into an organisational umbrella execute everything effectively.

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Optimization of K-Means Clustering with Modified Spiral Phenomena

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Abstract The technique of distributing a set of natural entities into groups of related objects is called clustering. Trying to find a good search platform for data mining has incrementally become a key problem as most conventional search methodologies are still unable to contribute to the improvement of knowledge discovery. Spiral optimization (SO) seems to be an accurate functioning algorithm that uses natural processes including the spiralling pattern and pressurized to treasure an optimal result in a reasonable period of time. A novel SO is introduced in this paper to tackle the clustering dilemma. With the exception of the actual SO, that recursively spins the objects across the self-righteous centre, the developed system divides the population into many subgroups to maximize searching heterogeneity and thereby boost the result of cluster analysis. The procedure of k-means has also been utilized to improve the usefulness of the anticipated algorithm. To assess the proposed method's accuracy, we introduce it to the problem of clustering and measure the findings through the optimization using spiral strategy and clustering using k-means algorithm. The outcomes illustrate that the suggested procedure is very optimistic.

Keywords Meta heuristic · Spiral phenomena · Optimization · Cluster analysis · K-means

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1 Introduction

There are several clustering interpretations in the research, ranging from basic to extensive. The most basic description is communal by altogether and contains single central perception: that the clustering is assemblage of related information objects. That is analysis of Clustering is the classification of a set of patterns (typically defined as a vector of dimensions or a point in a higher dimension) interested in groups created on their similarities. Numerous scientific communities use the expression "clustering" to define strategies to group unlabeled data [1]. These groups use various terminologies and interpretations to describe the clustering mechanism and the ways where it is used. As a result, we are in a state of uncertainty about the reach of this study. Considering the amount of studies on this topic, creating a properly detailed survey would have been a massive task.

The survey's usability can also be questioned, considering the need to resolve very specific vocabularies and conclusions about cluster analysis in the various populations [2]. While technological advancement has improved over the years, developing an effective clustering strategy remains a big challenge, particularly given the current massive data crisis. To address these issues, Optimization techniques become relatively reliable architectures that are focused on solving highly challenging issues such as travelling salesman problems, scheduling issues, benefit maximisation, and so on. Spiral optimization [3], bees optimization [4, 5], swarm optimization [6], firefly algorithm [7], and others are some of the utmost renowned illustrations of nature-inspired evolutionary procedures. Spiral optimization (SO) is one of these, and it's encouraging because it's quick and straightforward to apply. In addition, Tamura and Yasuda's spiral modeling was motivated by natural spiral phenomenon [3].

The remaining part of the paper is laid out as described. A short-lived summary to spiral optimization is addressed in Sect. 2. The proposed algorithm is then defined in Sect. 3. Section 4 contrasts the proposed method's simulation performance to other clustering methods. Section 5 is where the conclusion is reached.

2 Spiral Optimization

Tamura and Yasuda [8, 9] introduced the spiral optimization (SPO) technique as a simple metaheuristic principle influenced through spiral phenomenon in existence. The inspiration intended for specialising of spiral phenomenon came from the reality that the processes responsible for producing logarithmic spirals which possess the metaheuristic features of diversification and intensification [10]. The SPO optimization is a multi-point searching technique that takes multiple spiral structures which can be represented as stochastic dynamical systems and has no objective function like gradient. The primary design findings on the SPO algorithm are listed below.

The initial SPO method relies on 2-D spiral structures was developed for 2-D unconstrained computation [8]. Through converting a two-dimensional spiral model into an n-dimensional spiral model, the n-dimensional challenges are addressed [9]. The spiral architecture is composed of a compound rotation matrix and a phase rate together with the location of initial search points, become important research concepts since they determine the spiral patterns used to search.

A phase rate setting was suggested [11] based on a mathematical approach to several simulation results. In some other hypothesis, the compound rotation matrix was established besides the preliminary points were positioned to confirm that spiral dynamics produced descent methods on a regular basis [12]. Because of its basic nature and definition, the SPO has been the subject of numerous in-depth analyses, which have helped to enhance its global quest efficiency [13–15] and suggest innovative implementations [14, 15].

Spiral Model for Two-Dimensions:

Spiral Model for Two-Dimensions is described In two dimensional orthogonal coordinates which flipping the point x towards left side across origin by an angle θ causes x^* to be defined by

$$x^* = R_{1,2}^{(2)}(\theta)x \tag{1}$$

where the given below matrix is used to rotate the point x,

$$R_{1,2}^{(2)}(\theta) = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix} \tag{2}$$

We generate the given bellow spiral model that utilize this rotation matrix which is given in the Eq. 2, it produces a point on the $x_1 - x_2$ plane that converges there at origin from that of an arbitrarily selected point x_0.

$$\begin{bmatrix} x_1^{(k+1)} \\ x_2^{(k+1)} \end{bmatrix} = S_2(r,\theta)x(k) \tag{3}$$

where $S_2(r,\theta) = R_{1,2}^{(2)}(\theta)$ which is given in Eq. (2), $x(k) = \begin{bmatrix} x_1^{(k)} \\ x_2^{(k)} \end{bmatrix}$, $x(0) = x_0$, $\theta \in [0, 2\Pi)$ which is the angle of rotation at each iteration k with respect to the origin and $r \in (0, 1)$ which is the rate at which the length between a point and thus the origin converges during every iteration k. Since the core is at only the origin, shown above Spiral model would not have enough versatility for implementations. As a result, we improve the above spiral model by placing the middle at some arbitrary point x*

$$x(k+1) = S_2(r,\theta)x(k) - (S_2(r,\theta) - I_2)x^* \tag{4}$$

The composition rotation matrix R^n of the generalised spiral model for n-dimensions, which consisting of rotating matrices centred on all possible combinations of two dimensions (axes), is as seen below.

$$x(k+1) = R^n\left(\theta_{1,2}, \theta_{1,3} \ldots \theta_{n-1,n}\right)x(k) \tag{5}$$

$$R^n\left(\theta_{1,2}, \theta_{1,3} \ldots \theta_{n-1,n}\right) = \prod_{i=1}^{n-1}\left(\prod_{j=1}^{i} R^{(n)}_{n-i,n+1-j}\left(\theta_{n-i,n+1-j}\right)\right) \tag{6}$$

where $R^{(n)}_{i,j}\left(\theta_{i,j}\right)$ is a matrix with a maximum of n(n − 1) rotation matrices. Finally, by using the above equations As a result, we improve above mentioned spiral model by placing the centre at some arbitrary point x^*, for a *n*-dimensional space is as given bellow:

$$x(k+1) = S_n(r,\theta)x(k) - (S_n(r,\theta) - I_n)x^* \quad \text{Where k} = 1, 2, \ldots \tag{7}$$

Algorithm 1: K-Means clustering algorithm

Let $X = \{x_i | i = 1\ to\ n\}$ be the set of data tuples and $V = \{v_i | i = 1\ to\ c\}$ be the set of centres.

1. Select 'c' cluster centres at random.
2. Compute how far that each tuple is with respect to the cluster centre.
3. Allocate the tuple to the cluster centre with the shortest length between it and all other cluster centres.
4. Compute the novel cluster centre by means of the following formula:
   $V_i = \left(\frac{1}{|r_i|}\right)\sum_{j=1}^{|r_i|} x_j$, where, '$|r_i|$' represents the number of data points in *i*th cluster.
5. Compute the length between each tuple and the current cluster centres that discovered in step 4.
6. Stop if no data points were reassigned; otherwise, continue from step 3.

Spiral method for n-dimensional data is used to construct logarithmic spirals is depicted in algorithm 2. The spiral methodology for optimization is a structure which is dynamic in nature whose condition $x(k) \in R^n$ converges to a centre $x^* \in R^n$ with a logarithmic spiral trajectory through an initial point x_0, that is the main term used for clustering techniques using enhanced spiral optimization. SO lacks strategies to disrupt search patterns because its search technique is similar to the methodology of hill-climbing, i.e., to regularly update the finest solution (in this case, the finest centroid). As a result, during the SO convergence process, the spiral's centre can

become locked on the local optima. To address this issue, this paper proposes a new spiral optimization method that uses the foregoing key concept to affect the existing search paths of SO that allows to "escape the local optimum." In a nutshell, the central term in the genetic algorithm is the mutation operator which is similar to the above theme. K-means is being applied to modify the resolutions that the suggested methodology initiate in order to maximise "intensification" of the anticipated method. In addition, to maximise the projected algorithm's "diversification," the data is split into many sub parts, similar to the GA island model, which would then share information with one another. The algorithm 1 shows the k-Means technique that was used to maximise the performance. In K-Means clustering, an appropriate similarity metric is chosen depending upon the type of data being clustered; some well-known proximity measurements include Euclidian distance, Manhattan distance, Minkowski distance, Hamming distance, Mahalanobis distance, and many more. The following formula is being used to locate the new cluster's centre.

$$V_i = \left(\frac{1}{|C_i|}\right) \sum_{j=1}^{|C_i|} x_j \tag{8}$$

3 Proposed Algorithm

Algorithm 2: The proposed algorithm
Let D be the dataset containing the N number of data points.
Let C represent the set of clusters from D.

1. Set the parameters θ and r to the values (0, 2π) and (0, 1) respectively;
2. Select the random points as initial centroids;
3. Apply k-Means algorithm to get a set of clusters $C = \{C_1, C_2, \ldots C_k\}$
4. for each centroid $\{c_i \in C / i = 1, 2 \ldots k\}$
5. for each point $\{x_i / x_i \in D\}$ Begin
6. for k = 1 to k_{max}, Begin
7. $x(k+1) = S_n(r, \theta)x(k) - (S_n(r, \theta) - I_n)x^*$//where S_n, I_n is as described in Eq. 7.
8. End//step 6
9. Calculate the distance between each new data point and cluster centre c_i.
10. End//step 5
11. End//step 4
12. Assign the original point to the cluster centre c_i as in K-means with respect to the corresponding new data points.

13. Recalculate the new cluster centre as in K-means
14. Stop when no data points were reallocated; otherwise, continue from step 4).

To obtain the optimal clusters using the phenomena of K-Means clustering the strategy that is used in spiral optimization which is defined in Eq. (7), is included as a step in K-Means clustering. Algorithm 2 explains the overall methodology.

First, as seen in algorithm 2, the inputs θ and r are initialized to values in the ranges (0, 2π) as well as (0, 1) respectively. K-Means clustering is then used to segment the population into subgroups (i.e. clusters). After that, each subgroup is initialized by selecting the clusters formed in the above step. Then, using K-Means clustering technique, the best centre (i.e., the centre mostly with highest fitness value) from every cluster c is chosen, as seen in the algorithm. Each data item in the current implementation is rotating first and It should be noted that the points are rotated around the cluster's chosen centre with respect to the rotating mechanism is as given in Eq. (7). Compute the distance between the centre and all of the data points that are formed after rotation and assign the original points to the relevant clusters depending on the distance found with respect to newly formed points, this step is similar to crossover the chromosomes of the data set. After that, the centre of each cluster is updated and It would determine whether or not the stopping criterion has been satisfied. If the terminating match is found, the algorithm will conclude and retrieve the optimal so far point as the final result; instead, it will start implementing the three operators (rotation of points, distance calculation and centre updating) as shown in algorithm.

4 Experimental Results

Evidential experiments on databases, assessment methods, and similar solutions of the planned method be presented in this chapter. In order to assess the importance of the projected clustering strategy, tests were also conducted on K-means clustering, which attempts to group the provided data from UCI data sets [16]. Various cluster determination metrics, such as cluster pureness and cluster HM, as well as conflicting definitions of both, are used to assess the exactness and degree of efficiency of the novel solution.

The recommended data records are chosen based on subject viewpoints and information bases to set it up. Furthermore, grouping of these data into corpuses is noted, which aids in the optimum cluster evaluation based on the chosen parameters. The method was tested on a machine with a 4-GB RAM capacity and an i5 cpu. The instructions use the Python programming language to explain how to calculate the outcomes on the resulting clusters.

Table 1 The provided algorithm's parameter settings

Parameter	Proposed algorithm
Angle of rotation (θ)	$\pi/2$
Rate of convergence (r)	0.994
Number of runs (k_{max})	30

4.1 Proposed Solution Evaluation Parameters and Strategies

Pureness measures, as well as reversed pureness and cluster HM, play an important role in cluster evaluation. Purity of cluster refers to the frequency of each group of each obtained cluster. While the Purity parameter will eliminate noise from clusters, it cannot distinguish correlations between data. For example, if each record is called a single cluster, the purity parameter gives such clusters a higher purity value. As a result, the inverted purity parameter is used, which is essential for evaluating data clusters as related categories. This inverted parameter is critical for determining which group has the maximum recall value for each grouping. Since this function is unable to nullify the mixture of numerous records captured from various fields, determining a cluster involving all input records gives the maximum importance to inverted purity. In addition to the above two conditions, the HM of clusters is taken into account. The inverse purity and mixture of purity, referred to as F-Measure, is calculated by comparing each group with the cluster with the highest combined precision and recall [15, 17–20]. The model parameters for the empirical tests of the suggested solution are shown in Table 1. Table 2, displays the statistical evidence from the proposed method's experimental study.

Table 2 Comparison of the suggested algorithm's experimental findings and K-Means clustering

Data set name	Iris		Glass		Wine	
Name of the algorithm	Proposed algorithm	K-Means algorithm	Proposed algorithm	K-Means algorithm	Proposed algorithm	K-Means algorithm
Number of tuples	150	150	214	214	178	178
Number of clusters	3	3	7	7	3	3
Average F-measure	0.81	0.77	0.84	0.77	0.79	0.747
Average cluster purity	0.86	0.81	0.81	0.76	0.8	0.75
Average cluster accuracy	0.85	0.77	0.9	0.85	0.89	0.83

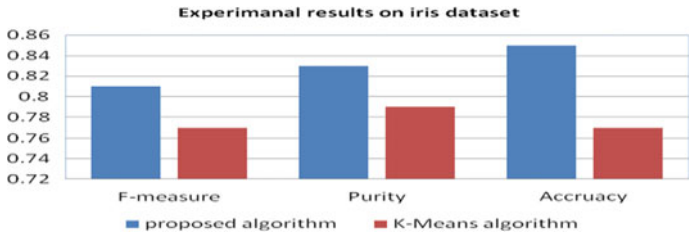

Fig. 1 Resulted values for iris dataset

The purity, F-Measure, and precision of clustering on various datasets are depicted in Figs. 1, 2, and 3.

The above-mentioned datasets findings demonstrate the proposed clustering technique's phenomenal efficiency benefit. The purity, accuracy, and cluster harmonic mean of the suggested methodology's resulting clusters are all higher than that of the order of k-means clustering.

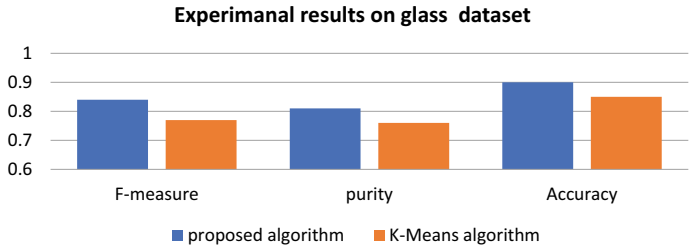

Fig. 2 Resulted values for glass dataset

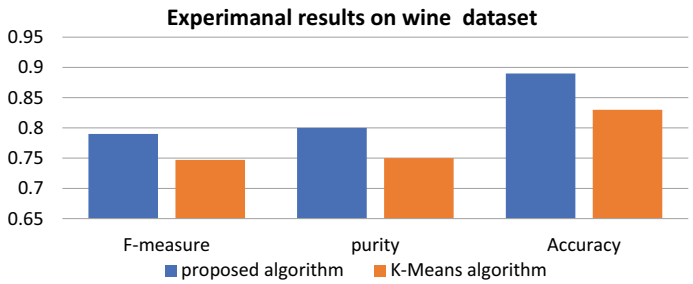

Fig. 3 Resulted values for wine dataset

5 Conclusions

We suggest a clustering approach that is based on spiral optimization and k-Means clustering for continuous and discrete data objects in this article. We tested our suggested method on benchmark datasets with a variety of characteristics. The experimental findings prove that the proposed method is successful for clustering on actual datasets. The experimental research also demonstrated the importance of the proposed methodology for clustering the provided data during the unsupervised learning process. The proposed model's efficiency was evaluated by contrasting it to the findings of another conventional model known as K-Means. To analyse the effectiveness, various cluster efficiency metrics like purity, f-measure, and accuracy were used. The findings of the empirical analysis prompted further studies in a variety of areas, including the use of the proposed system in diverse methods and ways to develop additional useful models for determining the validity of different attribute values. Furthermore, the results of the experimental study are thought to encourage the research to expand in a variety of ways, including the use of the proposed technique in various applications.

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Malware Techniques and Its Effect: A Survey

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Abstract Malware is worldwide outbreak which tends to mitigate attacks and collects private data. Studies said that the impact were surpass. There are a variety of malware by which it attacks on honest users. Malware detectors are basic tools to protect against malware. It is therefore important to study malware detection techniques and identify the type of malware attacked on your system. In this paper we will study what actually malware is and how is attacks the users. The survey provides information about different types of malware attacked on the system. In this paper we will study and analyze different malware detection techniques. There are many malware detection techniques given in this survey with an idea of comparison and decision making to distinguish among the malware. The survey also provides a reference to the user for more information.

Keywords Malware · Creeper · Virus · Worms · Spyware · Key loggers · Botnet

1 Introduction

The term malware is derived from combination malicious software of two words. It is software that creates mischief or hurts the user. Programs are also called as malware because they might perform some unknown operations in the system without knowing to the user. So many examples are available; here one of example as Sony music CD's install a root kit on purchaser computers with the aim of copying data as they faced a lot of problems in the future. Malware are different from normal programs because most of them can spread itself in the network, damage the infected system [1].

These malicious programs have different functions such as stealing, encrypting or deleting the sensitive data, alerting or hijacking core computing functions and monitoring users' computers activity without their knowledge [2]. They have the ability to bring down computer performance to knees and can cause destruction to

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the network. The most common way of attacking the system is Internet as users visits a lot of websites and there may a chance that some websites are malicious.

Malware authors use variety of techniques to spread malware that infect devices and networks. The most common way is Internet. If a user is visiting some malicious website then by downloading pirated contents like emails, videos, advertisements, movies, pirated games or software, or any files then there is high probability that malware enters your system in [3, 4]. If the malware is built by using advanced technology then it directly access the Operating systems then it starts to encrypt files and record personal information. Malware can also transmit by offline like if a user plugged in a pen drive which contains malicious code or via a CD/DVD.

Malware spreads via a file or link by an email and if the user clicks on that link or open the file which he received through an email then malware executes. Malware is in fact a possible threat to individuals and managing organizations. From a very long time, Creeper virus is first appeared and its evidences suggest it came in the early 1970s e. Some strains are sent to link, or over email or through some executable file. Instead of the same, it may be passed through social media or messaging systems. The internet mobile devices may also be vulnerable to attack [5]. Malware is a collective term of all kinds of threats. Many believe that malware is same but each malware is distinct and have different attacking techniques in the form of Adware's, Botnets, Trojan horse and many more.

2 Background Details and History Behind Malware Generations

The early malware was spread by offline by floppy disks (which are carried from computer to computer) [6]. Here is a list of some early versions of malware:

- **1971 Creeper**: As an observation, it was designated to test on a program that might move between one computer to other computers. The creeper program will run on the TENEX operating system and spread through the ARPANET. The systems which are infected by the creeper they display the message "IM THE CREEPER: CATCH ME IF YOU CAN". So when the creeper program will run it will try to print the file but if it doesn't print then it will find another TENEX system and to set up the connection and transfer to the other system and start running on it.
- **1974—WABBIT**: It is a self-replicating program, it will recreate itself on a computer until it slow down the system, and it also makes this replication process until the system performance was reduced and it might eventually crash the system. WABBIT (rabbit) name is given by researchers to this virus because of the speed at which it was able to replicate. It does not require any program and documents for nesting. It works locally and does not require a network connection. The main purpose of WABBIT is to consume resources on the computer operating system and it will reproduce itself continuously to meet the user hard drive capacity. Ex: fork bomb.

- **1982—Elk Cloner**: It was the wide spreading and self replicating microcomputer virus which stores on floppy disks to affect the PC's when the computer booted from the floppy disks which was infected, then the virus copy was placed into the computer memory. So when the normal uninfected disk was inserted into computer then the entire disk operating system (DOS) along with the Elk cloner virus will be copied to the uninfected disk. In this way the virus will transfer from one disk to another disk.
- **1986—Brain Boot Sector Virus**: It is the first computer virus to infect the MS-DOS. It was the standard name to the computer virus. Brain effects the IBM PC by replacing the boot sector (boot sector is a sector of a data storage device) of a floppy disk with the copy of boot sector virus and the origin boot sector is moved to another disks and it was marked as bad. Normally Infected disks will have 5 kilobytes of bad boot sectors and the disk label was changes to @Brain.
- **1988—Morris Worm**: It was self replicating worm written by a student at Cornell University who named Robert Tappan Morris. According to him the purpose of this worm is to measure the size of the precursor of "internet" of time—ARPANET (The Advanced Research Projects Agency Network). Although it caused denial of service for about 10% out of 60,000 computers which are connected to ARPANET. The worm spread by making use of vulnerabilities in UNIX send mail, finger as well as by guessing weak passwords. Before it spreads to any other system. This worm checks that "the computer is infected or not" and was running a Morris Worm process. If it was infected then Morris worm will re-infect it 1 in 7 times so that the user will not avoid Morris worm infection by creating fake Morris worm process.
- **1991—Michelangelo Virus**: It will re-write the first 100 sectors of the hard disk so by this the file allocation table will be destroyed and computer cannot boot. it is having destructive payload where all the data will be replaced with the random characters so that the data will not be recovered and it damages the disks And this will be done only when computer is booted on his (the artist Michelangelo) birthday dated March 6 and the virus will not check Master Boot Record (MBR) is infected previously or not. If MBR is infected by same virus then it will move the previous virus to the original MBR where it was stored so that recovery of MBR is not possible.
- **1999—Melissa Virus**: It was the fast spreading macro virus that will spread by an email. It targets on Microsoft Word and Outlook-based systems. The virus infects the computer through the emails with the title "Important Message From", followed by current username. So when the user clicks on the message it displays "Here's that document for. Don't show anyone else" and below there will be another document with the title name list.doc so when user click on that doc to open the file then it go for login to pornographic sites unknowingly. Then it will mail itself to the first 50 contacts of users contact list.

2.1 Types of Malware

There are various types of malwares as known in the form of Virus, Worms, Trojans and many more. We are describing as.

2.1.1 Computer Virus

It is in the form of malicious software program code, so when program code is executed it creates the multiple copies of itself by modifying other computer programs by inserting its own code, when this replication is successful then the areas which are affected by this program are considered as infected with computer virus. It is designed to infect objects on the disk. It can corrupt particular file or software often triggered by individual's action. An example if there is a word document and the virus has corrupted the documents then it becomes junk and we can't retrieve the information or even it can corrupt the word processor s/w completely. At this time if we try to copy the document from one computer to another then it damages the other computer. If a virus is attached to a program, file, or document then virus will be in inactive state until the situations cause the computer to execute its code. It can spread through emails, text messages, Internet file downloads, links etc. To recognize computer infected with virus, here is the list of points to check whether your computer is infected with virus or not:

- Occurrence of nonstop pop-up windows.
- Some unknown changes are done to homepage.
- Large number of mails will be sent from a user mail account.
- Constantly crashing the computer.
- The performance of the computer to slow down.
- When the computer is turned on the hidden programs will run.
- Some unexpected things might happen like changing passwords.

2.1.2 Worms

A worm is computer malware program it spreads the copies of itself from one computer to other computer, but instead of writing code in multiple times, if it is installed once then it looks for the other system to infect these worms can enter into our systems as attachments in spam emails [7]. Once it is opened it provides some link to a malicious website or it is automatically gets downloaded and starts infecting the systems. It may modify, delete the files or it may also inject malicious software. Sometimes it may keep more and more copies of itself and overloads the hard drive space. It harms the system. It may also steal data by installing a backdoor and allowing a hacker to gain control over a computer and its system settings. To recognize a computer has a worm, here are the list of points to check whether your computer has a worm or not:

- **Check your hard drive space**: As the worm spreads the copies of itself from one computer to other computer repeatedly so they use the computer unused space.
- **Monitor speed and performance**: If some programs are crashing or not running properly then that could be a warning that a worm is eating up your processing power.
- **Keep on checking new files and old files**: The computer worm has the functionality to delete and replace files on a computer. So it would be better to check the new files and old files frequently.

One of the Worm example is Morris worm—it was the self replicating worm, written by a student at Cornell University who named Robert Tappan Morris. He wanted to discover "how big the internet was". But the code contained bugs and caused variety of problems and damaged around 60,000 UNIX computers, financial damage between 10 $ million and 100 $ million.

2.1.3 Trojan Horses

It is a malicious program that does not replicate but remains unnoticed and collects the username and passwords. It gets downloaded when we install any software or any mp3 songs or any games from a strange website. So it enters into the system without the knowledge of user and it helps criminals to get access over the user data and causes serious damage to the system. It has same privilege as the user has. As it has same privilege it can delete or modify the files or it might install some malware software unnoticeable. Most of the criminals use Trojan because it is unnoticeable. It performs the activities such as creating backdoor to get access, disabling the firewalls, antivirus etc. The working of Trojans can be best explain in an example, if you received an email from someone and you try to click on that which looks like valid attachment then you will be fooled because the email is from a cyber criminal, and when you clicked on the file it will be downloaded and opened which has gone on to install malware on device [8]. Backdoor Trojan permits access to the system by an unwelcomed party by allowing remote administration of system which will include a key logger-which records every key pressed to find the users confidential data. Here are some common types of Trojan malware:

- **Backdoor Trojan**: The Trojan will create the backdoor so that the attacker will gain access to the systems and the attacker downloads your data and he might add malicious software into the systems.
- **Distributed Denial of Service attack Trojan**: These Trojans will carry the attacks against the computer networks which gets installed or downloaded via spam emails and turns those systems into parts of Botnets. These Trojans will have a backdoor through which hacker's gets access to the devices and it activates their Botnet army to attack coordinately. Once it is activated then it starts generating traffic to the server, website by sending request continuously. By sending continuous request the server or the website will shut down and visitors or the users cannot access them.

- **Downloader Trojans**: It targets already infected computers. It does not have any backdoor but it performs the actions which benefits to the hacker. These Trojans downloads the variety of files and programs on to the hard drive. That includes unwanted apps, or upgrades for the installed malware.
- **Fake Antivirus Trojans**: These Trojans are download as same way the other Trojans via email attachments, visiting to malicious links. Once installed it acts as antivirus software and continuously informs the user about the non-existing security threats found in their device. It is same like ransomware. It prompts the user to pay money to download the full version antivirus software. And pop ups will continuously appears with false alerts even the user is working anything else.
- **Infostealer Trojan**: It steals the data from the infected device.

One of the example of Trojan horse is Strom worm a backdoor Trojan created by Russian hackers, in 2007, that was distributed to the millions of PC's worldwide via emails about a fictional strom wave that was killing many people in Europe. These Trojans are used to create Botnet and attacks against the websites and servers and cyber security companies.

2.1.4 Ransomware

Ransomware is a type of malware if a system is attacked by this malware then it threatens to publish the user data or it may block the access to it until the demanded amount of money is paid. And there can be some simple ransomware which may lock the system. It is not so difficult for a knowledgeable person to remove that lock [9]. But if the user pays the demanded amount of money also there is no guarantee that payment will result in the correct decryption key or that the decryption key provided will function properly. Some of the Common types of ransomware are:

- **Crypto locker**: It encrypts the user data of each file with the randomly generated symmetric key and this symmetric key is encrypted with the public asymmetric key. Key and adds this to the file. Once all 70 common types encrypted then it displays the message demanding for money to decrypt the encrypted file, if they won't return money then symmetric key will be deleted and data will be lost.
- **Scareware**: It acts as the antivirus software. It finds the issues on your computer and it demands money to recover it. Some types of scare ware may lock your computer.
- **Raas (Ransom as a service)**: It is the malware hosted by the hacker to steal the files, information and system hostage and then requests for a ransom to return the access to the victim.
- **Mac ransomware**: The ransomware called KeRanger attacked Macoperating systems. This malicious software infected apple user systems through the app named Transmission which encrypts the victim
- **Ransomware on mobile devices**: Ransomware attacked mobile largely in the year 2014. It enters through the malicious app that says it has been locked due to illegal activity.

The targets of ransomware attacks are having target groups:

- **Groups that are recognize as having lesser security teams**: Universities can come into this category because they have high file-sharing with less security.
- **An organization that pays quickly**: Government agencies, medical facilities, banks, etc. this kind of groups can come into this category because they need quick access to their files. So they may willing to pay to get the access quickly.
- **Organizations that having sensitive data**: Firms that are having sensitive data are targeted because cybercriminals on the legal argument could result if data is hacked and inform them about data is held for ransom.
- **Businesses in the Western market**: Cybercriminals will target those who pay much i.e., corporate entities. This involves focusing on the United States and the United Kingdoms, Canada due to greater wealth and PC use.

A one of the example of ransomware is Crypto Locker, this is a that was first seen in 2007. It enters via infected email attachments. Once it is entered it searches for files to encrypt and hold it for ransom, caused 5,00,000 computers. Security companies managed to seize the worldwide network of home computers that are used to spread the Crypto Locker. So by doing this the controlled the part of criminal network and snatch the data by without knowing to the criminal. Later this actions led to development of online where the victim can get the unlock key and release the data without any payment.

2.1.5 Spyware

Spyware is the malicious software that enters into devices and snook personal information and mainly the internet data. It is mainly designed to get access over your computer without the user's knowledge. It gathers your personnel information and relays it to the external users or to the other data firms. Its aim is to track your every data and sell your internet usage data. It also captures your credit card details and bank account information, or it steals your personnel identity. Some Spywares install other malicious software like Trojan and keep backdoor as well. Even they can install a keylogger to keep track of credit card details and other personal details.

- According to Norton Cyber Security Reports. In 2017, there are 978 million people in 20 countries were affected by the cybercrime.
- Spyware is a threat to organizations and to the every individual user because it tracks the private data.

For example: key logger it is a malicious program that keeps the track of everything we type and sends to criminal who has created the key logger. Spyware infects the computer by following effects on PC's, Android or IOS, Mac's, devices and even windows are more susceptible to attacks. These are the common ways to become to recognize whether spyware is present or not:

- Accepting pop-up or prompt window without knowing it.
- Downloading the pirated software.
- Accepting unknown sender emails attachments.
- Downloading movies, songs or games from untrustworthy source.

The spyware can be prevented by following points

- Don't download the software from unreadable source.
- Do not open email attachments from the unspecified senders.
- Do not download files from duplicitous source.

A Spyware example is Dark Hotel it targeted businesses leaders and the executive leaders using hotel WI-FI. To gain the access to those powerful people's systems, they used different types of malware. Once he got the access then attacker installs the keylogger to capture everything including the Usernames and passwords and some other sensitive data.

2.1.6 Adware

One of the most reasons for adware is to collect the information about the user to make the advertisements based on that. It is called adware when it is on the computer and it is called as malware when it is on the mobile or tablet. This adware or malware slows down your systems and even it might prone to crashing.

The effects of adware are:

- **Slow computer**: It takes longer time to launch and run the programs or to load the documents or files, anything else you do, then computer have an adware. It slows down device processor and takes lots of memory space. In this way it decreases the overall performance.
- **Attack with ads**: Normally it is usual to get the advertisements when browsing. It's even normal to those ads that related to something you searched before. If the ads are getting continuously and unable to close those or they are redirected to full page ads, then your system is infected with the spyware.
- **Constant crashing**: If the programs are continuously crashing then your system is infected with the adware.
- **Browser home page changes**: It is also known for changing the browsers home-page. It may redirect to a new page to install the more adware and other forms of malware on to the system.
- **Slow internet connection**: It slows down the internet connection because it downloads lots of advertisements from the internet.

An Adware example is Fireball: it is an adware that contaminated 250 million devices and computers in the year of 2017. It hijacks the computer browser to manipulate search engines and starts tracking the network tasks.

2.1.7 Rogue Software

Rogue software is disgruntled software in the form of malicious code, and it can be considered as an Internet fraud way because it deceives users into trusting that there exists a virus on their computer. The major attention points to noted for a fake malware tool, it changes user's credentials through fear and it is considered likely to be form of ransomware.

2.1.8 Key Loggers

A key logger (also known as keystroke logger) is software that routes the keys stroke on your keyboard in a secret way so those users don't know that tasks are being observed. In collection of the account information details, credit card information, name of user, secret passwords, and other some private data, this is actually done with the malicious intent. It can cause serious threat to the users by intercepting passwords and some other confidential data entered via Keyboard [10]. Mainly keyboards plugs are present at the back of the computer, so that user cannot see the connections. Whenever the user hits the keys, everything will be collected and save as a text in its own small hard drive consists of several gigabytes of memory.

A keylogger software installed two files in same directory. One file was the DDL file which does all the recordings and the other one was an exe file which positions the DDL file and activates into the function. Keylogger will record everything that user types and informs to one who installed that keylogger. Besides keystrokes, some key logging programs also have the functionality to record the user's data, such as noticing things which are copied to clipboard and taking screen-shots of display screen.

Keyloggers Categories

The keylogger is divided as the software based and the hardware based. These are the common keyloggers with both of these categories.

- **API based keyloggers**: This keylogger software will use API (application programming interface) keyboard to take down the entire key bash. Whenever you type a key then an alert message will be shown on that application saying that you are active to the hacker. So that every character will be seen on the screen. This keyloggers captures everything as separate one. And the logs are kept on the small hard drive for easy access.
- **Form Grabbing based keyloggers**: This Grabbing based keyloggers logs the data from the online forms when user submits his/her form to the website. It is quite similar to the above keyloggers as they breaks (interrupt) the submission and retrieves data which is in form. This includes like name of candidate, login credentials, gmail, phone number of user. This whole process takes places when the user

clicks on submit button and it is being retrieved before the form is transfered to website.

- **Kernel based keyloggers**: This keylogger slows down the core of the computers kernel which is very difficult to detect and remove. So this keylogger software hides inside the operating system and records every keystrokes as they pass through the kernel. They are distributed through Rootkits, or through the other malicious software that bypass kernel operating systems and targets the hardware.
- **Hardware keyloggers**: These devices utilizes electric circuit inside the keyboard to log the keystrokes. So these are created in the keyboard and also available as the USB connector for PC's and the Mini-PCI card for laptops. This keylogger will have the internal memory to store the keystrokes i.e., the hackers must have the physical access to the keyboard to get the data.
- **Acoustic keyloggers**: Acoustic keyloggers are complex. They uses principles of acoustic crypt analysis to track down the keybash. Each key whatever the user types has unique acoustic signature. There might be a little bit of difference but individual signatures are analyzed through the statistical methods Key loggers will spread as the same as other malicious software. This keyloggers are purchased knowingly to threat someone. Keyloggers enter through the emails, instant messages or by visiting the malicious websites. Key loggers are difficult to detect. But it can be detected if the users have following issues with the systems.

Slow performance when browsing the web. Mouse or keystroke pause or showing nothing whatever the user types or it shows the error screen when loading the graphics or web pages.

2.1.9 Botnet

It is a bad intention for good technology. This is string of connected devices to perform the tasks. It maintains the chat rooms or takes the overall control of computer. This botnets are dangerous in internet. They are the work laborer of the network. They are connected computers performing a number of repetitive tasks to keep websites working. In such situations system is directly hacked but sometimes a program crawls the internet to exploit the security and starts hacking automatically**.** The botnets adds user to their website. It happens through downloading the drive-by software or by tricking you to download the trojan horse on the computer. Once it is installed it gets contact with its master computer and it informs that everything is ready. Therefore the computer is now under control of the one who created the botnet into the system. Once owner of botnet gets the control of the user's computer, they use the user systems to perform some criminal tasks. These are the common tasks that are executed by botnets:

- To attacks to shut down websites, it launches the distributed denial-of-service (DDos).
- Sends spam emails to millions of internet users.

- Creating the fake traffic over the internet over a third party websites for financial gain.
- Targets the user by replacing banner ads in user web browser.
- Pop-ups ads are designed to get user to pay for the removal of the botnet through a phony anti-spyware package.

3 Conclusion

We have presented a survey on the various malware attacks and their effects from beginning to advance. These buzzwords in security like virus, worms, ramsomware, spyware, Adware, Rogue software, keyloggers and more have surprised in the digital world. The online activity placed on the vulnerable risks from financial loss to keyed data loss associated to them.

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Peer Level Credit Rating: An Extended Plugin for Credit Scoring Framework

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Abstract Credit scores hold significant importance for the people to avail credit from the banking and fin-tech companies. With the increasing trends of using the contemporary model of credit history evaluation, there is a need for a more comprehensive solution that can take in to account the peer trust factors too. In this manuscript, the emphasis is on understanding the existing set of machines learning-based credit scoring systems and to propose a "Peer Level Credit Rating" system that can support in a more comprehensive solution. The proposed framework upon testing in conjunction with some of the existing credit evaluation solutions, the accuracy and the structure of the credit scoring system can be more strengthened. The key benefits of the proposed framework are responsibility and accountability tagged to the trust score from the endorsers and to develop a sustainable scoring pattern for managing the credit scores of individuals.

Keywords Credit scores · Fintech · P2P lending trust · GA based credit score

1 Introduction

The economic development of a nation depends on various factors, wherein even the banking system is one of the critical factors that influence the holistic economic development. The business fundamental of a bank relies on a sustainable model of a collection of deposits from the customers, disbursal of loans, interest collection over the loans issued.

The credit management systems of the banking industry have evolved over a period of time and today, there are a set of banking rules and practices in place towards disbursal of loans to the customers. Irrespective of credit category (credit cards/personal loans/secured loans/mortgage loans etc.) credit score is turning to be

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one of the important criteria in the process of decision making about the disbursal of loans [1].

Though, there are few other factors like the employment status, organization in which the person is working, income tax filing records, loan amount, etc. are important in the role of decision making, still the credit history (recorded in the form of credit score) is one of the key attributes in loan disbursal. Depending on the nation and its banking system, in every country, there is a par credit score which is considered a good credit history.

Predominantly such credit scores are rated based on the reports furnished by all the private and public banking and financial institutions to a credit scoring agency. The credit history of the individual is managed based on an individual's unique identity number (depending on the country of operations). The information furnished to the credit scoring agencies is profoundly the payment default information, credit utilization ratio (usually in the case of the credit cards), number of loans issued to a customer, etc.

Such credit scores have become a conventional system towards deciding on the credit history metric of an individual. But with the changing times, there are digital payment solutions and many fin-tech start-ups that have proposed contemporary solutions in the disbursal of loans. For instance, in the Indian digital payment's scenario, there are many fin-tech companies offering a distinct set of loans to the customers [2].

Despite that in many cases, still the credit scores are given important, few of the fin-tech companies are looking beyond the aspects of credit history. One of the constraints in the credit history managed in the Indian scenario is the relative credit history (wherein any kind of loan settlements in forced manner) are impacting the credit scores of the customers for long.

Some of the new age fin-tech start-ups are relying on the AI-based creditworthiness evaluation process, wherein in addition to the credit scores, certain other aspects to are taken into account. This kind of AI-based models are helping the organizations in having more holistic profiling of the customers. However, the success of such alternative creditworthiness assessment has many pros and cons.

In an illustrative scenario, some organizations handling instant loan disbursal apps in India, rely on the information that could be captured from the smartphones of the users. With the informed consent from the users, the apps are accessing the incoming text messages, contacts, bank messages and other notifications, social media profile of the users into account, and accordingly, decide on the credit to be extended to the customers.

Fintech start-ups are using such comprehensive analysis system for instant disbursal of credit to its customers. Taking in to account the growing importance for such solutions, this research review report examines the various kinds of AI-based solutions used by the fin-tech companies to work on the creditworthiness evaluation pattern. Such an outlook will help in understanding the existing patterns and if any possible scope of solutions that could be resourceful for the organization in improving the quality of the rating systems [3, 4].

In the further sections of this report, Sect. 2 covers the related work from the literature. Followed by, in Sect. 3 the discussions are carried out on various kinds of solutions that are currently used, gaps in the system and the improvements that could be considered by the system. Section 4 concludes the scope of the study and the potential scope for future research.

2 Related Work

Addressing the European market, a fin-tech company from Europe has developed an AI-based solution called TyrScorewhich takes in to account a distinct set of primary and alternative data in terms of assessing the customer's creditworthiness. The model rates the creditworthiness over a 100-point scale, with a higher score representing the higher creditworthiness of the borrower.

The model relies on the non-traditional data from the customer's social data, online behaviors, interactions over the social platforms, etc. Such a comprehensive solution can support in understanding the socioeconomic, psychological conditions of the customers, thus enabling for better levels of decision making for the banking and financial institutions [5].

In a research study carried out for developing a contemporary creditworthiness assessment model, authors of [6] have proposed a solution which is developed with logistic regression filtering the variables using higher degrees of correlation. Followed by the AI models to mitigate the complexities and enhance the convergence. The study indicates that the experiment of the model over the German dataset has indicated a positive outcome in terms of improving the dimensional interference and positive conditions of credit scoring.

Authors of a research study [7] have proposed a new model of the credit evaluation system, wherein the scoring model is developed using the LR (logistic regression), ANN (artificial neural networks) and the SVM (Support vector machines). The Radial Basis Function Kernel SVM provided as the system for credit scoring analysis can be resourceful for the creditworthiness assessments [7]. If such a comprehensive system is developed for accessibility, it can help in improving the overall structure of the credit evaluation system and help the decision-makers towards the loan or credit approvals.

In a research study that has focused on the usage of the AI models in the credit scoring evaluation, the emphasis is on how the MA (metaheuristic) and the EA (evolutionary algorithms) were considered as significant solutions towards improving the conditions that develop an integrated system. From the excerpts of the study, it is evident that the scope of using the AI-based models in the credit scoring has significant importance and in many of the developed nations, the interest towards using such comprehensive set of credit rating mechanism was on the rise. However, the challenges that are to be taken in to account with the existing set of data is about how effectively the consumer data is garnered by the agencies from distinct sources, which can help the system have more robust solutions in place [8].

Taking in to account the rising number of fin-tech start-ups and the peer to peer lending network applications, in [9] the authors have proposed a niche kind of credit rating and assessment system. The model proposed is mainly to cater to the P2P (peer to peer lending) platforms. The model is profoundly based on leveraging from the topological information embedded into the assimilation of networks which are derived based on the financial information available pertaining to the borrowers. Topological coefficients focus on the importance and community structures that are developed as additional variables for analysis, which can result in more comprehensive system development for credit scoring.

One of the fundamental factors in the case of the credit scoring models is the evaluation accuracy and the prediction outcome. In the case of the traditional scoring models, a certain set of structured financial documents are taken for statistical inference to decide on the credit scores. But in some of the unconventional models proposed, few of the factors like the social network of the individuals, their consumption pattern, their professional and private network, financial related habits and patterns, credit hungry conditions, what kind of social conversations the individual holds, etc. to are taken in to account in deciding the effective set of credit scoring conditions. If such a comprehensive system is used for evaluation, the scope of bad debts or non-performing assets for the financial institutions can reduce significantly.

"A Hybrid Meta-Learner Technique for Credit Scoring of Banks' Customers" is proposed in [10] post the comparative analysis of a significant set of credit assessment models. The hybrid model proposed in the research is the based-on insights gathered from the distinct set of models evaluated. Focusing on the two kinds of hybridization models and its operational efficiency, in the study, hybrid meta learner model was proposed. The fundamental solution employed in the system is the usage of classification and clustering together wherein the stacking ensemble method is adopted as the process. The study, on the basis of the experimental study carried out on real-time datasets, has claimed that (KNN-NN-SVMPSO)-(DL)-(DBSCAN) is providing the more optimal set of accuracy with lower levels of error rates.

Parameters that are selected in the case of credit evaluation holds significant importance. In addition to the fundamental financial information, some of the factors like the nature of employment, occupational risks involved, the credit repayment history, family dependency, dispensable income ratio, savings habits, compliance to the regulatory norms like taxation, etc. are some of the key parameters from the financial dimension. While the personal facets like the social network, spending and consumption habits, health-related issues if any, physiological or psychological factors that might affect the financial health of the individuals are also focused upon in the contemporary solutions.

Focusing on such comprehensive inputs, in the study [11], the authors have focused upon some of the models discussed in the solutions and accordingly has provided inputs in terms of how the GA (genetic algorithm) model can be one of the effective solutions which can support in shaping the credit rating system. It is evident from the studies that when there are a certain set of systems for managing the credit patterns of the customers, the accuracy in the system can be more effective.

The other similar set of a study carried out on the usage of the AI models for credit scoring system has proposed the solution wherein ten classifier agents are used as members towards addressing the ensemble mode. Focusing on the classifiers sets of SVM, Decision Tree, and the Neural networks, the model has proposed a structured solution wherein the accuracy of the prediction in credit scores has improved. There are a certain set of developments that are taken in to account for the conditions that can support the overall system of credit management, and the system is turning to be more effective [12].

In one of its market study report by the Financial Stability Board, the study highlights the fact "It will be important to assess uses of AI and machine learning in view of their risks, including adherence to relevant protocols on data privacy, conduct risks, and cybersecurity" [13].

Considering the level of information security challenges that are being encountered in the industry, the viewpoint mentioned in the report has critical importance. For instance, when the companies are managing so much of personal information in the system, the scope of system compromise and the information security remains high.

As pointed in the report, though the alternate models of the credit evaluation process are gaining momentum, still some of the factors to be taken into account are about understanding how the ethical aspects of focusing on too many personal aspects of the individuals. For many of the consumers, who don't have a formal credit history, this set of contemporary assessment models could be a boon. But the issues of snooping to personal data of the consumers always remains an ethical concern.

In [14], the study has focused on the dimensions and metrics that are considered in the credit score evaluation. In the machine learning models, the role of feature selection holds critical importance. The study focuses on the four sets of feature selection models that were earlier proposed for the credit scoring models and provides insights into the more suitable solution.

In summarization of the related work, it is evident that the decisions made using the algorithmic credit scoring application patterns are resulting in a more accurate outcome than the traditional models. One of the key reasons why the machine learning-based models are turning to be a more significant system for the credit scoring is the absence of scope for biased approach, less human intervention in the system, or any kind of socioeconomic biases that are impacting. Despite the lack of clarity on how the gaming solutions used, the smartphone category or brand used, and the network profile of social media might be resourceful in calibrating the credit score of the individual, still the fact remains that the numbers do not mislead.

3 Discussion

Credit scoring systems and credit assessment for the customers of the fin-tech solutions have become an integral part of the business system. However, the categorization of the customer profiles, allocation of credit to the customers is based on a distinct

set of solutions that the financial institutions are relying upon. Though there are imperative conditions of no standard procedures that are followed as a mandatory policy, the models of creditworthiness and credit score evaluation have evolved over a period of time. From the simple procedures of financial document-based analysis to the current trend machine learning-based credit scoring system, there is a paradigm shift that has taken place [1].

From the review of literature, it is evident that the machine learning-based models of credit scoring systems are turning to be fruitful and it provides a significant outcome in the real-time scenario. The point of contention in the current practices are about the accuracy rate of the credit scores that are generated by the machine learning-based solutions.

However, in the set of machine learning models that are proposed or the ones that are used earlier has a certain set of conditions ignored, which could be value addition in the right assessment of the scores. For instance, in the case of the fin-tech apps that rely on the social network profiling, and the text messages in the smartphones of the users, the process of score decision is highly reliant on the information available.

In an illustrative scenario of a user who has the social network profile, but is not highly active over social media, might be receiving lesser weight in the scoring. In the other dimension, it is not necessary that all the connections in the social network havea good acquaintance with the user, and they may hardly have any personal interaction. In such conditions, the social network figures of the user might be wrong inference [15].

The other scenario which could be attributed to the condition is that the user might not be interested in any active discussions or might have set off the message notifications to the smartphone devices. In such cases, there are potential chances of an inadequate or inappropriate set of information about the customers, in terms of deciding on their credit scores.

Considering the above-mentioned case scenarios wherein there are limitations with some of the existing credit scoring models, an alternative credit scoring framework is proposed in this manuscript.

4 Proposed Credit Scoring Framework

The framework proposed in this research article is the “peer-appraisal credit scoring”, wherein in addition to the existing set of feature selection, the peer ranking system is introduced in the credit scoring system. The inspiration for the model is derived from the basics of peer to peer lending networks. In the case of the peer-to-peer lending models, one user in the application network shall request for the funds, and based on certain evaluation criteria and the profiling, the other members in the lending network might extend the loans.

In the whole process, in addition to the credit evaluation, the factor of “trust” has significance. Deriving the value of trust in the lending formats, the proposed framework is attributed to peer-trust score. Similar to the age-old processes, wherein the

banks undertake the surety or guarantor for the loans or credit availed, the process of Peer Level Credit Rating, is about people from one's network endorsing the financial and personal repayment capacity of the credit availing member. To keep a check on the false referrals, the trust scores of each of the users are interlinked. The algorithm discussed below indicates the framework proposed.

4.1 Algorithm

Section—A (Credit evaluation process)

Let A be a customer of a fin-tech app, if A applies for credit from an institution, a_1 shall be seen as the first level credit score.

If $a_1 \geq K, K = CIBIL$, Experian, FICO, Tyrscore, etc. {k-is the minimum credit score considered by the organization,}—then the credit request is approved for further processing.

If $a_1 \leq K$, then the "Ts" (Ts—trust score)—processed for evaluation.

{Ts is the aggregate values of trust rated by the peer network of A on a scale of 0–20 (rating carried out in a discretionary manner)}.

{if the cumulative ratings are higher than 100, it considered as X_1 and for every additional 100 points the x multiples to X_2 for 200, X_3 for 300 points … Etc.)}.

{in collection of the trust score rating from peer networks like B, C, D, their personal credential like the PAN, or security number or unique identification number is recorded, to avoid any malpractices}.

$X_n(X_1 \, or \, X_2 \, or \, X_3) = \sum(Bs + Cs + Ds \ldots)$ wherein the Bs, Cs, Ds stands for the trust shown by the social and personal network members of the A.

$En = \sum(X_{e1} + Y_{e2} + Z_{e3} \ldots)$ is an endorsement score {if A has endorsed their peer network member credibility, then Gn score is {$e1$, $e2$, $e3$ indicates the reliability score awarded by the credit system for every endorsement)

$$Ts = (X_n + E_n)$$

Sn is the combined value score based on the other parameters (like the occupation, current annual income, social network, reputation of the organziation, job security etc.)

If $Ts + a_{1+Sn} \geq K$, then the credit request is approved for further processing.

If $Ts + a_{1+Sn} \leq K$, then the credit request is rejected or repositioned for lateral review.

Section-B—(E_n Estimation and Credit Monitoring)

- En Estimation stands for trust empowered on the other applicant members.
- For every trust endorsed to the other member, the point is added to the personal credential of a peer member. (For example, if A seeks the peer trust vote of B, then B endorses trust on A, then b will have one E_n point added to his credibility).

- If A fails to repay the credit in-time or has default payments history, it affects the E_n score of B.
- If A maintains the track of repayment successfully, for every 6 months period, the G_n Score shall be added by 10 points).

Example:

If B endorses trust score for A, C, F (three peer group members), then

$$BE_n = \sum(A_{10} + C_{10} + F_{10}) = En30$$

Periodically, when A fails in repayment of credit, C and F succeeds in payments on a timely basis, then $BEn = \sum(A_0 + C_{10} + F_{10}) = En20$.

The specific purpose of estimating the G_n score is to ensure there are not false trust endorsements to the peer group. In the case of such falsifying endorsements, there is an adequate risk for the endorsers losing their score points.

The following process flow details the framework of "trust-score".

Process Flow:

Process stages	Task/event occurrence description
Step-1	Customer registers to the fin-tech application system
Step-2	Provides preliminary socio and demographic information
Step-3	Provides mandatory KYC documents for verification
Step-4	Application, using the pre-defined Machine learning models shall calculate the credit scores
Step-5	If the scores are satisfied, approve the applicable credit value
Stept-6	If the scores are not satisfied, employ the "Trust Score" model
Step-7	To employ the trust score, the application will seek references from the customer, who can be contacted for a trust score, along with informed consent
Step-8	A trust score request shall be sent to some of the contacts (either random or a mix of professional or personal networks)
Step-9	Based on the cumulative trust score aggregate, the credit score evaluation shall be carried out
Step-10	Verification of the score standard to approve or reject the credit application shall be carried out
Step-11	Credit request or the credit score evaluation is complete

5 Implementation Scenario

The process of trust score implementation, when implemented in the case of the peer network, can be more pragmatic for the small peer to peer lending networks, wherein the opportunity to have more members engaged in their fin-tech network is

possible and also there is a more emphatic kind of credit management records for the consumers. Also, the scope of implementing such peer trust scoring pattern can lead to responsible ways of credit utilization among the consumers.

When the proposed network model is used in conjunction with any of the existing credit score systems as a futuristic model, the accuracy rates and the performance outcome of the model can be adjudged.

In the implementation scenario, synthesis data sets generated are evaluated to test the hypothesis of the model. The tabulated information furnished below holds the crux in the case of the model for generating the requisite values. The models is evaluated in silios, without any integration to the other kind machine learning or AI solutions.

Particulars	Values	Remarks
Actual data set	500	Total synthesis data collated
Records having eligible score	25	records having adequate credit score
Records with poor credit score (PCS)	475	Records for PCS analysis
Records tested for less than 2 peer score	43	Considered with one peer score
Records tested for 2 peer scores	123	Considered with two peer score
Records tested for 3 peer scores	136	Considered with three peer score
Records tested for 4 peer scores	173	Considered with more than 4 peer score

The data that is evaluated is based on the random data generated for the credit score patterns in between the range of 400–800, wherein the data that is suitable for PTS (Peer Level Credit Rating) rating model is chosen for analysis. Considering the key aspects that are to be considered in the process of peer trust scoring, the random peer score levels were tested for distinct set of records as per the inputs mentioned in the table above.

The PTS is garnered on random contact access basis of the peer members social network. In terms of adding the PTS score, all the members irrespective of their credit scoring levels are considered. Both En and Xn are autogenerated to test the data in impartial and unbiased conditions.

For testing the hypothesis of the proposed model, even in the case of the PTS score, random generation of the score was initiated in the range of 10- 40 for all the data records (475) chosen for the PTS analysis.

From the data generated for the synthesis records, it is imperative that the eligibility criteria among the datasets has increased by 63%, wherein the score of "If $Ts + a_1 \geq K$, then the credit request is approved for further processing" has resulted in 299 records from the PTS dataset of 475 and close to 59.8% of the cumulative dataset was considered for the case of the credit eligibility records.

Around 12%, 57 of the PST eligible records has attained the boarder line dataset conditions, wherein the inputs could be attributed to border line failure wherein the Ts score for the individuals has resulted in range of 720–748, when the eligibility criterion score is considered as 750. Rest of the 119 records from random datasets has remained ineligible data for the credit to be issued based on the records. To ensure

that the process evaluation is clear, and the complete model is based on synthesis scores at every point.

Despite the fact that model is to be tested under pragmatic conditions for the disbursal of credit, still the results from the model indicates that if rightly implemented, it can be more benefitcial structure and solution.

6 Conclusion

A credit score is one of the key factors in customer profile evaluation by financial institutions. In the last three decades of time, the ways in which the credit history are evaluated by the organizations is undergoing significant change. From the conditions wherein credit approval is based on the branch manager's discretion to the scenario wherein the machine learning-based models evaluating the social profile, risk profile, occupational profile, etc. of the consumers is a paradigm shift. However, as discussed in the related work of this report, there is an imperative need for a more holistic cadre of credit score development, when social and behavioral aspects are given importance. The "trust score" framework proposed in this model upon implementation in conjunction with the other successful credit scoring models, the scope of improving the peer trust-based lending structure can be improved. As a future extension of the framework models, the other possibilities that could be explored in the system are about using the Peer Level Credit Rating as a feature selection from various social networks based rating system. In such conditions, the model fo machine learning integration could be considered to improve the accuracy of the system.

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Machine Learning Based Solutions for Human Resource Systems Management

M. Rudra Kumar and Vinit Kumar Gunjan

Abstract Human resource management in the organizations today is more of a strategic alignment to the organizational objectives. The role of deep learning models, machine learning solutions handling the human resource management operations are increasing and the organizations are focusing on more pragmatic set of solutions. Machine learning models are currently making strides in to various set of functions in human resource management. This study provides an outline of key HR functions wherein the machine learning and AI based solutions can be implemented, which can improve the process quality. Focusing on three different dimensions of employee engagement, organizational culture management and the appraisal system, three distinct possible and potential scope of implementation of AI solutions are discussed in this report. Usage of decision tree model and the logistic regression models for the training of datasets to the application, can increase the chances of solutions being more significant and the ones that could deliver optimal kind of appraisal system. If the solutions are devised in the discussed lines, it can be resourceful for the organizations towards managing the strategic human resource practices.

Keywords HRM · AI in human resources · Machine learning for employee engagement · Machine learning in HR

1 Introduction

Human resources management is one of the key areas where in the role of information systems has been evolving over period. From the level of personnel department system to the current process of AI based human resource management solutions, there is paradigm shift that has taken place in the domain and significant

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solutions are evolving in the spectrum. In the current competitive scenario for organizations, human resources are considered to be one of the key assets that improve the sustainability of the organizations [1].

In the early developments of human resource departments, the MIS system was prevalent in terms of managing the employee data, pay-roll processing and other services of HR department. With the evolving, IT systems like the enterprise applications, the scope has expanded to the levels of managing human resources using integrated systems. Today, the scenario is about usage of the Artificial Intelligence and the machine learning kind of solutions in the human resource management.

With the increasing need for the organizations to have right kind of resources in the organization and focusing on the optimal performance management of the staff, it is evident that if quality solutions of AI are used, there is phenomenal scope for development. The objective of this review paper is to focus on the current practices of AI and machine learning solutions utilization in the HRM and HRD practices of the organization [2].

Machine learning models are currently making strides in to various set of functions in human resource management [3]. The effectiveness of the machine learning solutions is imperative in the case of the business functions management and though the system is embraced late in the case of the human resource solutions, the benefits of using the machine learning models are benefiting the system implementation.

For instance, the scope of using the bots for HR queries, handling non-human interventional support systems are experimented successfully. In many organizations, the transition from the conventional communication of email-based schedule management to group messaging solutions, etc. are scheduling, project development, and even in the case of general communication solutions. Towards handling such routine and repetitive tasks and at certain level of predictive factors, the scope of implementing the machine learning based solutions can be more pragmatic.

In the further sections of this manuscript, the review of the related work is carried out in the Sect. 2, followed by the discussion in terms of the potential areas of human resource management and human resource development, wherein the machine learning models can be significant solution.

2 Related Work

Human resource management in the organizations today is more of a strategic alignment to the organizational objectives. The transformation from the lines of personnel department to the strategic human resource management approach, has paved way to utilization of the information systems in significant manner. For instance, the current method in the form of using the enterprise applications, human resource information systems and other such phenomenal solutions indicate the ways in which information intelligence systems too are becoming an integral part of the strategic human resource process [4].

The role of deep learning models, machine learning solutions handling the human resource management operations are imperative in the case of

- Interviews scheduling
- Performance appraisals.
- Routine and non-human interventional processes like leave management, payroll processing etc.
- Group meetings management
- Training and development schedule and program management
- Customization of training
- Attrition rate analysis
- Recruitment procedural handling
- Analytics and reporting on relevant HR data
- Streamlining workflows
- Performance analysis systems

There are many aspects of system development domain, wherein the role of the machine learning models is turning to be more beneficial for improving the operational efficiency in the human resources management [5].

Change management and overcoming the challenges in embracing new technologies for the implementation of the existing processes are some of the crux factors to be handled in the transition of a system. In [6], authors have discussed about the pragmatic implementation of the issue in terms of the scope and pragmatic implementation of AI solutions in the HR management. The study highlights four key challenges of using the data science techniques in the human resource management are

- Limitations encountered due to the small datasets
- Ethical aspects in terms of legal and fairness of duty constraints
- Complexity involved in the HR process
- Employee reactions to the management models and the machine learning based decision- making approach.

Also, the study discusses the potential practical responses in the case of the challenges are about the principles are about casual reasoning, process formalization and the randomization of the solutions, which could lead to improvisations both efficient and significant for the development.

While there are many studies promising the role of machine learning in HR, as a positive and impeccable transformation, in [7], the authors of the study has focused on understanding the resistance and the apprehensions that could impact the HR professionals. Using the Delphi technique of study, the research study has carried out a detailed study on how the machine learning based HR solutions might turn to be a challenging factor for the HR professionals and how best the solutions can replace the human intervention.

Figure 1 as depicted in [7] reflects on the wide scope of distinct set of HR functions, wherein the role of AI based solutions are explored.

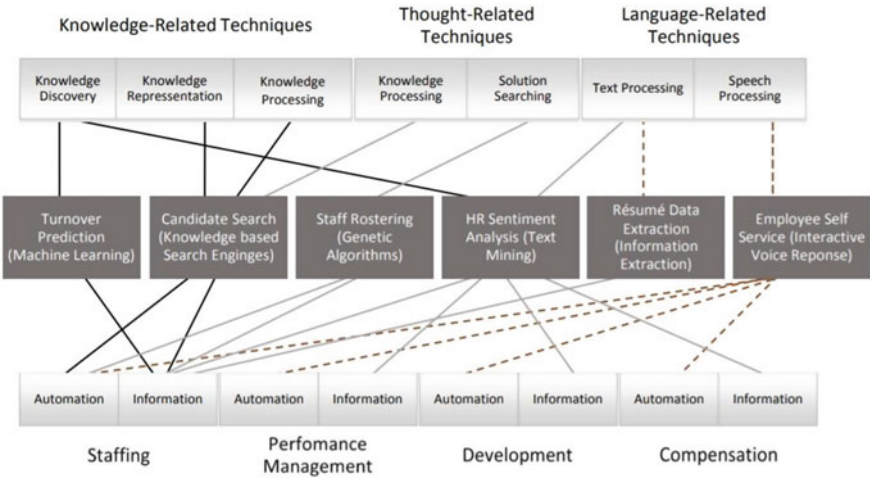

Fig. 1 AI based solutions for HR implementation [7]

Using numerous sets of instances and case scenario analysis, the study concludes that the machine learning models can best be the enablers for the HR professionals in ease of managing the HR functions and towards managing the decision making. But in overall the human resource professionals has still great scope of work to be executed at their competence levels.

This clearly indicates the resistance towards embracing the quality solutions which might ease some of the complex conditions that are prevailing in the systems and the possible solutions that can be embraced by the organization towards contemporary solutions development.

In [8], a qualitative study of the implementation of AI based systems in the human resource division was discussed. The study highlights that in many of the IT companies in the Indian IT sector are capitalizing on the AI based solutions. Though it is evident that the HR practices are paving way to AI based solutions, still the accuracy of the fact that majority of the companies are relying on the AI models might need more insights. The study carried out qualitative analysis and reiterate the fact that the machine learning models irrespective of the kind of algorithm structure are turning to be a positive outlook in the recruitment and selection process.

Though the process is being effective in appraisal system management, still in overall terms, there is need for more deep solutions that can improve the operational efficiency to much higher proportions. The study does not provide any solution-based model on what kind of AI solutions are embraced by the market, but provides inputs on how the companies and the HR departments are keen in the process implementation.

The actual role of human resource management is about enabling the optimum utilization and effective planning of resource management. Categorically in the case of the production and project environment, there is integral need for more emphatic

ways in which the problem is to be addressed. Focusing on such conditions, in [9], the authors has proposed a solution framework for data mining in HR, wherein the resource allocation to the schedules is one of the challenging factors.

The study has proposed a model driven by the two-stage solution. In the first stage, the process is about optimizing the multi-objective allocation based on the fuzzy logic strategy. Among the critical aspects that impact the model is about estimating the precise individual capability matrix. Relying on the Hungarian algorithm model, the study has worked as systematic performance approach, which can yield considerable results as required towards shaping the system.

If such systems could be embraced and there are profound set of practices implemented, there are phenomenal ways in which the HR practices could be improved in terms of more accurate allocation of duty, evaluating the performance of the individuals.

Another study carried out in 2018, has focused on the distinct areas of human resource management wherein machine learning model's implementation has the potential scope and the current trials of development are taking place. Though the study has absence of any constructive solutions or the application models testing or comparative analysis, still on broader terms, the study has highlighted how and where the segment of solutions are turning to be more practical and the models that can be significant with the solution. The study provides an outline of key HR functions wherein the machine learning and AI based solutions can be implemented, which can improve the process quality [10].

In [11] the study has focused on some of the critical success factors and the scope for implementation of AI solutions in HR departments of the organization. Similar to [10], even in this study, the authors have focused on the potential areas wherein the AI can be resourceful for HR functions. However, the depth in which the data is covered in [11] is highly detailing. There are various areas like the legal processing, analysis and observation of the mood trends of the employees, leave system management, chat bot system implementation was highlighted. As a solution evaluation, the authors of the study affirm that the recruitment cycle time which is considered with average of 34 days, can be brought down to 9 days, if effective set of algorithm practices are embraced and implemented. Though the affirmative result section to conclude on the 75% reduction in the time is not evident in the study, still from the kind of system adoption that is prevailing in the market, the accuracy of the data can be adjudged.

A report on employment studies in UK, has identified the transitional change in the jobs and the ratio of human intervention in the jobs. Highlighting the facts on how some of the jobs are changing in the various domain, also, the study highlights on the new age job creation. But also, the study lays emphasis on how the AI solutions shall be impacting the kind of HR processes currently carried out in the organizations [12]. The study is of viewpoint that the AI based systems shall support the HR departments in

- Administrative roles like payroll management and transactional information management for employee records.

- Routine task management for HR support to assist managers (rostering the duty schedules, performance tracking and reporting, supervising the works at plant etc.)
- Case works, induction process and training etc.
- Assistance in policy making related decisions etc. are also among the conditions that can support in improving the conditions.

One of the critical case instances, highlighted in the study is about how a Japanese company is relying on AI based solutions to identify the possible resignations from the employees. Using the series of inputs like the employee background, current performance in the organization and other functional, non-functional metrics, the system triggers alerts to the managers over the people who might possibly resign from the organization. Such an action helps the HR professionals in the department to take necessary action, that can help in mitigating the risks and ensuring the retention of the staff.

This clearly depicts the structure wherein the burden of estimations is reduced for HR professionals, and the AI based systems can be a supervised assistant that can serve quality insights to the department.

HRPA (human resource predictive analytics) is a framework discussed in [13], towards enabling more effective set of decision-making process in the human resource departments. The authors of the study have proposed on the method of using the HR score using the metrics analysis. Taking stock of 14 metrics which are very important towards managing the conditions for the staff and their relative performance, the study has proposed a system wherein the inspired from Dr. Jac Fitz-Enz which states four stages of HRM, (1) Scan, (2) Plan, (3) Produce, (4) Predict are used as framework system. Based on the scores generated from the system, the model can enable the HR teams in having better kind of decision-making solution. However, one of the factors that are missing in the instances from the paper is about the evidential interpretation about the metrics. The proposed HRPA is sound in terms of approach, but the lack of evidential metrics in the form of result analysis, leads to accuracy affirmation of the model.

The other interesting dimension which focuses on the evolving conditions of technology integration to human resource management practices are discussed and highlighted in a study by KPMG. As per the reports of the KPMG,—There is a flip side to this as well. The rampant discussion around AI and machine learning is pushing companies to invest in technology, but without much knowledge on how to use it optimally. In KPMG's report, 50% of HR leaders feel unprepared to use technology available around them [14].

The statement above, reflects on the conditions wherein there is need for bridging the gap in terms of technology usage in the HR domain, and the preparedness from the top management to the staff executing the HRM tasks in terms of using the system though the scope of applications and its success for the system can be high.

The other theoretical study that has focused in the domain of AI implementation in the human resource solutions iterates on the scope of how distinct set of functions in the human resource management can be implemented using the AI models. The

study highlights on various tasks that can be significant to ensuring there is right kind of metrics and processes in place towards developing a contemporary system. Also, the study has carried out the review of the earlier studies that has discussed the opportunities [15].

PA (people analytics) is the other contemporary term that is paving in to human resources management domain. In [16], the study highlights on how the transition from the data-based analysis to the people-based analysis is gaining importance in the human resource management processes. The study iterates that the scope was largely aligned with HRM, wherein the developments indicate the shifting focus of HR departments right from the levels of functional to strategic requirements of the organization. However, the study also discusses that the consideration to ethical issues were absent in the case of the system development [16].

In summary of the related work, it can be stated that there are profound ways in which the Machine learning solutions and AI based systems application in HR management are reasoned in distinct studies. But the crux of the studies is about scope for implementation. But hardly there are many studies that have focused on the real-time implementation models, wherein the data pertaining to the organizational information are chosen for the training of the Machine learning models and the implementation execution is carried out. This clearly indicates the profound scope and the need for more robust set of implementation conditions, wherein the efficacy of the system is analyzed for different contextual requirements of human resource management.

3 Discussion

Human resource management as a process has undergone many transformations as discussed in the earlier sections of this chapter. However, the fact is that the scope of improvements is not limited and with the changing trends, technology and the management practices, the evolution of the systems keep developing [4]. However, some of the key areas wherein the significant development in the human resource management and human resource development are taking place are

- Employee Engagement in the organization.
- Organizational Culture Management.
- Effective performance management and optimal resource utilization.

With the increasing focus on the effective and strategic human resource management requirements for the organizations, the scope and scale at which the process management for above three facets are focused upon, if machine learning models are implemented, it can make significant contribution.

In this section, the scope towards utilization of the Machine learning frameworks for the above-mentioned factors are discussed, which can be worked in a solution-model in the future studies.

3.1 Machine Learning Based Employee Engagement Practices Management

One of the key areas for the organizational HRM focus is about the effective employee engagement. Technically, the process is about ensuring that the employee is staying motivated in their job roles, have their focus aligned to the organizational and project objectives, and is able to deliver quality performance, whilst having adequate work life balance [17].

However, in the process of emulating quality practices of employee engagement, organizations have to focus on certain parameters like cultural diversity of the organization, organizational policy framework, employee background and the diversity ratio of the employee base, compensation policies, employee happiness index, and employee satisfaction score, industry practices etc. If such factors are managed in balance, can result in good employee engagement practice.

The scope to track employee issues using real time analytics and then apply sentiment analysis to address these issues is highly possible with the usage of the machine learning models. For instance, if a majority of employees has queries about late payments for travel reimbursements, such data can indicate certain shortcomings in the operational processes to which pragmatic solutions can be identified and the issue be addressed.

If the ML application system is developed, wherein the datasets are trained with Naïve Bayes Classifiers, the role of developing a trained set model which can accurately predict the conditions of the organization and predict the resulting outcome can be feasible.

As the Naïve Bayes classifier is fundamentally with Baye's theorem of assuming independence among the predictor metrics, this method shall be suitable to build the ML model for employee engagement analytics. In the metrics discussed in the above paragraph, many of them could be interdependent over each other, but might have contribution to the final score on individual basis. Hence, the proposition and the equation might change from one level to the other in the system, which might be delivering the requisite results.

3.2 Machine Learning Based Appraisals

Appraisals are integral part of the human resource management process. There are distinct set of appraisal models that are used in the HRM of the organizations. Though many studies have highlighted about how the machine learning and AI based appraisal systems can be helpful, still there is lack of experimental evidence pertaining to the usage of the application system for distinct set of appraisal models. Though in some of the organizations, AI based appraisal solutions are used, still there is large scale of companies wherein the model is naïve [18].

For instance, depending on the kind of appraisal format, the features that are to be selected for the appraisal process might change. For instance, in 360-degree appraisal, the role of feedback from the number of stakeholders is very high, but in the case of the supervisor feedback-based appraisal system, the features to be considered might be different and limited, whereas the peer-group based appraisal process might have distinct feature selection.

Taking such factors in to account, if the combination of the decision tree model and the logistic regression models are used for the training of datasets to the application, there are profound chances that the model can be more significant and the ones that could deliver optimal kind of appraisal system. One of the key factors that has to be taken in to account is about the human emotions that has direct attribution to the performance, when the appraisal systems are concerned.

Hence, taking in to account more effective and robust set of predictive models can be very resourceful in ensuring there is optimal kind of system in place for development.

3.3 Machine Learning Model for Organizational Culture Prediction

Organizational culture as a term is a gaining profound importance in the contemporary functioning of businesses. As discussed in many HRM reports, managing a suitable and effective organizational culture is playing important role in performance of the team, attracting quality talent and retention of the team. While some companies are using the formal or informal kind of work culture, predominantly the combined nature of formal and informal kind of culture is more prevalent in many companies. Towards understanding the HR process efficiency, the way organizational culture is shaped up is gaining profound importance. Taking such factors in to account, if the machine learning models are implemented to observe the facets of changing dynamics in the organizational culture, its relative impact on the employee performance, it helps in improving the overall ways of improving the organizational culture.

If the Machine learning model is developed with the trained datasets using the nearest neighbor kind of algorithm approach, it shall facilitate in improving the quality conditions of the system and towards improving the practices and the culture, which can lead to sustainable outcome for the organization [19].

There are numerous dimensions, in which the machine learning models can be significant solution for the organizational human resource management practices. However, when the organization is able to focus on the system towards implementation plans with more accurate decisions (like the ones that can be generated using the machine learning models and reducing the human intervention conditions), it can lead to overall development of the organization.

4 Conclusion

Human resource management and Human resource development as a functional process are getting aligned to the organizational objectives. There is significant influence of the organizational objectives and mission towards how the HR systems of the organization are functioning. Considering the competitive scenario that is prevailing for the organizations, it can be stated that if the companies can ensure there is profound set of practices like usage of the machine learning or the AI kind of application systems for the organizations, the chances of improving the accuracy of decision making and operational efficiency are much higher.

Despite the fact that there are numerous studies that has focused on the usage of the AI models in the human resource management, still very few practical solutions and algorithmic models were discussed pertaining to effective HRM management practices. Certain key areas wherein the potential scope of the system is considered as the solution of AI in HRM are Administrative roles like payroll management and transactional information management for employee records. Routine task management for HR support to assist managers in to day to day operational process management.

However, based on the frameworks and the functions of the HRM that were discussed in the earlier studies, in this review manuscript, three distinct areas of HRM (employee engagement, culture, and appraisal system) wherein the potential training models of the datasets that can be used are discussed. If an effective algorithmic solution can be developed in the areas discussed, it can support the organizations in having more qualitative and structural outcome in the system. As a scope for future studies, if there are some evidential solutions tested under distinct circumstances are proposed, it can help the organizations in managing the human resource management with operational excellence.

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WA-SCV Analysis for Scope Creep Management in a Software Project Requirements

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Abstract Scope creep in the case of a project management environment is a profound challenge. Globally, many of the system development project failures are attributed to the scope creep change failures. Many of the earlier studies have discussed the cause and effect analysis, challenges, and gaps in the case of the project scenarios. However, one of the common issues addressed in the organizational elements for project management and scope creep management is about having the right metrics or assessment models that can support sustainable ways of assessing the scope creep. As the scope creep is more attributed to the personal perspectives of the resources, this manuscript provides the scope of the weighted average model of project scope creep analysis scenario. The model proposed in this manuscript is the WA-SCV (weighted average analysis of scope creep variation), wherein the ratings of impact for various project attributes are collected as datasets using the pre-defined weighted average value. The weighted average model discussed in this study is assessed on a case scenario. The results indicate the potential of the proposed model to be used for scope creep analysis.

Keywords Scope creep · Project scope creep estimation · The weighted average value for scope creep · Scope creep in SRS

1 Introduction

Software systems developments have a distinct set of factors influencing the successful outcome. Over the last decade, there are many contemporary ways of project management practices that have evolved for effective ways of handling the projects. Some of the common issues observed in the life cycle of software systems

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development project leading to failures are the unrealistic project schedules, engaging non-competent resources integral to project management, and scope creeps, leading to delay in the project schedules [1].

Irrespective of the project dynamics, it is very important for the projects to have a more robust kind of set-up and understanding of the project tracking, limit the scope creep and adherence to schedule, leading to sustainable outcome from the project scenario. Scope creep one of the primary and intrinsic reasons as cited in the earlier studies, triggering the delays in the project scenario; this study focuses on the cause and effect conditional analysis of the project scope creep and its relative effect in comparison to the SRS (Software Requirements Specifications) [2].

1.1 Project Scope

Project scope refers to the project planning segment constituting the process of identifying, documenting the project deliverables, goals, work-breakdown schedules, and the relative time and cost analysis. In simple terms, project scope can be stated as the boundaries of key elements in application requirements accepted for deliverables in a project scenario [3].

The scope creeps in a project environment can be defined as the deviation in the set of requirements addressed or being developed in a project scenario. The variance in the requirements could be small modifications to a significant change in the complete structure of a project environment. Some of the earlier studies focusing on the project management structure discuss the scope creep as one of the intrinsic issues affecting the project outcome. Predominantly, scope creeps vests around the continuous or uncontrolled growth in the project deliverables post the initiation of the project implementation [3].

Profoundly, the issue of scope creep could be attributed to lack of definitive inputs in the SRS or the conditions wherein the project teams work on the changes in the project scenario depending on the requirements for the business operations emerging over some time. More often, the scope creep is observed in the case of the projects that have a longer duration for completion or the ones that do not have a definitive agreement in the form of SLAs (Service Level Agreements) constituting what shall be integral to the outcome to be delivered in the project [3].

Despite that, certain organizations are adopting the agile model of system development, considering scope creep issues. Still, the issues of time and cost additions for the project scenario could not be ruled out in wide levels of changes to the scope creep integral to the project scenario [4]. Thus, there is a need for the organizations to ensure there are significant models in place to restrict the scope creep issues in a project environment [5].

1.2 Software Requirements Specification

SRS is a systematic approach to defining the software system to be developed. It constitutes critical information about the levels of functional and non-functional requirements to be incorporated into the development of a software application system. In simple terms, it is the expectations of the customers, stakeholders, or sponsors of the project, which is to be fulfilled in a project scenario. Emphasis is more about developing a document that depicts and clarifies what is to be built and the road map for the developers to work on effective software requirements specification [5].

1.3 Reasons for Scope Creep

The reasons for the scope creep in the project scenario are many; however, some of the intrinsic reasons for the scope creep are in-complete or in-effective SRS, leading to changes to the project.

In certain instances, despite the project teams being more consultative to the project requirements and the details of key requirements from the project being listed effectively, the changes stand imminent during the project's progress. This could be attributed to the changes in the functional requirements of the project, or the visual esthetics, or the interface level changes preferred by the project sponsors [2, 3].

1.4 Implementation Issues for Project Due to the Scope Creep

Considering the timebound development practices, globally, the project teams prefer to adapt a project lifecycle management model, which leads to the construction of the WBS, allocation of the project resources to execute the project requirement, and initiate the project development plans. However, when the scope creep takes place, there is a disruption to the project schedule, and the project teams need to revise the conditions that affect the project outlook [2].

While small changes to the scope could be absorbed into the schedule based on the project schedule's buffer time, any major changes to the project scenario could lead to critical issues for the project team. For instance, in managing a waterfall model of project management life cycle, focusing on system development can be a profound challenge for the organizations. As the waterfall model of system development relies on a phased approach, wherein once a specific phase of design development is complete, revisiting that phase costs the project time and efforts [1, 3].

This manuscript discusses the significance of the scope creep handling in the projects and chalks a conceptual framework of the weighted average rating model to assess the scope creep for implementation. The objective of this paper is to provide a framework that has some quantification metrics that can impact the project scenario, based on the pragmatic conditions of how the considered scope creep can impact the project schedule.

The objective of the subject is to consider the process of revising the project baselines for time and cost in the instances of significant scope creep expected in the system. Any minor changes impacting the project scenario can be incorporated into the system as per the developments, and accordingly, work towards improving the overall quality of the system.

2 Related Work

In [6], the study's authors have focused on the distinct set of scope creep indicators and propose a model wherein the scope creep related indicators are analyzed using the survey process with the stakeholders. The study, though focused more on the construction segment in specific, some of the key elements for project management, remain the same across the scope management scenario. In this study, taking such factors into account, the emphasis is three key aspects that could lead to scope creep conditions. Firstly, the ineffective SRS, followed by the project locations (contextually be the domain for the project) and the communication issues between the various stakeholders integral to the project environment. Focusing on the communication gaps at the stages of SRS development can be more pragmatic for the organizations in reducing scope creep issues.

In an interesting study carried out by the authors of a study [7], the emphasis is on understanding the significant gaps in terms of scope creep and the potential variations. While in a broader outlook, the variations and the scope creep are the same, at a micro-level, there is a considerable difference in the variations and scope creep. The quantitative survey by the organization highlights the varying degree of knowledge of the project team in classifying the new requirement as potential variations or scope creep evolving in the project.

The study refers to the conditions wherein the academic conditions signify the scope of insufficient awareness of scope creep leading to conditions of ambiguity and uncertainty, focusing on the relative measures of potential variations and scope creep is pragmatically important for the project managers. Potential variations could technically be a mild change to the proposed system, wherein the cost and time resources for the project might not have a huge impact. But in the case of scope creep, as the design system and fundamental aspects might have to be rejigged, the efforts and relative costs could be much higher.

Another study [8], wherein the authors of the study have focused on the project scenarios in UAE, refers to the scope creep as a potential threat for the project completed within the time limits. The study highlights the need for the organizations

to focus more on stakeholder communication as the critical element in handling the scope creep conditions. Many of the existing project management frameworks and models help the project teams manage project communication among the stakeholders more effectively. The conclusive summary of the study refers to the need for managing project communication among the team members in effective ways. And the commitment from all the stakeholders in the project to work towards successful management of the project outcome.

The authors of a study [9] have focused on empirical analysis of the software projects developed in a software company and discuss the three-dimensional visualization impact for the scope creep management. This trio visualization model proposed in the study offers a visual representation of the historical data related to the project, which helps the stakeholders understand the data perspectives for visualization of the scope creep and its management based on the mathematical model perspective. Visualizing the scope creep and its implications in terms of project success is concluded in the study as a potential solution to support the effective management of scope creep in software project scenarios.

Authors of the study [10] have reviewed the earlier studies in the scope creep conditions of the software project implementation. Accordingly, they have identified a certain set of integral issues in managing software solutions development more effectively. The organizations and the project management teams must encounter certain bottleneck elements which affect the smooth handle of the scope creep in a project management scenario. The authors of the study, based on a comprehensive review of the model, highlight thirteen elements that are overly critical in the case of the project implementation conditions.

In [11], the authors of the study refer to the practices wherein scope creep has a huge impact in terms of the non-pragmatic developments leading to significant issues in the requirements. The study cites the case scenarios wherein, more often, changes to the system lead to issues of poor scope management conditions. Focusing on the earlier studies and requirements, the study highlights how the scope creep stands intrinsic reason behind the failures for 80% of the software project failure. In terms of developing a more successful launch of the software applications, the teams must address the issues of scope creep in the project in more structured ways and early conditions.

A study focused on the functional analysis model of developing the projects [12] highlights certain interesting coherence among the varied attributes. In a subjective approach that the function point analysis is a successful model for modulating the project, the impact of the scope creep and function points are discussed in the study for two widely developed domains as ERP and Financial. The investigation results from the analysis refer t the conditions wherein the scope creep, function points, and the project success have direct coherence. Insights from the study refer to the conditions wherein the success elements can be more focused on improving the success ratio in the projects.

In summary of the review of a distinct set of more integral metrics evaluated for the project scope creep scenario. The literature refers to the consistent attempts from the academicians and the industrial teams for improving the practices that can

support in reducing the conditions of scope creep in the project environment and work towards sustainable practices for completing the projects successfully.

3 Significance for Analyzing the Scope Creep

Projects in the current scenario are increasingly complex, interdependent, and developed for more complex business transaction processing, improving operational efficiencies, etc. With every minor task in the project schedule consuming certain timelines and cost for the development, today, the process of pricing the development costs of a project and successful completion of the project within the timelines are heavily reliant on the scope of the project well-defined.

However, if there is any deviation in the scope, irrespective of the development stages, the project charter's impact is high. Despite that, the scope creeps in the early stage could reduce the relative damage in terms of project schedule deviations. Still, the task has a significant impact on the various aspects like the database models, coding script language selection, hosting server performance requirements, load-balancing, WBS (work breakdown schedule) implementation, and many other significant elements. While the factors mentioned above are functional aspects of project management, the economic scope of issues includes engaging the competent resources, adjusting the project schedules, cost variance, reallocation of the project schedule, and many more [13].

Thus, considering such elements, the project teams need to have an appropriate understanding of changes emerging in the project environment, measures to be taken in addressing the issues effectively, and towards mitigating the risks of over variance in the cost and time baseline. Hence, any kind of comprehensive solutions that can address the risks of scope creep for a project scenario can potentially improve overall development practices [12].

4 WA-SCV Assessment—Proposed Model

Considering the implications of the software projects scope creep scenario, the model discussed in the case scenario refers to the conditions wherein the weighted average model is used to assess the conditions integral to the project scenario. Accordingly, the stakeholders of the project can have informed decisions for the project.

The model proposed in this study is inspired by an organization model [12], wherein the organizational teams discuss the importance of scope creep and having a relative model that can be used for detailing the variance in terms of percentage of impact for the project scenario. It is important that the teams working on the scope creep analysis can analyze the variance in a methodical approach.

The variation metric proposed by the organization "Working Mouse" [12] refers to a structure wherein the various metrics are applied by the teams using specific

Fig. 1 The model and the variance conditions working

management techniques and according to wherein each partner or stakeholder of the project is ranking. As discussed in an article, the variation metric from an organization is expected to measure the requirement changes throughout the sprint when compared to the actual scope.

For instance, in a project scope constituting 20 issues, and the customer prefers to have changed in one of the issues, the change would lead to a 5% variation. Whereas if the partner considers adding an issue, in such instances, the issues count leads to 21 and 2 changes, thus resulting in 9% variation. The working pattern discussed by the study is significant, and it can help the teams have more insights on the scope creep levels, which can help in making informed decisions [12].

Figure 1 mentioned above refers to the model and the variance conditions working as indicators for the project conditions. Thus, focusing on the model above as the foundation, the weighted average model for managing the project requirements scope creep is analyzed in this manuscript.

4.1 Proposed Model

The model proposed in this manuscript is the WA-SCV (weighted average scope creep variation) analysis.

The model of scope creep variation metric in [12] is profoundly about ranking from each of the stakeholders towards the issues or scope creep factors considered in the model. However, the structure does not consider the issues of the impact of the project on the WBS, cost variance, time variance, project flow, overall impact conditions.

If the right kind of scope creep analysis over the project must be considered, the weightage over the project impact varies depending on the specific attributes. Thus, the model discussed in this study is about creating a comprehensive solution wherein

the specific weightage is provided for each of the attributes (WBS, Cost, Variance, Competency, Other Resources). Accordingly, the stakeholders in the project shall be ranking the project scope creep scenario. Based on the weighted average, the variance value will be estimated to consider the issues as integral to the project or beyond the current scope shall be perceived.

4.2 Stakeholders for Ranking

The stakeholders for the project scenario considered for the project are more internal stakeholders who are on the development side of the project requirements. The rationale behind considering only the internal stakeholders of development for the ranking is that the resources currently working for the project shall have more idea on the relative impact of the project schedule, critical paths are affecting the project, and other significant aspects integral to the project scenario [14].

The following are the major stakeholder's integral to the project scenario in the proposed model.

- Project Manager
- Project Coordinator
- Systems Analysts
- Business Analysts
- Team Lead

4.3 Weighted Average Model

The weighted average model estimates the arithmetical mean value based on varying degrees of importance for the numbers over a dataset. In estimating the weighted average, every number over the dataset is multiplied in lines of a predetermined weight before the calculations [15]. The weighted average approach can be more pragmatic for the project scenario, as the datasets are assigned distinct weights based on the project conditions. A more detailed structure of the weighted average models can be reviewed in [13]. Calculation patterns discussed in this manuscript are based on the estimation process discussed in [13], and accordingly, weightage is customized for the datasets considered in this manuscript for estimating price variations [16–18].

4.4 Process Flow

The weighted average table depicted below represents the key datasets considered to have more impact from the scope creep. However, the model can be customized with

datasets and weightage values, and the value data point is considered more relative to the respective project scenario.

Table 1 represents the value consideration in the case of an idle scenario, and the experimental scenario of the figures indicates the perceived values for stimulated project scope creep environment [15].

The weighted average value for each stakeholder is estimated for the project, and respectively, the average rating from each of stakeholders are ascertained for average to identify the holistic perception about the impact that the scope creep could have on the project environment [19–21], in Tables 2 and 3.

Table 1 The table represents the value consideration in the case of an idle scenario and the experimental scenario

Data point	Value data point (A) rating scale of (1–10)	Assigned weight (B)	Weighted value (WV = (A * B))
Impact on WBS	A1	4	WV1
Cost variance	A2	5	WV2
Schedule variance	A3	4	WV3
Competency	A4	4	WV4
Other resources	A5	3	WV5
Total	A = Sum (A1:A5)	B = Sum (B1:B5) = 20	WV = Sum (WV1:WV5)
Weighted average value			=WV/B

Table 2 Averaging the weighted average of stakeholder rating

Project stakeholder	Weighted average value
Project manager	WAV1
Project coordinator	WAV2
Team lead	WAV3
Systems analysts	WAV4
Business analysts	WAV5
Average value of ratings	=(AVG of WA1:WAV5)

Table 3 Conditional evaluation of the scope creep value

Average value	Scenario
>1	Scope begins
1–5	Warning
5–10	Tolerance
>10 to <15	High risk
>25	Project charter derail

5 Experimental Analysis

The case scenario assessed for the project scope creep analysis is an eCommerce application development project to be developed for a retail company. The details of the organizations are maintained discreet to maintain confidentiality.

Some of the scope changes proposed for the change by the client are

- To Add backup payment gateway solutions
- To display the products surfed from the last login sessions on the hot-surf list
- To capture the search strings keywords from respective regions and list them for the analyst modules

In line with the pre-agreed deliverables in the application, the aforementioned were the inclusions sought by the client, as change. Thus, the key stakeholders were sought to rate the impact on each of the dataset elements considered, and accordingly, the project estimation for scope creep is carried out in the current project scenario.

The table below represents the weighted average calculation pattern for a distinct set of project attributes, as discussed above.

5.1 Weighted Average Calculation Model

Tables 4 and 5 according to the rating scale definitive structure considered, the model refers to the average values in the range of 5–10 as the "Tolerance" zone, and thus, the current scope creeps average value is determined as 7.75, and thus the scope creep can be seen as in the tolerance zone. Accordingly, the project teams can make informed decisions for further course of action.

Table 4 The projected rating of one of the stakeholders (project coordinator)

Data point	Value data point	Assigned weight	Weighted value
Impact on WBS	10	4	40
Cost variance	8	5	40
Schedule variance	5	4	20
Competency	7	4	28
Other resources	5	3	15
Total	34	20	143
Weighted average			7.15

Table 5 Stakeholder's rating

Project stakeholder	Weighted average value
Project manager	7.15
Project coordinator	7.50
Team lead	8.20
Systems analysts	8.70
Business analysts	7.21
Average value of ratings	7.75

6 Conclusion

In the current trends of project management implications, one of the critical challenges that impact the project scenario is the project management patterns impacted by scope creep. Based on the scope creep variation metric discussed in [12], in this manuscript, the weighted average variation model is proposed, and the experimental study of the model signifies the potential scope for using the model. Also, the scope of customization possible in terms of weightage or the datasets or the dataset values enables the model to be more flexible in terms of improvising or customizing the solution to the respective project management environment for an organization.

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Diabetic Retinopathy Classification Using Lightweight CNN Model

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Abstract Diabetic Retinopathy (DR) is a dangerous disease nowadays, which may cause vision loss. Current deep learning models are successful in classifying different stages of DR effectively. Still, there is a memory bottleneck to deploy these models into mobile-like devices. The computational cost of existing deep learning models needs to reduce for commercial medical applications. Existing lightweight models facing challenges with parameter reduction, minimizing quantization loss, and gradient error. To combat these challenges, we proposed a lightweight CNN model that can occupy less space and improve the model's performance. Our model experimental results prove the storage and execution efficient compared to competitive models.

Keywords Deep learning · Diabetic retinopathy · Gradient error · Lightweight CNN · Quantization loss

1 Introduction

Diabetic Retinopathy (DR) is a dangerous disease, and it is widely spreading in India due to mainly food habits and lack of physical activity of Indians. It may affect vision loss if not detected early. Hence research teams are working with leading eye hospitals and finding advanced solutions to overcome the challenges of DR [1]. DR detection methodologies currently depend heavily on skilled professionals. But the large volume of detection in India-like countries is a tedious and laborious task. To overcome this challenge, computer-based systems with advanced deep learning approaches are in greater demand. Recent developments using drones for navigation and augmented reality with mobile-like devices demand storage-efficient CNN models. Hence there is excellent demand nowadays for high competition and storage efficient model deployment on low-end devices [2].

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Current deep learning approaches are heavily dependent on high computational resources. Most real-world applications generally use mobile and embedded devices with limited storage and computation [3]. Several techniques propose to reduce deep model size and parameters. Quantization is one of the well-known methods that reduce the size of the model and removes redundancy. The second approach is parameter pruning which reduces the parameters by deleting redundant and unwanted parameters. Due to mobile phones' widespread usage nowadays, a mobile application-based DR screening system significantly reduces clinical professionals' efforts. The third approach is low-rank factorization which reduces the size by only retain essential parameters. The fourth compact filter-based approach reduces computations and memory occupancy. The remaining strategies focus on advanced loss functions and minimizing error. Recent researches using mobile-based screening advises patients to suitable hospitals for treatment [4].

Existing low computing device-based approaches using compression methods losing prominent features of fundus images leads to performance degradation in Classification. Binarization used in some of the layers may lose the crucial elements. Hence careful layer-wise observation is a necessary and essential task of compression methods. Existing model compression methods use modern loss functions, and gradient-based error prediction approaches to achieve better accuracy [5]. Model optimization methods face several challenges like losing classifiable features lost of crucial regions and quality of the image [6]. The final classification results depend on the quality of the input image. Hence proper screening and preprocessing help get quality input images. Real-world datasets may not consist of appropriate illumination, orientation, scaling, and rotation. Data augmentation in preprocessing stage overcomes these challenges. Modern research uses embedded computing devices to produce economical, efficient, and prominent results. DR detection research nowadays is moving towards finding efficient, lightweight models. We address various challenges of current lightweight models in this contribution and propose a novel, memory-efficient model.

2 Related Work

The DR classification using pretrained, customized, and lightweight models briefly described in this chapter. Some critical insights and latest developments in this area summarize below.

Existing memory-efficient lightweight models like MobileNet, SqeezeNet, and ShuffleNet are not guaranteed model performance [7]. Recently hybrid deep learning approaches are successful in getting noticeable results [8]. Some authors build memory-efficient lightweight models with minimal latency [9]. We addressed various challenges of lightweight models in this contribution.

The crucial contributions of our model are.

- Storage efficient, lightweight model without loss of information

- Optimization reduces the continuity problems that arise with binarization and minimizes the overall loss
- Hardware friendly binary representations with minimized quantization error and gradient error
- High stable and quick convergence training process improves the performance of the Classification
- Efficient hyperparameter selection with optimizer improves the network efficiency
- Optimal solution with step-by-step binary quantization

The accuracy of the Classification is not much degraded when compared to competitive methods.

3 Lightweight CNN Model for DR Classification

Our proposed Lightweight model is binarizing convolutions of ResNet50 architecture [10]. Convolution and Dense layers are binarized, followed by pooling layers. The output layer is modified with five different classes for DR classification, as shown in Fig. 1. Our model produces fewer parameters by binarizing weights and activations of ResNet structure with residual blocks.

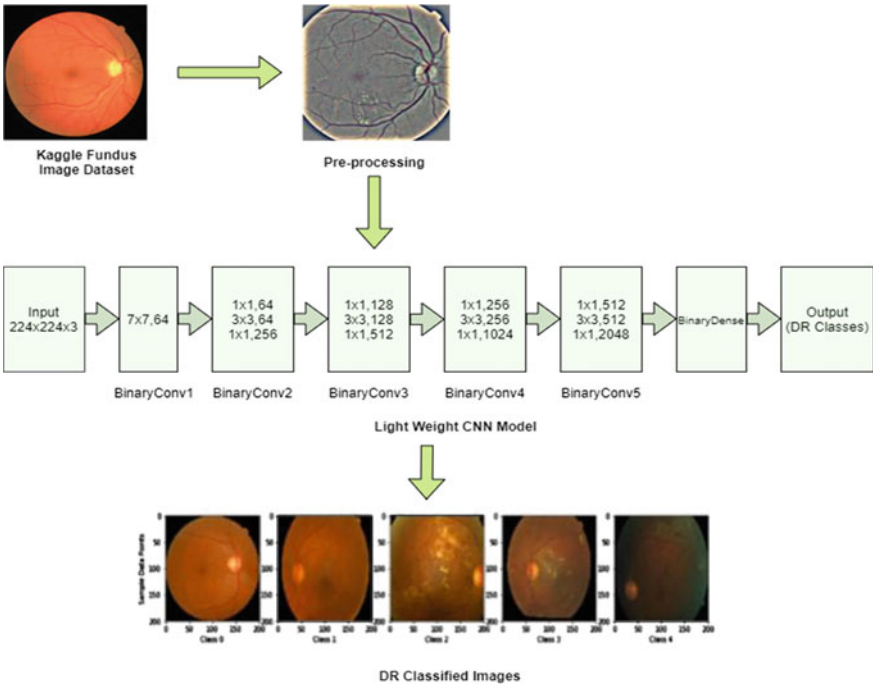

Fig. 1 The architecture of lightweight CNN model for DR classification

Our lightweight model drastically reduces the storage space and also improves the execution speed with reduced computations. Unlike the existing pre-trained network, our model produces fewer parameters that are crucial enough for classifying images. Our model acts as a regularizer and controls overfitting problems when training the model.

4 Implementation Details

We implemented our model using TensorFlow with Keras and Python language. Experiments were conducted with 12 GB graphical memory and 16 GB primary memory system.

4.1 Dataset

We considered the Kaggle Fundus images dataset [11] with expert graded annotations to meet ground truth. Inconsistencies and variabilities of the dataset were resolving with domain experts' grading process.

4.2 Fine Tuning

Our lightweight model converges effectively with 1000 epochs and intermediate results updated for every 250 epochs. With the best learning rate of 0.03, the mini-batches fine-tuned model size is 256 with batch normalization and Adam optimizer.

4.3 Performance Evaluation

Our model performance compared with base models and competitive models to prove the efficiency. We considered five base models and BCNN using Inception V3 are comparable competitive models. Our BCNN using ResNet 50 outperforms compare to our previous model of BCNN using Inception V3 for DR classification. Our model's storage and execution efficiencies represented with memory consumption and runtime prove the model best suitable for mobile-like devices.

5 Result Analysis

We compare our model performance with AlexNet, VGG-16, Inception V3, Resnet 50, DenseNet, and our previous model of BCNN using Inception V3 as shown in Table 1. Classification performance in terms of memory saving and reduced run time considered for model evaluation. Comparison between epochs and accuracy plotted in Fig. 2. Comparison of memory consumption for different models plotted in Fig. 3. and runtime for various models plotted in Fig. 4.

Table 1 Comparison of DR classification on Kaggle dataset

Classification	Accuracy	Memory consumption (in MB)	Run time (in s)
AlexNet	68.34	116.58	16,356.3
VGG16	76.25	137.28	18,998.8
InceptionV3	92.23	183.27	26,143.6
Resnet50	91.81	293.5	26,143.1
DenseNet	93.45	316.53	20,054.9
BCNN using InceptionV3	91.04	114.53	13,243.6
BCNN using ResNet50 (**light weight CNN model**)	**91.13**	**172.58**	**12,934.8**

Bold values represents best run time and memory consumption of our model with comparitive models

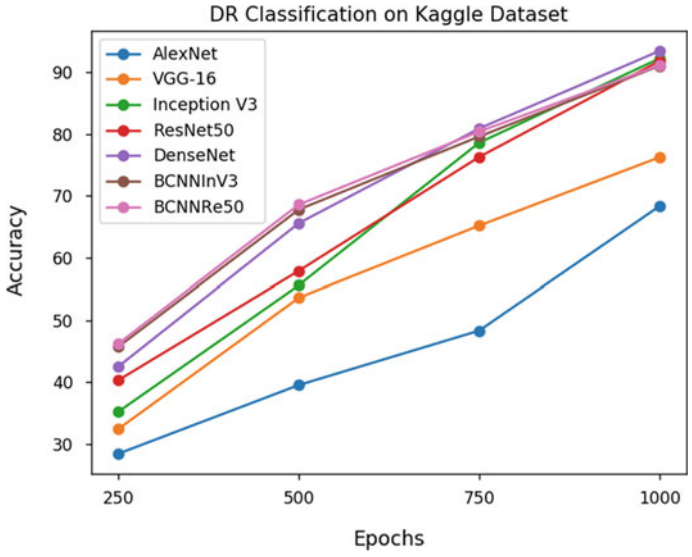

Fig. 2 Epoch versus accuracy graph for DR classification

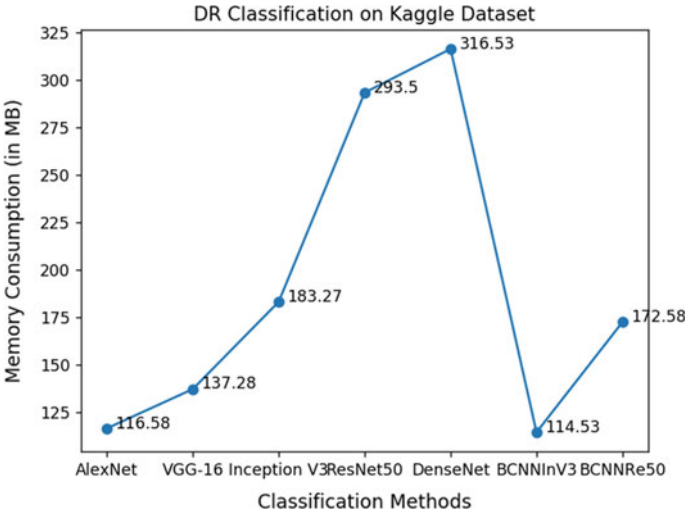

Fig. 3 Comparison of memory consumption for DR classification models

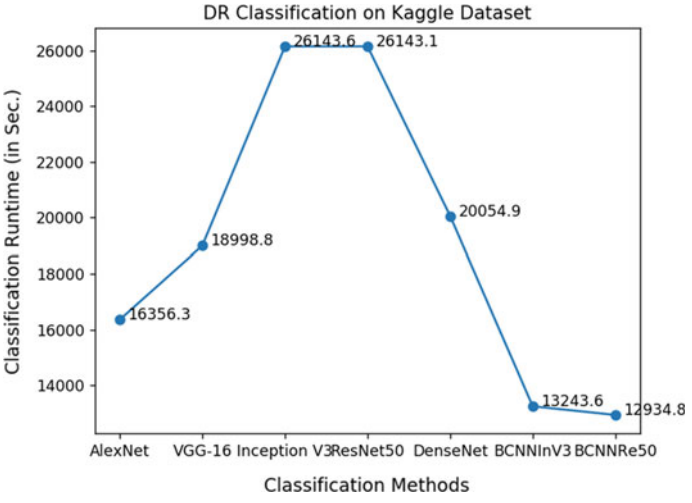

Fig. 4 Comparison of runtime for DR classification models

We evaluated our model accuracy for every 250 epochs, and the results obtained enlighten our model's efficiency compared to competitive models. With the slight reduction in accuracy, our model drastically reduces memory occupancy and increases the base model's speed.

6 Conclusion

This paper presents an easy way to use a Binary CNN using ResNet 50 that allows a balanced memory organization in a short period. This proposed lightweight model reduces memory consumption and speeds up the execution with hardware compatible approach. Our model effectively works with limited memory availability portable devices and embedded computing devices with large-scale images. Our results with the Kaggle fundus image dataset showed our model's efficacy without much compromising the classification accuracy. This model reduces memory usage by 41.19% and gains a 50.52% improvement in runtime. Optimizations used in this model drastically reduces the loss, quantization error, and gradient error. In future, real-time databases with advanced training methods, optimizations, and regularization techniques. Modern lightweight approaches with advanced quantization and training may produce more effective results in the future.

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