Vehicle Navigation Protocol in Real-Time Fleet Management

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R. Kannadasan ; Rohin Sri Kumar ; Keerthan Satya Devineni ; N. Prabakaran ; A.S. Anakath ; A. Jayanthiladevi **All Authors**

Abstract: In Real-Time Fleet Management, vehicle routes are built dynamically according to travel durations, location of the vehicles and also customer requests which are revealed ... **View more**

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Abstract:
In Real-Time Fleet Management, vehicle routes are built dynamically according to travel durations, location of the vehicles and also customer requests which are revealed gradually. To account for such situations, algorithms which are fast and can accommodate the uncertainty are needed. We here highlights the use of parallel computing strategies for solving real-time vehicle routing problems. The vehicle routing problem is related to linear optimisation and falls under the domain of logistics and transport. Vehicle routing problems comprise of determining optimal vehicle routes according to various constraints such as the total demand should not exceed the total capacity, service durations are met The objectives of solving the Vehicle Routing Protocol varies depending upon the dynamically of the system. In general, systems, which are weakly dynamic, focus on optimising or minimising the routing costs. The systems, which are strongly dynamic, focus more on minimising the expected response time.

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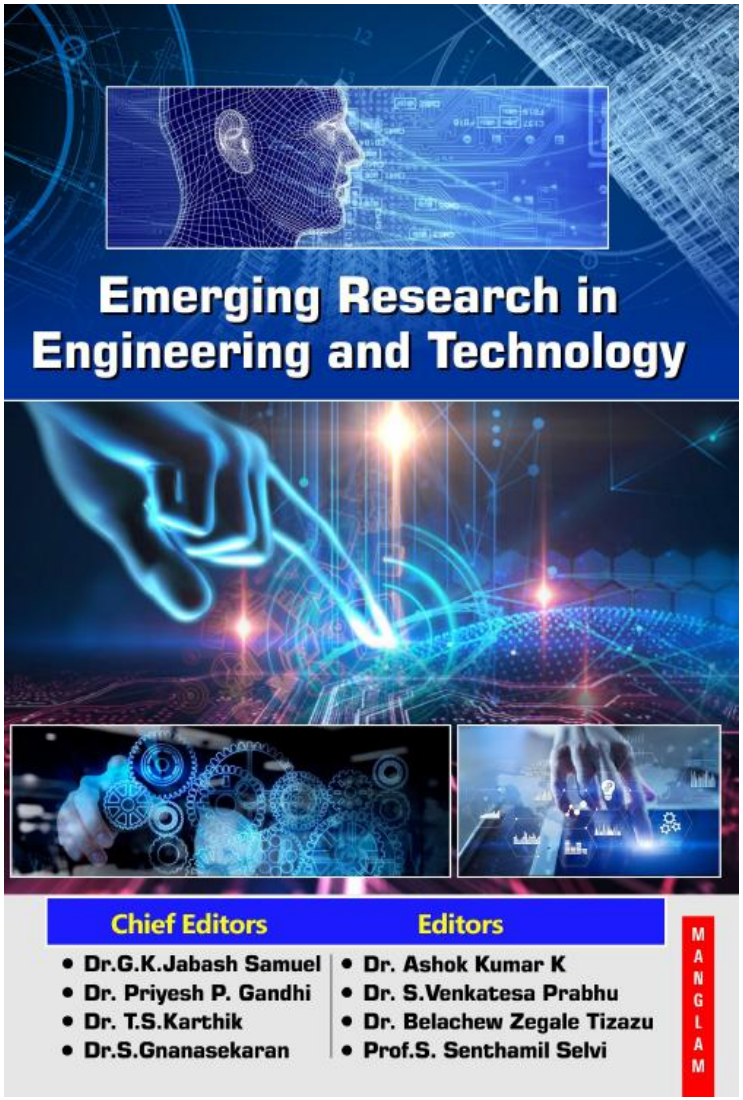

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Surface Engineering for Enhanced Tribological Performance

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ABSTRACT

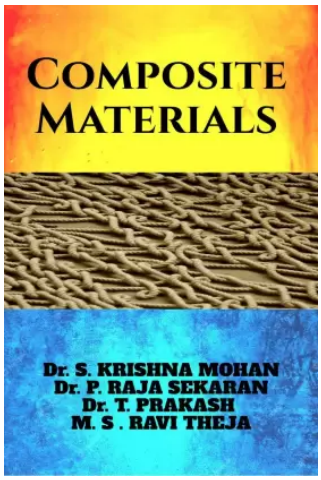
Economic and technological progress, as well as environmental concerns, requires that modern equipment be designed with ever more stringent performance criteria, frequently pushing components to the very limits of their capabilities. One major consequence of this increased demand on performance is that tribological deficiencies, such as lubrication breakdown excessive wear and tribo-corrosion, can be significantly amplified, leading to unnecessary operational costs, decreased efficiency and premature failure. Because tribological processes result from the interaction of two or more bodies in relative motion in a particular environment, surface engineering can be used to confer to surfaces the high performance needed for demanding operational conditions. In this context, the design of the appropriate material system must be guided by an accurate understanding of the degradation mechanisms and the surface response to loading and deformation, frequently acting in synergy.

Solid Particle Erosion (SPE) occurs in situations where hard solid particles present in the environment are entrained in a fluid stream, and impact component surfaces. This type of damage is most prominent in the first stage of the aircraft engine, where the compressor blades can be eroded to such an extent that aerodynamic performance and even structural integrity are compromised. Consequently, much work has been done in academia and industry in order to understand the material loss mechanisms present in SPE and to develop protective technologies that will increase component lifetimes. One such technology is the use of hard protective coatings to impede the erosion of the predominantly metallic engine components.

Keywords: Solid particle erosion, Scanning electron microscope, Particle size, Sputtering, X-ray diffraction.

Introduction

The design of the appropriate material system for a given tribological solicitation must be guided by an accurate understanding of the degradation mechanisms and



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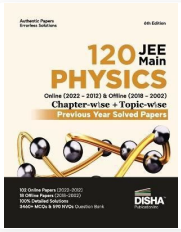

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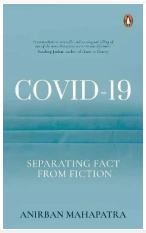

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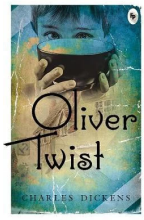

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Microstructure and Mechanical Properties of Thermoplastic Polyurethane/Jute Cellulose Nanofibers (CNFs) Nanocomposites

N. Siti Syazwani, M. N. Ervina Efzan, C. K. Kok, A. K. Aeslina & V. Sivaraman

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Abstract

Cellulose nanofibers (CNFs) are linear polymer that exhibits high stiffness and strength due to extensive intermolecular and intramolecular hydrogen bonds among the molecules. These nano materials are taking place in replacing synthetic fiber as reinforcement in nanocomposites. This present work investigates the potential used of CNFs in improving microstructural and mechanical properties of

thermoplastic polyurethane (TPU) nanocomposite. Cellulose nanofibers used in this work was extracted from jute fiber via chemomechanical method. Neat TPU and TPU/jute CNFs nanocomposite were successfully prepared by using melt blending method. In addition, the morphology and mechanical properties of prepared net TPU and TPU/jute CNFs nanocomposite were evaluated through field emission scanning electron microscope (FESEM), shore durometer and vickers micro hardness. FESEM micrograph reveals that the jute CNFs exhibited a uniformly dispersed in TPU matrix. The incorporation of jute CNFs result in increases of 20.13% hardness strength of prepared nanocomposites.

Keywords

Microstructure **Nanocomposites** **Nanomaterials** **Jute** **Polymer**

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COMPETITIVE RESOURCE ALLOCATION IN HETNETS: PRICING , BANDWIDTH ALLOCATION AND SPECTRUM SHARING

Miss.V.Surya[1] , Mr.J.Noorul Ameen[2]

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Abstract - *To furnish consistent versatility with high velocity remote availability, group of people yet to come remote organizations should uphold heterogeneous remote access. Estimating plans embraced by various specialist co-ops is critical and will affect the choices of clients in choosing an organization. In this article, they give a far reaching study of the issues identified with valuing in heterogeneous remote organizations and potential ways to deal with the arrangement of the estimating issue. To begin with, we survey the connected work on evaluating for homogeneous remote organizations where a solitary remote innovation is accessible to the clients. At that point, we layout the significant issues in planning asset designation and estimating in heterogeneous remote access organizations. To comprehend these difficulties and tradeoffs they present a two-level heterogeneous remote organization model with two kinds of clients: portable clients that can just interface with macro-cells; and fixed users that can associate with either macro-cells or small-cells. The conceivable Nash equilibria for various framework boundaries are arranged into four classes comparing to whether diverse SPs relegate data transmission to the large scale or potentially little cells. Every SP's(Service Providers) HetNet (heterogeneous networks)consists of two sorts of cells(macro-and little) and two kinds of clients, versatile and fixed. The little cells serve fixed clients just, while the full scale cell filter serves either client type. Related with every phone type is its complete rate limit, where the all out appraised limit of a little cell is ordinarily bigger than that of a large scale cell with a similar measure of data transmission.*

***Key Words*: Service Providers, HetNet (heterogeneous networks), macro-cells or small-cells**

1. INTRODUCTION

Game Theoretic Approach — In general, a wireless system may consist of multiple entities whose objectives are different and possibly conflict with each other. In such a case, a solution which is optimal from the global point of view, may not be desirable by all the entities. For example, the total revenue is maximized if each of the service providers allocates all of the radio resources to the user offering the highest price, while other users do not receive any resource. Instead, a solution that ensures satisfaction of all the entities in the system is desirable. In this multi-entity environment, non-cooperative game theory can be used to obtain the optimal pricing policy. Here, the competition can be either among user entities, who compete for the radio resource, or among service providers, who offer wireless services to the users. The most popular solution of this competitive situation is the Nash equilibrium concept, which guarantees that none of the entities in the system wants to change its strategy, given that other entities stick to the Nash equilibrium. Based on the competition among users in a CDMA cellular system, distributed power control and pricing adjustment algorithms were proposed, where the objective of each user was to maximize its individual net utility (instead of total or group net utility as in) The net utility was computed based on the amount of successfully transmitted data, which is a function of SIR at the receiver. However, increasing the transmission power by one user increases interference to other users. A non-cooperative game was formulated, and Nash equilibrium was used to obtain the transmission power and the price (per unit transmission power).In cognitive wireless networks, where primary (or licensed) users can offer (or sell) spectrum opportunities to secondary (i.e., unlicensed) users, competitive pricing for spectrum trading becomes an important issue. The pricing method in this competitive environment can be either secondary user driven or primary user driven. In a secondary user-driven scheme, the secondary users request (i.e.,bid) for the spectrum, and a primary user makes a decision on rice and allocates spectrum opportunities to the secondary users accordingly. On the other hand, in a primary user-driven scheme, primary users determine the prices of available spectrum. A secondary user makes its decision based on offered spectrum price and quality of wireless transmission on the corresponding spectrum. In both the cases, the competition can be modeled as a non-cooperative game, and the solution non spectrum pricing can be obtained from the Nash equilibrium. In a multi hop network, traffic of a user can be routed through multiple nodes to the destination. As a result, a user must pay the intermediate nodes for functioning as relays. This pricing problem in a multi hop network was considered in the literature, for example, in. In this case, the relay nodes can optimize the price charged to the upstream nodes of a traffic flow to maximize the profit. A non-cooperative game model was developed to obtain the competitive solution among the nodes in a multi hop network

2. LITERATURE REVIEW

C. Chen *et al.*, 2015 .,The current 3G-Cellular radio access network cannot support many concurrent high data rate unicast or multicast flows due to limited radio resources.

The value of the heterogeneous architecture depends on the Cellular network's ability to utilize the local ad hoc networks in order to reduce the 3G coverage needed for multicast streaming. Our overall contribution is a framework to increase the availability of multipoint streaming services to wireless users; the contribution includes a detailed evaluation of the trade-off between the 3G coverage and the ad hoc spanning tree size.

A. Ghosh et al., 2012,With the pervasive penetration of wireless technologies in our lives, the wireless spectrum has finally been dried-up. However, preliminary studies and general observations indicate that a large portion of licensed spectrum are not in use for a significant amount of time at a large number of locations. These finds and the need for more efficient utilization of wireless spectrum lead to the proposal of cognitive radio technology as a new mechanism for flexible usage of spectrum. To address the impact of the network dynamics on video streaming, the playout buffer is typically deployed at the receiver to guarantee the smooth media playback. Given the channel conditions and the video packet storage in the play out buffer, we propose a centralized scheme for provisioning the superior video service to users.

3. PROPOSED SYSTEM

The work investigates the interplay of interference and service pricing on user adoption of small-cells when small- and macro-cells operate in common spectrum and when they operate in fixed separate bands. The authors conclude that almost all users choose small-plus-macro service and pay a higher price. The pricing and bandwidth allocation decisions are obtained via a two-stage process. In the first stage each SP determines how bandwidth is split between macro- and small-cells. In the second stage, each SP sets two prices for accessing the macro- and small-cell networks. This order is motivated by the observation that determining the bandwidth split may occur over a slower time-scale than price adjustments. At equilibrium the macro-cells only serve mobile users, and fixed users only associate with small-cells. The prices in macro-cells are always higher than the prices in small-cells. This market structure applies irrespective of the number of SPs, and whether the SP(s) maximize (individual) revenue or social welfare. This is consistent with the current small-cell deployments in practice, where small-cells are primarily used in indoor systems. Additional properties of the equilibrium are also characterized, for example, it cannot be the case that one SP provides only macro-cell service while another provides only small-cell service. (However, one SP can provide macro-cell service and another can offer both macro- and small-cell service.) Moreover, we show that the Nash equilibrium can be computed via a sequence of coordinate gradient-based updates, and use this to illustrate numerically how the equilibrium changes with initial bandwidth endowments.

4. SYSTEM DESIGN

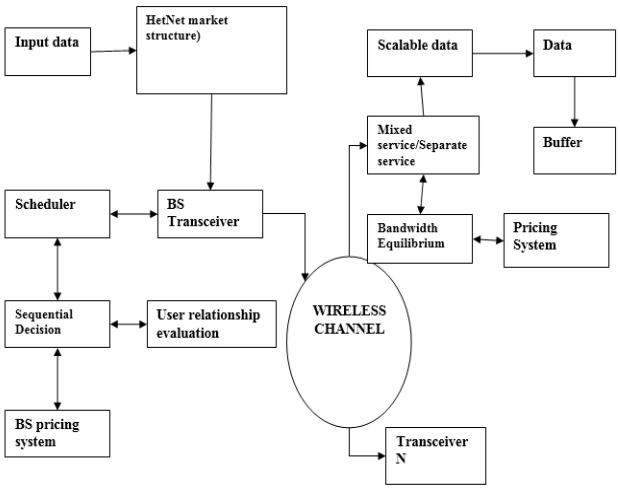

Fig:1 Pricing And Bandwidth Allocation Decisions .

5. SEQUENTIAL DECISION PROCESS

The bandwidth and price adjustments of SPs in the network as a two-stage process:

1) Each SP first determines its bandwidth allocation between macro-cells and small-cells. Denote the aggregate bandwidth allocation.

2) The SPs announce prices for both macro-cells and small-cells. The users then associate with SPs according to the previous user association rule. This order reflects the fact that bandwidth partitioning takes place over a slower time-scale than price adjustments, since changing the bandwidth partition could conceivably involve reconfiguring equipment at both base stations and handsets, and adjusting the placement of access points along with transmission parameters in order to keep the rate per cell fixed. Adjustment of prices would not require these additional changes.

The average energy efficiency, throughput, and transmit power consumption performance of the proposed algorithms were evaluated and compared to other baseline works. When the available spectrum of both groups is very small, the prices are high in both type of cells. In that case, it is better for SPs to allocate all bandwidth to small-cells since that results in more data rate and therefore more revenue. However, if one group of SPs has a large amount of bandwidth, allocating all bandwidth to small-cells significantly decreases the price in small-cells. Thus, it is beneficial to invest in both small-cells and macro-cells to maximize revenue.

1) All bandwidth is allocated and prices are set so that the total rate demand is equal to the supply.

2) The bandwidth allocation falls into the separate service case.

Theorem 1 (Existence of Nash Equilibrium):

A sub game perfect Nash equilibrium always exists for the bandwidth and pricing game and every equilibrium falls into

the separate service case.The proof of this theorem has two steps. We first prove that no Nash equilibrium exists in the mixed service case. We thenprove that a Nash equilibrium always exists in the separate service case using Rosen's Theorem .

Even under the separate service case, the equilibria can fall into one of the following distinct cases:

1) Small-cell only Nash Equilibrium (SNE): All SPs only allocate bandwidth to small-cells.

2) Macro-Small-cell Nash Equilibrium (MSNE): All SPs allocate bandwidth to both macro- and small-cells.

3) Small-cell Favored Nash Equilibrium (SFNE): A subset of SPs only allocate bandwidth to small-cells and the other SPs allocate bandwidth to both macro- and small-cells.

4) Macro-cell Favored Nash Equilibrium (MFNE): A subset of SPs only allocate bandwidth to macro-cells and the other SPs allocate bandwidth to both macro- and small-cells.

6. CONCLUSION

When the available spectrum of both groups is very small, the prices are high in both type of cells. In that case, it is better for SPs to allocate all bandwidth to small-cells since that results in more data rate and therefore more revenue. However, if one group of SPs has a large amount of bandwidth, allocating all bandwidth to small-cells significantly decreases the price in small-cells. Thus, it is beneficial to invest in both small-cells and macro-cells to maximize revenue. However, certain classes of Nash equilibria are asymptotically socially optimal when the number of SPs tends to infinity. In order to achieve the benefits of competition, we have to ensure full competition in every active market. Otherwise, even an infinite number of SPs may not yield the socially optimal outcome. Specifically, certain classes of equilibria (MFNE and SFNE) are not asymptotically socially optimal since only a subset of the SPs compete in either the macro- or small-cell markets. Furthermore, a resource allocation strategy is devised to suit the virtualization framework. "Adaptability ratios" are introduced to model network suitability to different services. Combining "adaptability ratios" with Nash bargaining, an iterative resource allocation algorithm is devised. Through simulation, the advantages of the proposed algorithm are validated.

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Research Article

Green and Sustainable Mobile Robots Design - a MCDM Approach

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Abstract

To safeguard the environment, products and technologies are made friendlier to it. In this context, more research works were already done in computing and supply chain management fields. But, only less amount of research happened in Robotics field. Particularly green robotics was not addressed well. This research work tries to address green robotics with two real world case studies. Further correlation between green robotics, green computing and green supply chain is also discussed. The strategies which are bringing sustainability in robotics are discussed. Adoption of green concepts from first stage (robot design and fabrication) to final stage (robot application) is addressed. The metrics used to verify green concepts are discussed. The criteria used in this study are green material selection (as per international standards), energy saving, cost saving and green computing. Two numerical examples – design of two educational mobile robots are presented. The problems were solved in a MCDM approach. A hybrid method, ISM-ANP was employed to crack the problems. The simulation results ensure that effectiveness of the proposed MCDM method.

Environmental Chemistry Environmental Engineering Green Robotics Sustainability MCDM ISM ANP

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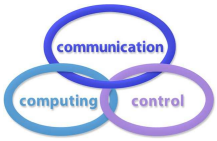

CCC Publications

Threshold based Support Vector Machine Learning Algorithm for Sequential Patterns

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Abstract

Now a days the pattern recognition is the major challenge in the field of data mining. The researchers focus on using data mining for wide variety of applications like market basket analysis, advertisement, and medical field etc., Here the transcriptional database is used for all the conventional algorithms, which is based on daily usage of object and/or performance of patients. Here the proposed research work uses sequential pattern mining approach using classification technique of Threshold based Support Vector Machine learning (T-SVM) algorithm. The pattern mining is to give the variable according to the user's interest by statistical model. Here this proposed research work is used to analysis the gene sequence datasets. Further, the T-SVM technique is used to classify the dataset based on sequential pattern mining approach. Especially, the threshold-based model is used for predicting the upcoming state of interest by sequential patterns. Because this makes deeper understanding about sequential input data and classify the result by providing threshold values. Therefore, the proposed method is efficient than the conventional method by getting the value of achievable classification accuracy, precision, False Positive rate, True Positive rate and it also reduces operating time. This proposed model is performed in MATLAB in the adaptation of 2018a.

Keywords: Data mining; Sequence Patterns; Threshold based Support Vector Machine Learning Algorithm; Classification Accuracy; Sequential mining;.

1 Introduction

The bioinformatics analysis is widely used in the area of computer science and applications, which deals with the data for collecting, organizing, and analysing. [1] Here the DNA and protein sequence are analyzed. Pattern mining algorithm with its sequential database are analysed with various domains. In this frequent data, a small gap in the pattern is restricted for finding valid pattern of

dataset. The pattern recognition process involves the gap constraints, length constraints, maximum supports, and minimum type. Here the maximum support is no greater than the sub-support matrix. Youxi Wu and others uses non-overlapping sequence to specify the gap constraints by pattern mining approach. Here the gap constraints is obtained by finding transcriptional site of gene from DNA cells. Bioinformatics is also utilizes the area of Genomic signal processing for dealing with the digital signal processing (DSP) applications. [2] Clustering method is to identify the sequence of gene data, which is performed with online collaborative model. [3] Particle Swarm optimization technique with adaboost model had classified the result of DNA gene sequence by data mining approach. Identifying the species name or organism type is by gene sequence and classification techniques. This will provides the DNA-attributes, nature of DNA cell and the type of species of DNA. The data mining is used to extract the data from required field; in this, the subtopic performs the pattern mining approach for analysing patterns by statistical mode. Classification technique in data mining is mostly prefers machine learning algorithm. The sequential pattern analysis will discover the pattern of transcriptional gene data. This technique is to find the matches of frequently occurrence of data. To identify the pattern various measures are investigated. The minimum support matrix is to provide the threshold value to the sequence. The DNA sequence having the responsibility to regulate the gene, the characters A, G, T, and C is ordered with biological term s. the Adenine and thymine is paired with X mentioned and Cytosine and Guanine is paired with Y mentioned. In previous research work, [4] has described the dataset by performing the artificial neural network and deep learning algorithm. [5] Hadoop and weka distribution has proposed with machine learning algorithm and data mining techniques. Support Vector Machine (SVM) learning algorithm describes the classification of genes via intron and exon combination in the DNA cells. This classification process is based on size of given dataset. The boundary function of SVM is based on the value of threshold used for dataset, which determines the weight of classes of the boundary. After performing train function, the class of train and performance of test is validated. By determining kernel function, we can evaluate the class region of data. Based on the different threshold value assignment, the classifier will provide the various tested sequence of data. It is used in the linear classification method for analysing the larger datasets. After determining training nodes of sequence, the boundary will terminates to sort the value for arranging the nodes. Based on the database the classification is done with umber of sequences and list of identity, which evaluates the sequential dataset classifications. Here the sequence of data is identified as Is and dataset is represented as X_d. With the set of support matrix, we can determine the total number of sequence presented in the dataset.

$$\sigma(s) = |Is \epsilon Xd | s < Is | - - - - - - 1$$

With the ratio of 's', the number of sequence in the database is given by,

$$\sigma(s) = \frac{(|Is \epsilon Xd | s < Is|)}{Xd} - - - - - - 2$$

Here equation (2) represents the exact and relative support matrix is changeable by's' ratio. If the pattern sequence's' is greater or equal to the threshold value of dataset 'Xd', that expresses $\sigma(s) >= SminTHD$. Various node values are represented by kernel function 'k'. if the K > 0, the processor initialize the distribution factor. In pattern mining process, the k is always increments to the value '1' that is k+1. Sequence of data contains various items and it is performed with various classification technique that is GSP, SPADE, Prefix span, and GSpan. These techniques are used feature classification of SVM model. Minimum support matrix will fix the threshold value for mining the sequence patterns. The sequential data mining with classification is done by extracted dataset. Initially the dataset is analysed for its application and performs the sequential operation. Sampling process is done by getting the threshold value of each sequence. This high dimensional data is send to the training process and performs the operation of minimum support. It will generate the minimum valued data to the testing process and it minimizes the dimension of original dataset. After that by performing classification process, we can classify the dataset according to the genes sequence item sets. Transcriptional dataset is used for gene sequence determinations and it classified based on the mined data. Machine Learning technique is used for classifying the dataset by assigning class value to

the train and test sets. Class boundary is selected in training set, it maximizes the support matrix's margin, and it will denote the length and distance of class boundary for getting compact data. DNA sequence has classified by integrating DM and ANN approach [4]. Auroral image sequences dataset is to presented and it is classified using pattern-mining techniques [20]. Nowadays, the machine-learning (ML) algorithm is a most widely used technique for data mining algorithms. Fingerprint based DNA sequence is to detect the present gene, identify the forensics, and testing the parental genes. Bioinformatics sequence used in machine learning algorithm provides better result as compared with other existing methods. Genome sequence having high volume of gene data, which is analyzed by monitoring number of data sequences. Transcriptional data sequence is used for classifying the gene function by specifying species.

This proposed research work is summarized as follows. Section II is the survey analysis of recent related literatures. Section III is the Existing method description and techniques used. Section IV is the proposed methodology-using threshold based support vector machine learning model for classification and gene expression. Section V is the result and discussion part. Section VI concludes the proposed method and provides the thought about future work.

2 Literature Survey

Gyula Dorgo., et. al., (2018) has proposed the sequential mining approach for alarm suppression applications. Statistical data is processed to find the abnormal condition of alarm. Here the suppression sequence is to set systematic analysis for processing and controlling the action. The technique uses bayes classifier with multi-temporal sequence mining algorithm. This method reduced the losses and suppression speed, since the operator will keep the operation in normal condition by indicating the present state display. Target and action limit is set with alarm rate with period, which is used to analysis the sequential data. Threshold value is assigned with statistical configurations of dataset. After performing the sampling process, the data sequence is initiated with threshold value for minimizing the dimension of data length. Alarm reduction model comprises fault detection and observation unit, which provides the result of work reduction and failure prediction. Here the data mining technique is used to extract the pattern of alarm suppression ratio. The alarm will triggers the next relay and it returns to next end state of sequence pattern. By the use of suppression in the sequential pattern mining, the alarm management and control strategy is performed and it reduces the data loss but increases the execution time.

Bao huynh., et. al., (2017) has proposed the parallel method is used to mining the sequential dataset with dynamic load balancing and dynamic bit vector options. The frequent data is performed in the closed sequential patterns and it is analysed by prefix span, which reduces the execution time of classifier. If the database contains the large set, the sequence will shows the exponential numbering of dataset and it is compact by data extraction process in data mining approach. Here the parallel method is used to solve the problem of expensive computations and large sequence analyser. Since it improves the processing speed but the number of stages increased while performing sorting process. Parallel architecture is modelled for performing sequential pattern analysis with dynamic bit vector and load balancing. Here the CPU time is changed based on the different architecture in parallel analysis. This method is design with various datasets and performed in Intel core i5-6200U with 2.3 Hz frequency and 3MB memory.

Po-Ming Law., et., al., (2018) has present the pattern mining technique for temporal query and sequence exploration of recursive operations. This method is not sufficient for support matrix analysis. While performing the event analysis, the sequence are extracted by providing the mined data in the output. By enabling the event sequence, have to identify the item sets. This makes the reduction in data loss on large sequence analysis. Sequential mining approach is to processed and controls the data for reducing the data loss. Since the classified sequences and segments are visualized in the database. Here the database is the marketing and health information analysis. By setting the time and by set the number of events in the constraints makes system effectiveness. The analysis process includes splitting and selecting the segments based on patterns, which depends on temporal data.

Seema Sharma., et., al., (2018) has present the machine learning technique for processing data by data

mining technique. This survey analysis the knowledge based acquisition with its classification. Based on the assignment of class and group of given data, the predefined values are set for each instance and performs classification. Here the technique used is SVM, decision tree, and K-nearest neighbour with Bayesian network. By using decision tree for classification methods, the splitting strategy is to generate the gain value and it ratio. For finding the value of gain ration, we have to calculate the entropy and information gain. Here SVM technique uses K-nearest neighbour node, which reduces the data loss while performing classification. With various techniques and determinations, the computational cost is increased for large sample sets, which is very sensitive.

Anuja Jain., et., al., (2017) has proposed the data mining technique for hadoop with weka distributions. Here the supervised Machine Learning (ML) algorithm is used for classification. For big data mining technique the Hadoop approach is used and it is connected with Weka tool. ML algorithm uses Naive Bayes and SVM for big data analysis and it compared the result of accuracy for raw data versus normalized data. By this work, it handles the problem of big data analyses, which are data integration, data volume, technical skills requirement, and cost solution. Here the Hadoop uses Apache open sources, which allows the system for distributed processing model. By clustering process specification of characteristics is assigned by predefined classes. Transactional data is analysed by sequential data processing technique, which is created by decision tree structure. Reinforcement learning technique is to connect with dynamic setting data, which provides the feedback to the user for rewards and punishments.

Sadok Rezig., et., al., (2018) has proposed the technique for predicting maintenance activity by sequential data sets. The data-mining algorithm used for various applications, which bases the spare parts maintenance. Threshold value is assign for support matrix is set previously and by this information, we can finds the sequential data patterns. Frequent data mining is combined with process of classification, prediction, and clustering. Threshold support value provides the pattern assignment of each data to be processed. By this technique, we can analyse the raw data for removing the unwanted data this will reduce the data loss. Sequential pattern is used to generate the raw data into sequential model, which is known as antecedent and consequence. Here they takes the spare part maintenance of a company, which provides the maintenance parameter, spare part code and description about the spare part. By this parameters they can obtain the sequence, intervals by weeks and percentage of supports. Final determination is about classification with its related parameters.

Cheng Zhou., et., al., (2016) has presents the sequential classification method, which is based on data mining with pattern recognition techniques. Here the feature vector based model is used to generate the sequence for classification. The efficient technique is to composed pattern mining technique takes the interesting data to label the class value, which is based on support matrix and classification rule. Some situations, the dataset is not allocated properly in an order, this leads to data loss. However, by the use of sequence classification rule, we can remove the unwanted data. Since it, obtained the mined data and accuracy of classification techniques. Naives Bayes classification technique is used in pattern mining approach for processing sequential dataset. Interesting dataset pattern is based on support and cohesion. By comparing with predictive accuracy, it will not support for big data mining approach.

Sathish Kumar S., and Duraipandian N., (2012) has presented the DM and ANN based classification technique for DNA sequence analysis. To identify the species from DNA gene sequence, this is considered as a raw dataset. If the dataset contains unwanted information, it is neglected for classification process. Here the artificial neural network model is used for data mining approach. High dimensional dataset is mined by principal component analysis strategy and it is validated by 10-fold cross validation approach. By this statistical validation, the classification model is performed. By this bioinformatics data, they can obtain the species name by DNA cells and classification accuracy. Genomic signal processing tool is used to classify the dataset. This species classification model is depends on nucleotides and data is mined by nucleotide pattern. By calculating various pattern lengths, can obtain the parameters assignment as A, T, G, and C. In training phase, multi dimensional structure is reduced by using artificial neural network. In support matrix, species brucella suis and C-elegans are determined. Classification technique improved the accuracy rate.

3 Existing Method

Plenty of research ideas are focusing with the performance of various mining techniques for bioinformatics datasets. Data mining technique is the most emerging technology, which is used for various applications. The conventional method used the artificial neural network (ANN) for classification. DNA splice junction sequence is used for data analysis. While performing sequential pattern mining, initial stage having larger data dimension, this should be reduced as small data dimensions. By comparing with artificial neural network classifications, the proposed research work improves the accuracy and truth factor. Gene sequence is associated with genome for assigning the genetic information about the species. Most of the conventional method uses ANN, genetic algorithm, and fuzzy logic system with the structure of hybrid model

3.1 Neural Network based Pattern mining Technique

Neural network classification method is used in the previous research work [1]. With data mining technique, the sequential pattern recognition had performed. The Radix Tree miner algorithm is used to structuring the model. Here the sequential pattern mining technique is employed by performing larger dataset. The neural network model is performed to classify the dataset. In this data set, A, C, G, and T are the nucleotides, which assigning the value of each item sets for performing classification in NN. By Radix tree miner, if the sub-trees are not divided for upcoming process have to neglect the set because it is an unwanted data. This takes number of stages high than the proposed T-SVM based pattern miner technique. Execution time of classification technique is increased by increasing number of hidden layers in the NN. When compared to the previous work with proposed T-SVM based pattern mining technique, the execution time is reduced in proposed method, this makes the system efficiency. Figure 1 shows the block diagram for existing Neural Network classification for sequential

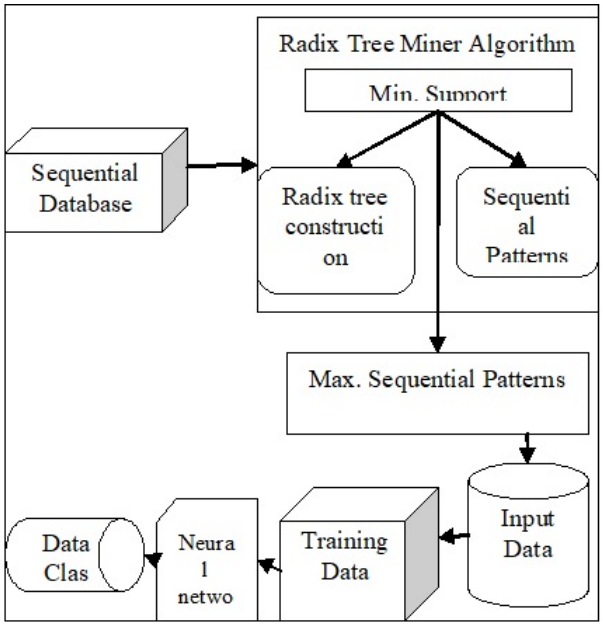

Figure 1: Block Diagram for NN for sequential pattern mining technique

pattern mining for Splice gene sequence dataset. Initially the raw data set of DNA cells are collected from various sources. It has high dimensionality in nature. This is reduced by various techniques like radix tree miner algorithm and artificial neural network for classification. The algorithm had evaluate the sequence for identifying pattern. In support block, the threshold value of each sequence value allocated for minimizing the sequential pattern dimensions. For each data set, the sequence ID is given with respect to the pattern alignment. The length of sequences is increased by time complexity of radix tree miner algorithm. After performing radix tree miner the high dimension data set is sent to the training process. Prefix span method is also used for making pattern of gene sequence, but

it consumes much timing to complete the process and requires more memory to process from the projected data sequence.

4 Proposed T-SVM Based Sequential Pattern Mining Techniques

The proposed threshold based Support Vector Machine learning algorithm is preferred in this research work for classification of sequential pattern mining approach. The proposed method takes the data set of splice-junction gene sequence as mentioned in previous research work data set. Here the DNS sequence contains the four variable set of nucleotides, that is Adenine 'A', Guanine 'G', Cytosine 'C', and Thymine 'T'. These species are formed as nucleotide. Initially the long sequence set to be processed for reducing the dimension of dataset, this makes the system efficiency. The proposed method is integrating the data mining technique uses Machine Learning (ML) algorithm for classification. To generate the length of each sequence, we can obtain the value of threshold. By the statistical data, we can obtain the classification in linear based supervised machine learning algorithm. Figure 2 shows the block diagram of proposed model with T-SVM algorithm and sequential pattern

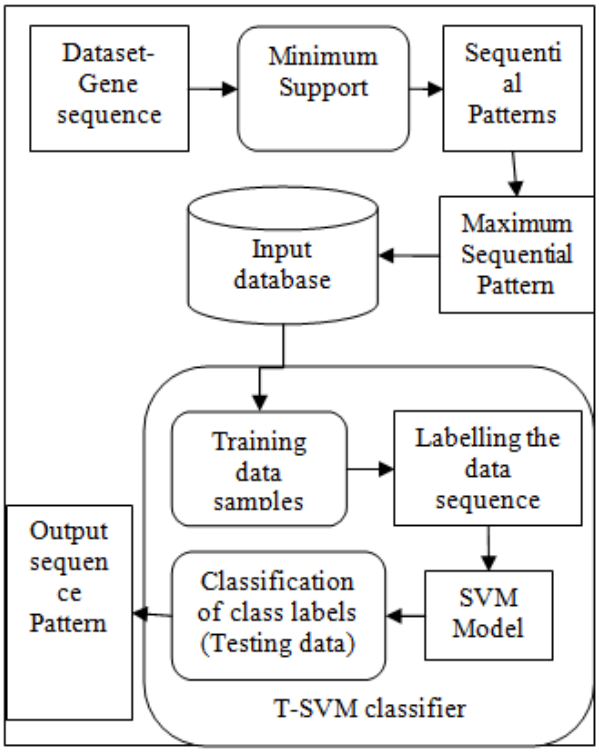

Figure 2: Block Diagram of proposed T-SVM for sequential pattern miner system

mining techniques. First, the dataset of Splice junction gene sequence is taken for this analysis. In minimum support block, the threshold value is set for initial data sequence, which is based on rule based mining technique. The gene sequences are mined by pattern mining techniques. Based on the threshold value, have to allocate the pattern for training process. After performing training process, the SVM model is to generate the class label to the sequential data for performing the testing process. Finally, the test sequence is allocated for performing classification based on its threshold value. However we can obtain the sequentially pattern mined data.

A.Dataset

Pattern mining process is performed for data set of Splice junction gene sequence of primates via DNA cells, which is taken from centre of machine learning and intelligent systems and it is associated with imperfect domain theory. The splice sequences are pointed from DNA sequences and it recognizing with two boundaries, called intron and exon. Here 3190 instance is capture with 61 attributes. The below table 1 mentioning the nucleotides arrangements in datasets indicates the variables D, N, S, and R. these raw dataset is generated for performing sequential pattern mining technique. This dataset

Table 1: Dataset character mentioned

Assigned CHARACTER	NUCLEOTIDES Order
D	A G T
N	A G C T
S	C G
R	A G

is capable of 10-fold validation techniques, which is applied to the 60 sequential DNA nucleotide positions. Class distribution is mentioned as EI and IE of intron/exon. Genetic information about the DNA sequence is given as ,

1. Molecular biology
2. Evolutionary biology
3. Metagenomics

This information is based on genome and proteins in the DNA sequence. This nucleotides collection of gene is the primates splice junction sequence, which is identify by potential targets, study with differ organism in evolutionary biology, and species representation in metagenomics. The transcriptional dataset is analyzed by three different analysis that is microarray analysis, tiling arrays, and regulatory sequence analysis.

B.Sequential Pattern mining Technique

Machine learning algorithm uses pattern-mining techniques with sequential data. Hidden parts of sequences should be mined by ML algorithm. This technique will control and detect the pattern for classification. Based on the sequential data, the statistical analysis is taken for classification model and it is extracted for respective applications. These sequential patterns are identified by assigning threshold value of each sequence of data and it is from transactional database. Dataset is frequently analyses the pattern for pattern arrangement and it fills sufficient to the algorithm. This is for predicting the respective pattern recognition and classification models. Based on pattern mining techniques, the pattern is allocated by threshold value and it minimizes the dimension of pattern. It is completely depends on outcome of the model. The distance of sequence in SVM is calculated by,

$$Distance(i) = (2 * m - 2 * count)/(2 * m - count) - - - - - - - 3$$

Where, I is the iteration and 'm' is the length of input sequence. By pattern mining is a function is expressed as sigma that is given by

$$F_w, s(X) = sgn(wTX + s) - - - - - - - 4$$

$$\mathrm{F_{support}}\ (\mathrm{X}) = \mathrm{sgn}\ (\textstyle\sum_{i-1}^{n} b\ \lambda i\ Xi + s)\text{--------}5$$

Here this pattern is recognized from given input data sequence. Sequential pattern is identified as S, which s presented by threshold value S= S1, S2,. . . . . ,Snand dataset is the sequential arrangement of nucleotides that is A, C, T, and G is given by, Here S1 and S is represented as,

$$\mathrm{S} = \frac{Xd}{a} S1 + \frac{xp}{a} S2 \text{ ---------}6$$

$$S1 = 1/X_d \sum (a_t - \mu 1)(a - \mu 1)^T - - - - - - - - - - 7$$

$$S2 = 1/X_d \sum (a_t - \mu 1)(a - \mu 1)^T - - - - - - - - - - 8$$

For k=1 the confusion matrix is,

$$\begin{bmatrix} 569.4 & 63.4 & 58.2 \\ 116.9 & 521.7 & 53.4 \\ 424 & 326.8 & 739.2 \end{bmatrix}$$

Confusion matrix is in the order of EI, IE, and Numbers of training region and the value is based on class test and gene train function. This confusion matrix provides the better accuracy result to the classification system. Based on the threshold variations in the input sequence, the arrangement of pattern is by labeling each sequence. This variation leads to changes in resultant pattern of every instance. This class of information of each sequence is the mined pattern. Based on the data sequences,

Table 2: Sequential Pattern mining techniques

K	**SEQUENTIAL PATTERN**
1	'AAGCCCATCCTAGAGAAGCTGACCCAGGACCAGGATGT GGACGTCAAATACTTTGCCCAG'
2	'ACGGAGCGAGTCTGGAACCTGATCAGATACATCTATAACC AAGAGGAGTACGCGCGCTAC'
3	'TGCTCTCCCAGGTCTACCCTGAACTGCAGATCACCAATGT GGTAGAAGCCAACCAACCAG'
4	'TGCCTCCTTTCACACTCCTCTTGGGGCTCGTGACATTACG AACCCTAACCCGGGCCCTGC'
5	'TCGTGGCGTTTGTGGCAACCCCGGACACGGGGCACCAGC CAGTCAGCGGAGCCTCCTCAC'
6	'CATCGTCTACCTGGGTCGCTCAAGGCTTAACTCCAACACGC AAGGGGAGATGAAGTTTGA'
7	'GCCGCTTCCTCATCCTGGCACACTCTCTTCACAGCCGAAGA AGGCCAGTTGTATGGACCG'
8	'CGCACCTGGGCGCCCTGCTGGCAAGATACATCCAGCAGGC CCGGAAAGGTAAGAATGCTG'
9	'GGCCAGATCGTGCCATAGCACTCCACTTTGGGTGATAGAGG GAGACTCTGTCTCAAAAAA'
10	'GGAGTGGGGGCGGTGCGTCCTCCGGCCGGCAGCGGTGGC CACAGCTCTCCTCCCGCCGCC'

the pattern-mined data is shown in Table 2. By the confusion matrix changes, the varying threshold value to each sequence is mined in a ordered pattern. Highlighted sequences are characterized as D, N, S, and R of nucleotides and it is mentioned in table 1. Probability of intron and exon is calculated by,

P_EI=numbers of EI /length of class

P_IE=numbers of IE /length of class

Based on the above equation model, we can obtain the probability value of EI and IE. By length of class and number of intron and exon will show the gene class of train function. The probability mining is given by,
For Sum the probability of 'a' is given by,

$$P(a) = \sum_b p(a,b) - - - - - - - - - - - - 9$$

For multiplication of the probability is given by,

$$\mathrm{P(a,b)} = \mathrm{p(b|a)\ p(a)} \text{———} 10$$

The Bayes theorem is used to represents the pattern recognition in T-SVM. It is given by,

$$P(b/a) = \frac{(p(a/b)p(b))}{(p(a))} - - - - - - 11$$

The gene sequence of primates is having attributes, nature and species types, which is classified based on the threshold based support vector machine-learning algorithm. Initially the nucleotides sequence pattern is mined by pattern mining, but it have a high dimensionality in nature. It is reduced by classifying the sequence of each sub sections. After performing training, the sequence should be allocated for testing; this provides the classified result by labeling the each class values.

C. Threshold based SVM Model

Proposed threshold based SVM model is used for classification of sequential patterns. Based on the statistical analysis of proposed method, we can classify the result. Kernel based classification model is structure for train and test sequence. The train data is linearly separable by pair of weight function and support. That is function of <w,s> is given by,

$$f(x) = f(W^T X + \lambda_0) - - - - - - - 12$$

$$W^T X + s >= 1, for X \varepsilon pi(pos)$$

$$W^T X + s >= -1, for X \varepsilon pi(neg)$$

Here the weight function 'w' is represented as,

$$W_p = \sum^{-1} \mu_p \text{ -------- } 13$$

$$W_{p,0} = -1/2\ \mu_p \sum^{-1} \mu_p + P(a) \text{ --------- } 14$$

The above represented functions are mined with DNA cells of primates. This linear function generalized with weight vector and data miner variable. Here the combination of nucleotides is mined for sampling the sequence, which have threshold value of each class of sequence. The labeling of each sequence is assumed for class value of the DNA. By extracting this sequence at each instance, the DNA gene formation is made for the species recognition. Here the support matrix is used to assign the threshold value of given sequence. After it is given to the training process of SVM model, the kernel function in T-SVM classification result is improved. The gauss distribution function is represented by single mean valued sequence that is given by,

$$G(a|\mu,\sigma^2) = \frac{1}{(\sqrt{2\pi\sigma 2})} \exp\{-1/2\sigma(a-\mu)^2\} \text{-------} 15$$

The probability distribution function of Gaussian distribution model is given by,

$$P(i_a) = \varsigma P(i_a, i_b) di_b - - - - - - - - 16$$

This proposed Threshold-SVM model is used to assume the threshold value at internal sub-section of sequence having threshold value by sampling process. After getting the extracted data sequence, the pattern is set by pattern mining technique for describing DNA attributes. This will determines the support value for constructing confusion matrix at each value of 'k'. After completing the process of training and testing, the mined dataset is classified. Table 3 represents the sequential pattern of training and testing process with its execution time. Here the gene sequences are aligned with respective threshold values for classification.

5 Results and Discussion

Thus, the sequential pattern mining technique was applied in primate splice junction gene sequence dataset and it is classified using threshold based support vector machine learning algorithm. Based on the dataset parameters, the classification process is performed. This achieves the result of classification

Table 3: Train and Test gene sequence alignment

TRAIN GENE SEQUENCE	TEST GENE SEQUENCE
'ATTCAAACAGCGCCTCAGACTACTTCATTTGG TACAAACAAGAATCTGGAAAAGGTCCTC'	'TGGACCATCGCGGATAGACAAGAACCGA GGGGCCTCTGCGCCCTGGGCCCAGCTC TGTCC'
Elapsed time is 1.308294 seconds.	Elapsed time is 5.475533 seconds.

accuracy and reduces the execution time. Table 4 represents the determination value of proposed T-SVM model using SPM technique.

Performance metrics

The evaluation of whole system is work with various aspects like accuracy, sensitivity, and precision.

a.Classification Accuracy

By finding the confusion matrix, we can calculate the accuracy by correctness value of proposed systems and it is associated with the value of true positive, true negative, false positive, and false negative in matrix form. Here the true positive is the rate of actual value to the predicted value of data. True negative is the actual and predicted rate is with class zero valued function. False positive is the rate of false rate of actual value versus predicted value. False negative is the actual class value versus predicted false value zero. The classification accuracy is calculated as,

$$Accuracy = \frac{(TP+TN)}{(TP+TN+FP+FN)}$$

b.Sensitivity

In pattern recognition, the sensitivity of mined pattern is depends on actual sequence and trained sequence with its threshold value. The sensitivity is also known as recall, which is calculated by actual value to the false negative value.

$$Sensitivity = \frac{TP}{(TP+FN)}$$

c.Precision

Precision value is about the capturing the correctness of the given sequence. The probability of getting the value of actual value into predicted value versus test sequence. It is formulated as given equations,

$$Precision = \frac{TP}{(TP+FP)}$$

Table 4: Values obtained in proposed T-SVM using SPM technique

Parameters	T-SVM using SPM method
Accuracy	90.64%
Sensitivity	100%
Precision	1
Execution Time	677ns (Train and Test)
Number of Pattern mined	768
Correct Sequence	1879

Figure 3 represents the comparison result of proposed method's number of patterns mined for an instance with conventional methods. Here it achieves the best result as compared with previous techniques. For every instances, the variation in threshold value changes the sequence, here this above result is based on the initial k=1, the sequence are "AAGCCCATCCTAGAGAAGCTGAC-CCAGGACCAGGATGTGGACGTCAAATACTTTGCCCAG' is mined. Here the function Gauss and kernel is represented for training and testing process. Figure 4 shows the graph model of Gauss and Kernel representations of T-SVM model. The below figure 5 is the comparison result value of classification accuracy, compared with conventional radix tree miner and Prefix span method. Figure 6 is the comparison result representation of compilation time with the unit of ns. The whole comparison result is shown table 5, which contains the classification accuracy, time taken to complete the

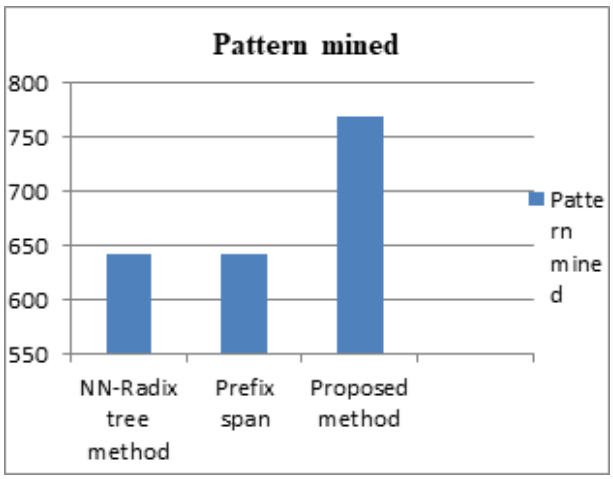

Figure 3: Comparison with the result of Number of pattern mined of an instance

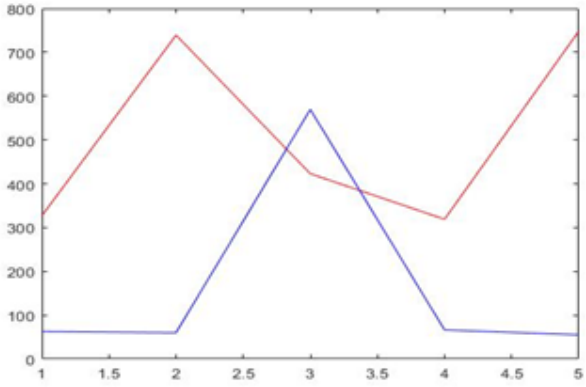

Figure 4: Gauss (red) and Kernel (blue) function

process, and number of pattern mined for an instance., which is compared with existing radix tree miner and prefix span methods. The proposed method achieves the better result as compared to the previous work. The above figure 7 shows the comparison results graph model; by this values, the proposed method achieves the result in the way of improved accuracy, reduced execution time, and number of pattern mined at an instance. Since the proposed method is efficient than the conventional method.

6 Conclusion and Future Scope

Thus, the proposed research work is concluded with the technique of sequential pattern-mining approach uses threshold based Support Vector Machine learning (T-SVM) algorithm for classification of DNA gene sequences. Here the pattern mining technique is used to model the given gene sequence by pattern mining method. Based on the data set attributes the gene sequence of DNA is mentioned. The high dimensional data set is reduced by performing training and testing of data. Based on the

Table 5: Comparison results

Parameter	**Neural network based Radix tree miner [1]**	**Prefix span based method**	**Proposed T-SVM method**
No. of Pattern mined	642	641	768
Accuracy	90.38%	74.83%	90.64%
Execution Time	795ns	907ns	677ns

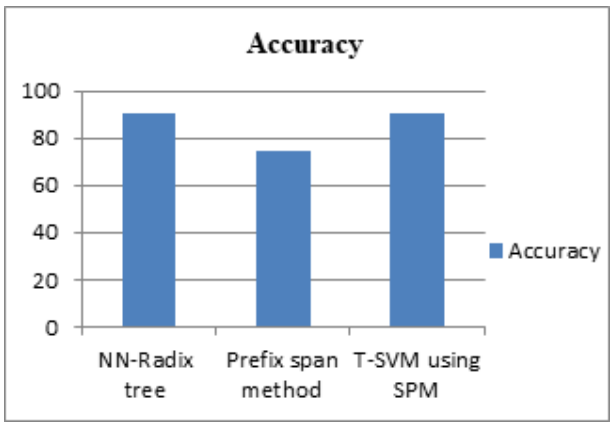

Figure 5: Comparison result of Classification Accuracy

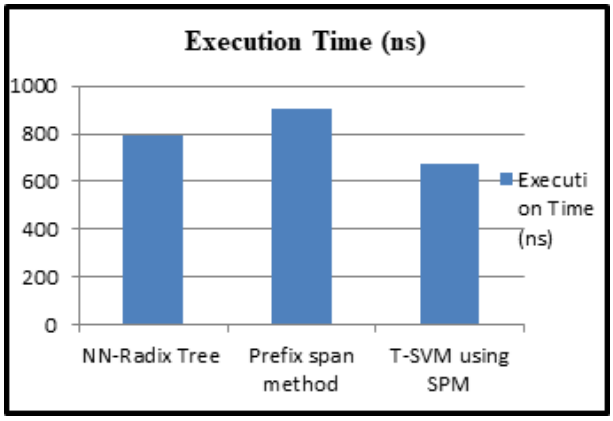

Figure 6: Comparison Result of Execution time of conventional methods versus proposed method

'k' value, the sequence of mined data is varied and it is given to the class database. By comparing with various classification techniques, the proposed method achieves the result by classification accuracy, number of pattern mined and execution time. In future work, the proposed method is enhanced by modifying novel techniques for various datasets with most achievable performance metrics. Classification accuracy is improved by providing correct sequence to the model.

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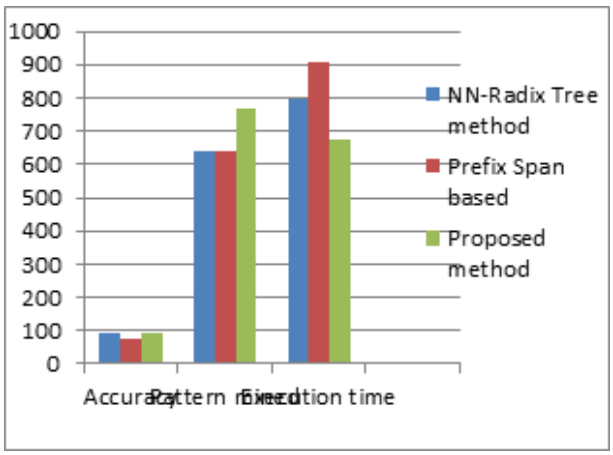

Figure 7: Comparison Result of Execution time of conventional methods versus proposed method

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Security for the Networked Robot Operating System for Biomedical Applications

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Abstract | References | Citations | Supplementary Data | Suggestions

Future mechanical frameworks will be arranged in exceptionally organized conditions in which they speak with modern control frameworks, cloud administrations or various other systems at distant areas. In this pattern of solid digitization of modern frameworks (likewise some of the time alluded to as Industry 4.0), digital assaults are an in-wrinkling danger to the uprightness of the automated frameworks at the center of this unique turn of events. It is normal, that the ROS shall assume a significant function in advanced mechanics outside of unadulterated exploration situated situations. ROS anyway has noteworthy security issues which should be tended to before such items should arrive at mass business sectors. Robot Operating System has emerged promptly as an alluring production method at micro and nano scales, particularly in the area of biomedical applications because of its flexibility and condensed size. As disputed to conventional grippers in the field of biomedical applications where mobility is less and show size restriction threats, ROS based micro-grippers are clear from outside power input and yield better mobility. It also has a significant impact on the field of biomedical surgery, where security is a major threat. With the current improvements in wireless communications, Tactile Internet has endorsed a dominant impact. It is regarded as the future huge development which can give current-time regulation in industrial systems, especially in the field of tele surgery. Even though, in remote-surgery environment the data transfer is subjected to various attack points. Hence, in order to understand the real capacity of safe tele-surgery, it is needed to develop a safe verification and key agreement protocol for tele-surgery. We offer here an effective, secure and common verification method in the field of biomedical application in the field of robotic tele-operation. The developed protocol ensures safe interaction samidst the surgeon, robotic arm, and the devoted jurisdiction; The results obtained express the flexibility of the protocol against offline password assuming attacks, replay attacks, imitation attacks, man-in-the-middle attacks, DoS attacks, etc.

Keywords: Biomedical Applications; Industry 4.0; ROS; Robotics; Security

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RETRACTED ARTICLE: An enhanced design and random optimization for oversampling ΔΣ modulator

V. Kalaipoonguzhali & S. Kannan

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Abstract

Delta Sigma Modulator (DSM-ΔΣ) is a high-precision information converter that examines the Signal to Noise Ratio (SNR) in Radio Frequency Transmitter (RFT). This paper proposes an advancement model alongside with ΔΣ model for the designing process. The predictable result is low Over Sampling Rate (OSR) DSM, which would benefit fast, high-multifaceted nature computations, primarily required for wireless applications. The enhanced DSM is a non-ideal second-order feed-forward signal processing. The enhancement of the DSM in Multipoint Random pursuit (MPRS) significantly improves coefficients of DSM to investigate the SNR and Nyquist rate.

The advantage of multi-point in DSM is relatively easy for implementation on complex problems, with black-box function evaluations. This optimal DSM will deliver low OSR for wireless applications. This low OSR assumes a prevalent job in the sign preparation, and it impacts the general multifaceted nature and cost of the productive ΔΣ converter. From the results of the SNR 68.28 dB, the sampling rate is 64–256, and finally, frequency is 1.92. This enhanced model executed using MATLAB reenactments and the outcomes guarantee a decrease in OSR by SNR rate. This model contrasted with other ordinary and versatile modulators. To examine the adequacy of the work, the yield signal data transmission seen to build multiple times with no expansion in the inspecting recurrence.

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A Hybrid Deep Learning Intrusion Detection Model for Fog Computing Environment

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Abstract: Fog computing extends the concept of cloud computing by providing the services of computing, storage, and networking connectivity at the edge between data centers in cloud computing environments and end devices. Having the intelligence at the edge enables faster real-time decision-making and reduces the amount of data forwarded to the cloud. When enhanced by fog computing, the Internet of Things (IoT) brings low latency and improves real time and quality of service (QoS) in IoT applications of augmented reality, smart grids, smart vehicles, and healthcare. However, both cloud and fog computing environments are vulnerable to several kinds of attacks that can lead to unexpected loss. For example, a denial of service (DoS) attack can block authenticated users by rendering network resources unavailable and consuming network bandwidth unnecessarily. This paper proposes an intrusion classification model using a convolutional neural network (CNN) and Long Short-Term Memory networks (LSTM) to obtain the advantages of deep learning methods in order to accurately predict such attacks. The proposed integrated CNN with LSTM-based Fog Computing Intrusion Detection ICNN-FCID model is used for multi-class attack classification. Our proposed model is demonstrated using NSL-KDD, a benchmark dataset, and provides attack detection accuracy of about 96.5%. Comparisons of the accuracy of our model with both traditional and other recent deep learning approaches show that our model is superior in performance. The ICNN-FCID model can be used in fog layer devices where network traffic is monitored and the attacks are detected. As a result, the cloud server and fog layer devices can be protected from malicious users and are always available in providing services to IoT devices.

Keywords: IoT; Fog computing; IDS; deep learning; CNN and LSTM

1 Introduction

The Internet of Things (IoT) refers to the interconnected billions of physical devices that store and exchange data from around the world through the internet, where data can be processed and used for many purposes. The large amounts of data generated by the IoT need to be stored, processed, and accessed [1,2]. The cloud computing paradigm can be used for big data storage and analytics. The

sensing data of IoT devices can be stored in the cloud so that the smart devices can be monitored and actuated [3]. This will enable the development of new applications using IoT and smart devices.

Fog computing is an architecture that integrates cloud and IoT technology. The fog architecture acts like a cloud but is closer to the end user, and enables cloud computing facilities to be at the edge of the network, through which connected devices can obtain cloud services [4]. Fog computing enables the operations of cloud computing by means of a control plane and a data plane. A fog node is a device that includes the capabilities of computing, storage, and network connectivity. Multiple fog nodes can be installed to provide support to end devices. Switches, embedded servers, controllers, routers, and cameras can act as fog nodes. Most of the time-sensitive data generated by the end devices are sent to the fog node, where the data are analyzed. The response is sent to the device in a fraction of second. Then the fog node will send a summary of the data and work to the cloud for further analysis. The less time-sensitive data can be processed after seconds or minutes and sent to the aggregate node. After analysis, the aggregate node sends the response via the nearest node to the device. Later the aggregate node will send the report to the cloud for future review.

The IoT network's data that are not time-sensitive can be sent to the cloud, where they are processed, analyzed, and stored. The end devices will wait hours, days, or even weeks for the data. The fog computing architecture also uses private servers to store the confidential data. This local server is also useful for ensuring data security and privacy. The fog node can receive irrelevant data from malicious user during communication. The attackers can produce a flood of data to execute a denial of service (DoS) attack, thereby diminishing the availability of fog nodes and the cloud. A local fog server is vulnerable to several kinds of attacks, including DoS, Remote to Local (R2L), Probe, and User to Root (U2R). This requires effective detection and prevention of various attacks [5]. Since the fog node is constrained by limited resources, if it suffers a DoS attack, it will not be able to provide services for users and the network performance will be greatly reduced. An intrusion detection system (IDS) is used [6] to monitor a network or systems for malicious activity and such activities should be reported either to an administrator or collected centrally. An IDS can be network-based, meaning it is responsible for checking network structures and looking for attack signatures, host-based, which means it is used to monitor host systems, or application-based, meaning it monitors specific applications and programs.

An IDS can be implemented through deep learning models, which are advanced models of machine learning. This model consists of several consecutive layers that are interlinked, and each layer receives the previous layer's output as input. The key advantage of the deep learning algorithm over other machine learning algorithms is its ability to run feature engineering on its own. A deep learning algorithm scans the data to search for correlated features and combines them to enable faster learning without guidelines. Deep learning models are capable of creating new features by themselves. Once the deep learning model is properly trained, it can perform thousands of routine, repeatable tasks within a shorter time frame. A convolutional neural network (CNN) is a deep learning algorithm that can be used in various domains such as image processing, natural language processing (NLP), and biomedical applications. CNN has achieved excellent research results in image classification, sentiment classification, relation classification, textual summarization, and disease diagnosis and detection [7,8], and it has also been applied to various information security use cases, such as classification of malware, detection of intrusion, and Android malware, spam and phishing, and binary analysis. Historically, network intrusion detection was performed by machine learning models. However, these algorithms can cause the program to produce many false positives, causing repetitive work for security teams. Deep learning models can be used to develop more intelligent IDSs that can analyze network traffic more reliably. To address the challenge of intrusion detection in fog computing environments, this paper proposes an integrated CNN with LSTM-based intrusion classification methodology (ICNN-FCID). This methodology can reduce the number of false alerts and help security teams distinguish between bad and good network activities.

2 Related Work

This section lists various accomplishments in the area of intrusion detection, specifically the real-world IDS. Much research has been carried out in the area of network intrusion [9,10]. Yang et al. [11] designed the SVM-RBM algorithm using a support vector machine (SVM) and a restricted Boltzmann machine (RBM) to detect network anomalies. They then used the unsupervised algorithm of RBM to extract useful features from the datasets and trained the SVM classifier in a short time using the Spark gradient descent algorithm. They explored the numbers of hidden units for improving the performance of SVM-RBM. Jiang et al. [12] proposed the use of LSTM recurrent neural networks (LSTM-RNNs) as an intelligent multi-channel attack detection model. They performed multi-channel training with different types of features for preserving attack features of input data. They then classified the attacks and normal data and used a voting algorithm to determine whether the input data are an attack or not with the results of the classifier's attack detection. They have shown that their work was superior to other attack detection methods, such as Bayesian or SVM classifiers.

Peng et al. [13] proposed a decision tree-based IDS system for fog computing environments. They digitized the strings in the KDD Cup dataset using a preprocessing algorithm, and they increased the quality of the input data through data normalization. This improved the efficiency of detection. Gao et al. [14] proposed a deep belief network (DBN), which is a combined form of unsupervised learning networks, a four-layer RBM, and a back propagation network, which is a supervised learning algorithm. Their result is demonstrated with the KDD Cup 1999 dataset. Farahnakian et al. [15] proposed an enhanced IDS model using the deep autoencoder (DAE) method. From the high-dimensional data, features were extracted using AE. They used four autoencoders in their deep autoencoder-based IDS (DAE-IDS), in which the result of the previous layer is used as the input to the next layer in AE. Each layer undergoes greedy unsupervised training to improve the efficiency. After the four autoencoders were trained, they used a softmax layer to classify the inputs to normal and attack. They also used the KDD Cup 1999 dataset in their work for evaluating the efficiency of DAE-IDS.

Wang et al. [16] proposed a hierarchical spatial-temporal features-based intrusion detection system (HAST-IDS). They used deep CNNs to learn low-level spatial features of input data and LSTM networks to learn high-level temporal features from raw data. The deep neural networks automatically completed the entire process of feature learning using the DARPA1998 and ISCX2012 datasets. Kim et al. [17] proposed a DNN-based IDS model for detecting attacks. They used the KDD Cup 1999 dataset. Their DNN model used four hidden layers, 100 hidden units, and a ReLU activation function for the proposed IDS. Potluri et al. [18] used the NSL-KDD dataset to develop an accelerated DNN model for identifying the anomalies in the network data. The input layer contains 41 features that are fed into the DNN and two hidden layers are used for selecting 10 features from 41 features in the dataset. The first two hidden layers come into the pre-training procedure of the DNN. The hidden layer 3 is the softmax layer that will decrease the number of features to five.

Zhang et al. [19] used two hybrid algorithms that combine SVM, RBM, and DBN for the analysis of the false positive rate, accuracy, false negative rate, and testing period with the KDD Cup-99 dataset. Illy et al. [20] proposed using ensemble learners for increasing the accuracy of an IDS. In a Fog of Things environment, they used two classification levels. Othman et al. [21] introduced the Spark-Chi-SVM model for intrusion detection, which used ChiSqSelector for feature selection and an SVM-based intrusion detection model built on the Apache Spark big data platform. They used the KDD99 dataset in their work. In comparing Chi-SVM classifier with Chi-Logistic Regression classifier, the Spark Chi-SVM model demonstrated high performance. Many of the previous works are implemented with KDD cup dataset which consists of redundant records. Also most of the research works on fog computing have focused on architectural aspects except few. The contributions of our research paper are as follows.

- The deep neural network is highly applicable to this field. We have introduced an integrated CNN with LSTM-based intrusion classification model for IDS, called ICNN-FCID, for fog computing environments, where accurate prediction can reduce the number of false alerts. This is primarily because CNN is capable of extracting high-level representations of features that reflect the abstract nature of low-level network traffic communication feature sets and because LSTM is capable of learning long-term dependencies in data.
- The NSL-KDD dataset is used in our proposed model for training and testing.

3 Proposed Methodology

This section describes the architectures of the fog computing model, the CNN-LSTM model, and the proposed architecture and algorithm for intrusion detection.

3.1 Fog Computing Architecture

In our system model, a hybrid IoT network is considered and shown in Fig. 1. It includes the IoT devices D: a set of heterogeneous devices (d), which are equipped with sensing and communication capabilities. Sensing results are periodically reported to the cloud server via the fog device.

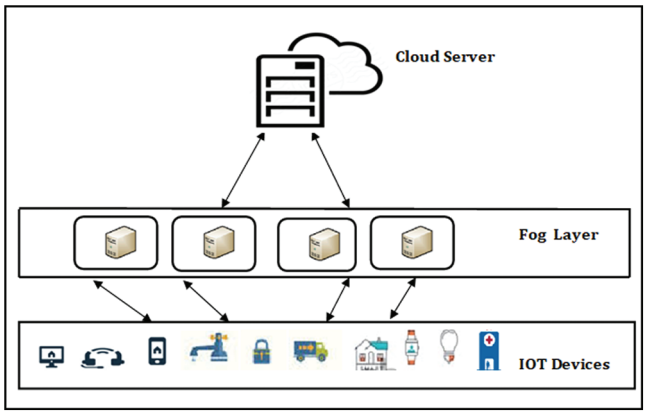

Figure 1: Fog computing architecture

$$D = \{d1, d2, d3 \ldots\ldots dn\} \tag{1}$$

The set D can be further divided into k subsets such as

$$D1, D2, D3 \ldots\ldots\ldots Dk \subseteq D \tag{2}$$

Each subset has m number of IoT devices

$$Di = \{d1, d2, d3 \ldots dm\} \tag{3}$$

where $i = 1 \ldots k$, $Di \cap Dj = \Phi$ for any $i \neq j$ and $|Di| = mi$

The fog layer consists of set of fog nodes and local fog server/cloud. The fog nodes serve as the relay between the IoT devices and the cloud server. F is a set of fog nodes.

$$F = \{fd1, fd2, fd3 \ldots\ldots\ldots fdx\} \tag{4}$$

The fog layer may be vulnerable to several kinds of attacks. These nodes can monitor the anonymous traffic where our proposed integrated DNN model is deployed to detect intrusive behavior. In this way, the fog layer and cloud server can be protected from malicious users. In addition, it gives fog nodes high availability for more time-sensitive applications.

3.2 CNN-LSTM

A convolutional neural network is a kind of deep neural network and is referred to as CNN or ConvNet [22–24]. The architecture of an ICNN-LSTM is shown in Fig. 2. The input layer contains the input.

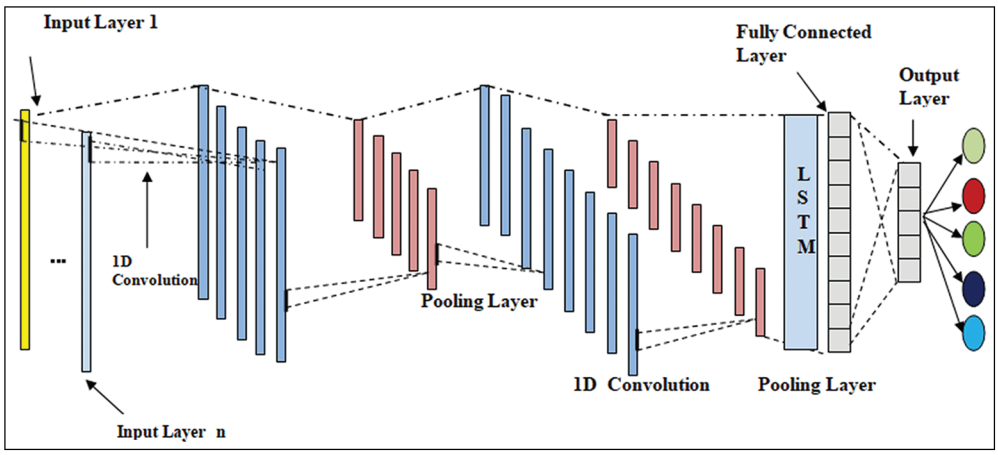

Figure 2: Architecture of ICNN-LSTM model

The primary building unit of a CNN is the convolutional layer, which uses a series of convolution kernels, which are used to identify the features part of the network traffic data. A set of n kernels and biases are $W = \{w_1,w_2,\ldots,w_n\}$ and $B = \{b_1,b_2,\ldots, b_n\}$, respectively, and are convolved with input data at each CNN layer. A new feature map x_k is produced by the convolution between data and each kernel. For each and every convolution layer l, the transformation is defined by:

$$X_k^l = \sigma(W_k^{l-1} * X^{l-1} + b_k^{l-1}) \tag{5}$$

The convolution operation is performed by sliding a filter or kernel over the inputs in the CNN learning process by which the optimized values of weights and bias can be obtained from different features of the input data without considering their position in the input data. The Activation Function, also known as the transfer function, is used to obtain the output of the node. The activation function is applied for every value in this layer. The ReLU rectified linear activation function is one of the common activation functions, and is a piecewise linear function. If the input is positive, it will output the input, else it will output zero and often achieve better performance.

$$f(x) = \max(0, x) \tag{6}$$

The pooling layer is another building block of a CNN. It is used to reduce the spatial size of the representation progressively through dimensionality reduction. In this way, the computational power for processing the data is greatly reduced and it controls overfitting. Max pooling, the most commonly used approach, will return the maximum value from the input, which is covered by the kernel. Max pooling discards the noisy activations. The LSTM layer is a class of recurrent neural network (RNN), which is able to learn long-term dependencies in data. In the fully connected layer, the non-linear combinations of

the high-level features are learned in the output representation of the convolutional layer. The flattened output is input to a feedforward neural network. In every iteration of training, backpropagation is applied. The model can distinguish between dominating features and certain low-level features. These features can be classified using the softmax classification technique over a series of epochs. The output layer compares output values that are predicted with the known labels. After that, it finds the error of the predicted value. The error is sent back through the loss function, through which weights and bias will be updated.

3.3 Proposed Architecture and Algorithm for ICNN-FCID Model

The architecture of the proposed ICNN-FCID classification model is shown in Fig. 3. It consists of three main processes: data preprocessing, training, and testing. These processes are shown in Algorithm 1.

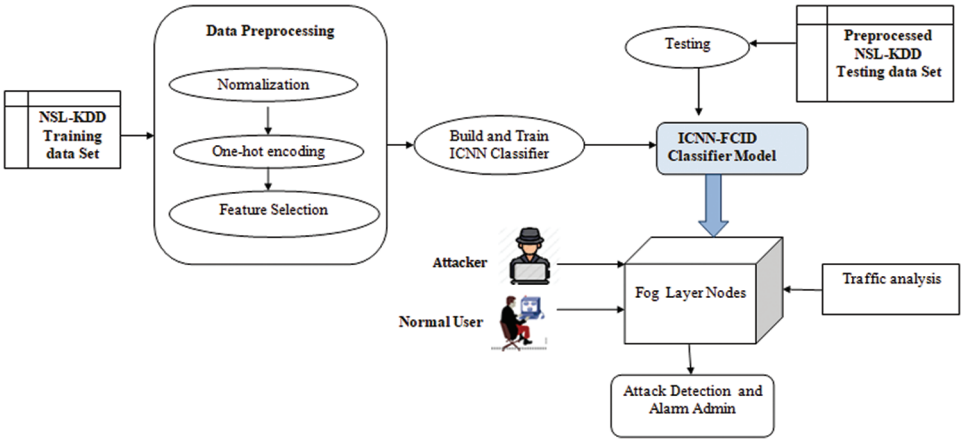

Figure 3: Block diagram of ICNN-FCID Model

During data preprocessing, raw data are transformed into a useful and efficient format. The raw data (real-world data) cannot be applied through a CNN model because errors will result. Data must be preprocessed before it can be used. This step includes the operations of data normalization, feature selection, and one-hot encoding. Data normalization is a technique used to scale the value of each feature having a different range of values to a common scale. In feature selection, the numbers of optimal features are selected. The symbolic features cannot be processed by the CNN model. One-hot encoding is used for converting data into numerical values. Through the feature selection process, the number of features in the NSL-KDD dataset is reduced. Using that subset of features, our ICNN-FCID model is trained and tested. With the CNN/LSTM-based intrusion classification deep learning model, a fog node can easily detect an attack and raise the alarm after processing the network traffic.

3.4 Algorithm 1: ICNN-FCID Classification Model

Input: TD: NSL-KDD dataset with 41 features of raw data.

Output: Well trained model of ICNN-FCID for IDS.

Step 1: Preprocessing of data with TD dataset.

1.1 Normalization of Data for all features in the dataset.

1.2 Selecting optimal features to create subset of features as TD1.

1.3 Feature Encoding using one hot encoding for the features in TD1.

Step 2: Build a Integrated Convolution Neural Network Classifier (ICNN-FCID) for the IDS.

Step 3: Optimize the Classifier using Adam optimizer.

Step 4: Train the classifier.

4.1 Forward propagating the inputs.

4.2 Backpropagation to the output layer.

4.3 Backpropagation to the hidden layer.

4.4 Updating weight

Step 5: Evaluate the performance of the ICNN-FCID classifier using model validation.

Step 6: Calculate the classification accuracy.

4 Experimentation Results and Evaluation

This section evaluates the proposed ICNN–FCID classification model for intrusion detection. In this experiment, the CNN with LSTM is used for five classes of classification (normal, DoS, Probe, R2L, and U2R attacks). Our model is implemented using Python and Keras (the deep learning library of Python) on a computer equipped with an Intel Core i7 CPU, 16 GB of RAM and Windows 10.

4.1 Dataset Description and Analysis

The NSL-KDD dataset used in our proposed methodology [25] is an updated, cleaned up version of the KDD Cup 1999 dataset. The NSL-KDD dataset was created because there were too many redundant records [26] in the KDD Cup 1999 dataset. It was created with the records of internet traffic by a simple intrusion detection network and consists of four types of subdatasets: KDD Train+, KDD Train+_20Percent, KDD Test+, and KDD Test-21. In this dataset, four classes of attacks exist: Denial of Service, Probe, R2L, and U2R. Each record contains 43 features. The first 41 features refer to the input of traffic itself, the 42^{nd} feature refers to whether it is a normal record or attack record, and the 43^{rd} feature refers to the score, i.e., the severity of traffic input.

4.1.1 Dataset Features Classification

The dataset has 32 feature columns containing numeric data, 6 features of each record contain binary data, and 3 features are nominal features. The total number of records in all categories of the NSL-KDD training dataset is 125,973. Of that number, 67,343, 45,927, 11,656, 995, and 52 records belong to the Normal, DoS, Probe, R2L, and U2R attack categories respectively, as shown in Tab. 3. Similarly, the test dataset consists of Normal, DoS, Probe, R2L, and U2R attack records, but contains additional attacks in each class that are not in the training dataset. The test dataset has 37 types of attacks, of which 16 are attacks not available in the training dataset.

4.1.2 Data Preprocessing

The NSL-KDD training and testing dataset must undergo certain preprocessing steps.

4.1.3 Data Normalization

This technique aims to change the numeric values of attributes to a standard scale without distorting differences in value ranges. The values in column y are transformed using Eq. (7) below.

$$z = \frac{y - \min(y)}{\max(y) - \min(y)} \tag{7}$$

4.1.4 Feature Selection

Our dataset, contains 43 features. The last two columns are Packet type and Score. Because some of the features were considered to have no effect on neural network analytical results, fewer resources were needed to complete tasks. The computational cost of the model can also be reduced. In our work we took the first 41 features except the last two columns. In that, the list of {7, 8, 9, 11, 14, 15, 16, 18, 19, 20, 21, 22, 25, 27, 31} features were removed, because they had zero values. This allowed us to reduce the data volume size from 41 to 26 features.

4.1.5 One-Hot Encoding

In the NSL-KDD dataset, there are four attributes with non-numeric values: protocol_type, service, flag, and class. These were converted into numeric values. The protocol_type feature has three value types: TCP, UDP, and ICMP. They were encoded into its binary vectors [1,0,0], [0,1,0], and [0,0,1] by applying one-hot encoding. The service feature has 70 attribute types and the flag feature has 11 attribute types. In this manner transformation was performed. After transformation, the 41-dimensional features were mapped into 112 dimensional features. The predicted targets were mapped with the five categories of classification: normal, DoS attack, Probe attack, R2L attack, and U2R attack. Tab. 1 shows all of the parameters and shapes in each layer in our model. We can see that the total number of parameters is 92,489 and all are trainable. The number of non-trainable parameters is 0.

Table 1: Summary of the ICNN-FCID model

Layer (type)	Output Shape	Param #
convid_1 (Con1D)	(None, 24, 64)	256
max_pooling1d_1 (MaxPooling1)	(None, 12, 64)	0
convid_2 (Con1D)	(None, 10, 64)	12352
max_pooling1d_2 (MaxPooling1)	(None, 5, 64)	0
lstm_1 (LSTM)	(None, 112)	79296
dropout_1 (Dropout)	(Nine, 112)	0
dense_1 (Dense)	(None, 5)	565
Total params: 92,469 Trainable params: 92,469 Non-trainable params: 0		

4.2 Evaluation Metrics

In this paper, a confusion matrix is used to describe the performance of our model. It includes significant details about actual and predicted output classes. True Positive (TPw) is the value that represents the number of records predicted as attacks that are actually anomalous records. True Negative (TNw) indicates the number of records predicted as normal that are actually normal records. False Positive (FPw) represents the value that indicates the number of records predicted as attacks, but they are actually normal records. False Negative (FNw) is the value that indicates the number of records predicted as normal that they are actually anomalous records. From the confusion matrix, we can define performance metrics mathematically as follows.

False Negative (FNw) is the value that indicates the number of records predicted normal that they are actually anomalous records. From the confusion matrix, we can define performance metrics mathematically as follows.

Accuracy: This is the percentage of the number of records that have been classified correctly to the total number of records.

$$\text{Accuracy (A)} = \frac{\text{TP}_\text{w} + \text{TN}_\text{w}}{\text{TP}_\text{w} + \text{TN}_\text{w} + \text{FP}_\text{w} + \text{FN}_\text{w}} \tag{8}$$

Recall: This is propositional to the true positive rate, and this is the percentage of the number of anomalous records have been correctly detected divided by the total number of anomalous records.

$$\text{Recall (R)} = \frac{\text{TP}_\text{w}}{\text{TP}_\text{w} + \text{FN}_\text{w}} \tag{9}$$

Precision: Precision quantifies the number of attack class predictions that actually belong to the anomalies class.

$$\text{Precision (P)} = \frac{\text{TP}_\text{w}}{\text{TP}_\text{w} + \text{FP}_\text{w}} \tag{10}$$

F-measure: This is the harmonic mean of accuracy and recall, which provides a measurement of derived effectiveness.

$$\text{F} - \text{measure (F} - \text{Score)} = 2 * \frac{\text{R} * \text{P}}{\text{R} + \text{P}} \tag{11}$$

False Alarm Rate: This is the misprediction of normal data as abnormal data.

$$\text{False Alarm Rate (FAR)} = \frac{\text{FP}_\text{w}}{\text{FP}_\text{w} + TN_w} \tag{12}$$

Misclassification Rate: This is the number of records that are incorrectly classified.

$$\text{Misclassification Rate} = \frac{\text{FP}_\text{w} + \text{FN}_\text{w}}{\text{TP}_\text{w} + \text{TN}_\text{w} + \text{FP}_\text{w} + \text{FN}_\text{w}} \tag{13}$$

4.3 Results

In our proposed ICNN-FCID model, the CNN section is composed of an input layer, convolution layer 1 with 64 filters, pooling layer 1 with pooling size 2 and stride size 1, convolution layer 2 with 64 filters, pooling layer 2 with pooling size 2 and stride size 1, LSTM layer 1 with output size 112, fully connected layer 1, and an output layer. Dropout by 0.3 is considered to prevent overflow. The Rectified Linear Unit (ReLU) activation function was used in all of the layers except the last layer. The softmax activation function was used in the last layer. For optimization, the Adaptive Moment Estimation (Adam) method was used.

Experiments were conducted with the ReLU, sigmoid, and hyperbolic tangent (TanH) activation functions, and the performance then compared. With ReLU we achieved the highest accuracy of 96.5%, precision of 85.25%, recall of 91.16%, and F-score of 86.43%. The accuracy, precision, recall, and F-score of our model with the sigmoid activation function were 85.58%, 80.06%, 90.50%, and 87.78%, respectively. The accuracy, precision, recall, and F-score with the TanH activation function were 88.3%, 84.53%, 89.30%, and 85.1%, respectively. All of the results are listed in Tab. 2, which shows that the ReLU activation function in the ICNN-FCID model provided higher accuracy than the sigmoid and TanH

activation functions. The number of epochs was set to 50 and the size of each batch was set to 64. We then assessed the performance of our proposed model by measuring its accuracy. In the experiments, the ICNN-FCID provided improved classification results and the accuracy of our model was approximately 96.5%.

Table 2: Performance evaluation of ICNN-FCID with activation functions

Activation Function	Accuracy (%)	Precision (%)	Recall (%)	F-Score (%)
ReLu	96.5	85.25	91.16	86.43
Sigmoid	85.58	80.06	90.5	85.6
Tanh	88.3	84.53	89.3	85.1

Table 3: Detailed performance of ICNN-FCID model on test dataset

Label	Accuracy (%)	Precision (%)	Recall (%)	F-Score (%)	False Alarm Rate (%)	Misclassification Rate (%)
Normal	97.73	96.45	98.36	97.40	2.73	2.27
DoS	98.93	98.56	98.22	98.39	0.70	1.07
Probe	98.34	97.67	86.61	91.81	0.24	1.66
R2L	98.94	98.16	93.10	95.57	0.24	1.06
U2R	98.53	35.41	80.00	49.00	1.29	1.47

We labeled DoS, Probe, R2L, and U2R attacks as 1, 2, 3, and 4, respectively, while the normal connections were labeled as 0. The confusion matrix for the NSL-KDD testing dataset of the ICNN-FCID model is shown in Fig. 4. In our model, as the epoch increases, the accuracy of the training and testing sets also increases. With the increase in epoch, there is a decrease in the loss of the training and testing sets. As the training rounds increase, the accuracy increases and the loss is decreases, but in the end, it appears to be flat. To find a better value of epoch, we tested every 10 epochs, from 10 to 50. The result is shown in Figs. 5a and 5b. Tab. 3 shows the performance of the ICNN-FCID model on the test dataset, as well as the accuracy, precision, recall, F-Score, false alarm rate, and misclassification rate for each class. The accuracy and false alarm rate for the DoS attack are 98.93% and 0.7%, respectively. The accuracy of the Probe, R2L, and U2R attacks is 98.34%, 98.94%, and 98.53%, respectively. The false alarm rate of the Probe, R2L, and U2R attacks is 0.24%, 0.24%, and 1.29%, respectively. Fig. 6 compares the performance analysis of the ICNN-FCID model with the three activation functions.

4.4 Comparison with Existing Work

The accuracy of our ICNN-FCID model was compared with conventional machine learning models and the latest algorithms of deep learning models. From Yin et al. [27] the literature reports that the traditional models of J48, Naive Bayesian, and Random Forest for intrusion detection have been implemented using the NSL-KDD dataset.

The accuracies in five class classifications of J48, Naïve Bayesian, and Random Forest were 81.05%, 76.56%, and 80.67%, respectively. Next, we analyzed the performance of our model with the implementation of the latest deep learning models. The deep learning classification model called stacked NDAE was proposed by Shone et al. [28] and had accuracy of 85.42%. Li et al. [29] proposed a

multi-CNN IDS fusion method that demonstrated 81.33% accuracy for multiclass classification. The accuracies of these models are shown in Tab. 4. Fig. 7 shows the results of the comparison of accuracies of our ICNN-FCID model with traditional J48, Naive Bayesian, Random Forest, Stacked NDAE, and multi-CNN fusion models. The experiment demonstrated that our ICNN-FCID model performs classification with high accuracy on the NSL-KDD dataset.

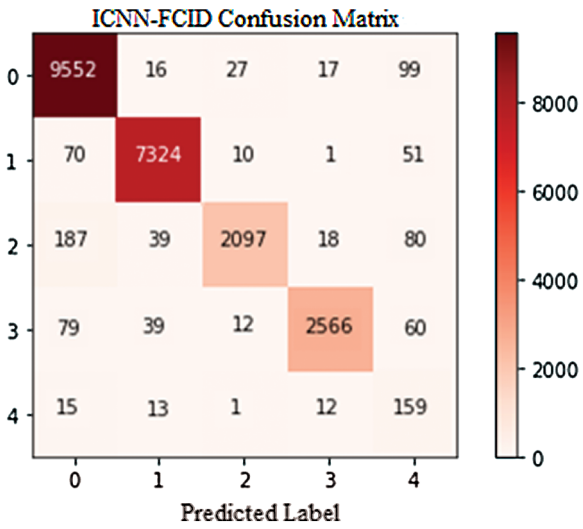

Figure 4: Confusion Matrix for NSL-KDD testing dataset

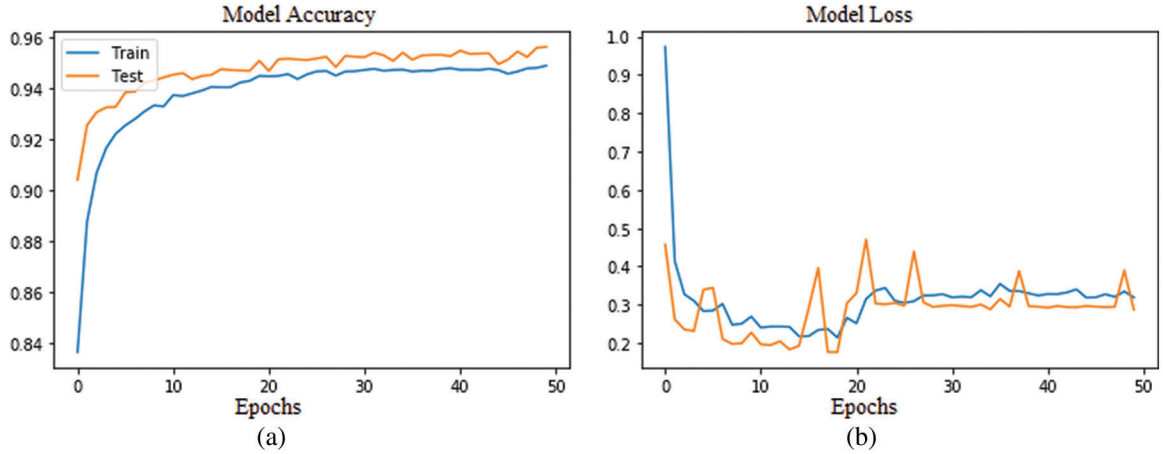

Figure 5: (a) Accuracy of ICNN-FCID model (b) Loss of ICNN-FCID model

4.5 Real Time Classification

Virtualization technology was used for simulating our experiments. We considered only DoS attacks. Fig. 8 shows the virtualization framework that was implemented for attacker-fog-cloud structure. All of the traffic to the cloud passes through the intermediate fog layer. Attack traffic can easily be classified on the fog layer through the ICNN-FCID model, so that the malicious traffic can be dealt with easily before it reaches the cloud server. Therefore, it provides efficient utilization of cloud resources and time. Using open-source tools and scripts on various operating systems and cloud servers, malicious traffic was

created to enforce this scenario, along with an intermediate fog layer through which the traffic was directed to the cloud. The malicious attack traffic was detected to save processing power both the cloud and fog node.

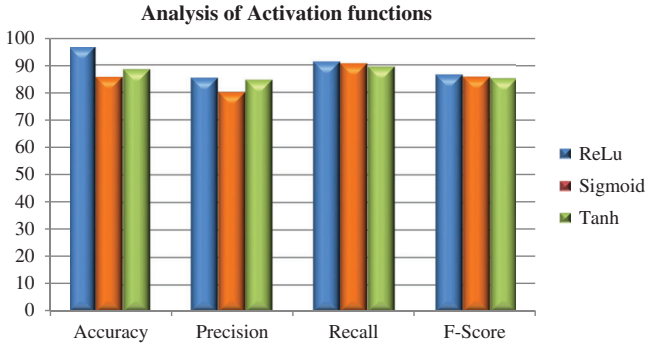

Figure 6: Comparative analysis of different activation functions

Table 4: Accuracies of our ICNN-FCID model, traditional and latest models for 5 class classification

Model	Accuracy of KDD Test+
J48	81.05%
NB	76.56%
RF	80.67%
Stacked NDAE [28]	85.42%
multi-CNN fusion [29]	81.33%
Our Model	96.50%

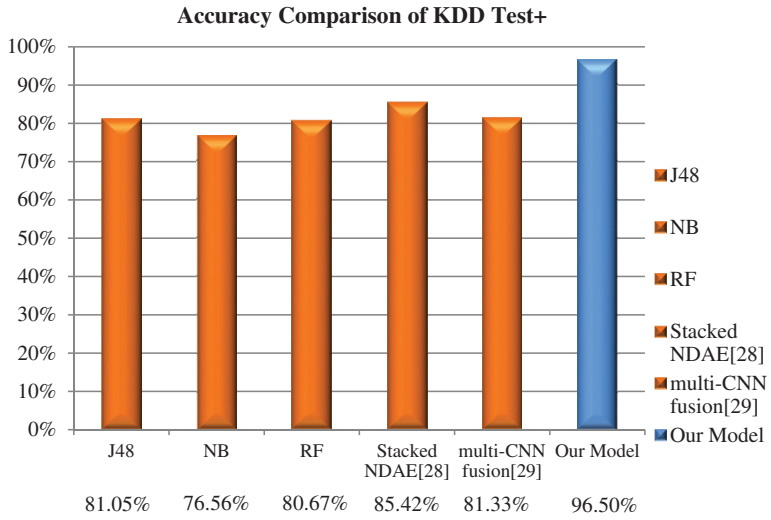

Figure 7: Performance of our ICNN-FCID model and other models for 5 class classification

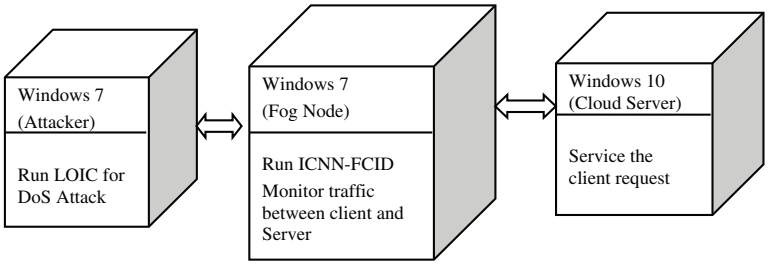

Figure 8: Real time classification framework

The VMware ESXi hypervisor was installed on the server and configured. Then the three nodes—two Windows 7 systems and one Windows 10 system—were deployed in the virtual environment using the web interface of the ESXi server, and the firewall was shut down to make the DoS attack easier. The proposed ICNN-FCID was deployed in one Windows 7 virtual machine (VM). This system was used to monitor all of the traffic. We used the open-source Ethereal Network Analyzer to capture the packets. We used the Low Orbit Ion Cannon (LOIC) network stress-testing and DoS attack application tool in another Windows 7 VM attacker system for creating a SYN flood to attack the target machine. After that, the network traffic was preprocessed we formed the dataset by adding 400 connection records. A total of 500 records were given as input to the ICNN-FCID model, which classified the packets with expected accuracy. Fig. 9 shows the real-time classification performance of the ICNN-FCID model.

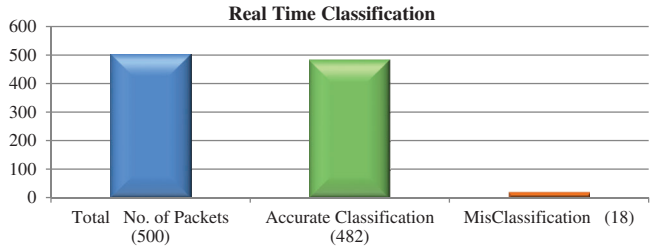

Figure 9: Real time classification performance of our ICNN-FCID model

5 Conclusion

We performed an experiment to demonstrate the feasibility of using CNN and LSTM for a Network Intrusion Detection System (NIDS), in order to exploit the power of deep learning to identify network intrusions. In this paper, a hybrid classification model combining CNN with LSTM, called ICNN-FCID, is proposed, then implemented and trained for intrusion detection in fog computing environments. To improve the accuracy of our model, we used normalization, one-hot encoding for the features in the dataset. We trained our hybrid model with the KDD Train + dataset, and tested it using the KDD Test + dataset. With a testing accuracy of 96.5%, our model outperforms traditional machine learning methods and other recent deep learning algorithms. The efficiency of our model for the classification of DoS, Probe, R2L, and U2R attacks has been demonstrated for fog computing environments. We conducted our test using virtualization technology to detect DoS attacks and it achieved the expected results. This means that the proposed ICNN-FCID classification model can function efficiently in real-time environments. The direction that our future work will take will be to provide an attack detection model using multiple CNNs with more real-time traffic.

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An IoT based Green Home Architecture for Green Score Calculation towards Smart Sustainable Cities

K. Manikanda Kumaran (/journals/tiis/digital-library/category-search?author=K. Manikanda Kumaran), M. Chinnadurai (/journals/tiis/digital-library/category-search?author=M. Chinnadurai), S. Manikandan (/journals/tiis/digital-library/category-search?author=S. Manikandan), S. Palani Murugan (/journals/tiis/digital-library/category-search?author=S. Palani Murugan), E. Elakiya (/journals/tiis/digital-library/category-search?author=E. Elakiya), Vol. 15, No. 7, July 31, 2021

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ABSTRACT

In the recent modernized world, utilization of natural resources (renewable & non-renewable) is increasing drastically due to the sophisticated life style of the people. The over-consumption of non-renewable resources causes pollution which leads to global warming. Consequently, government agencies have been taking several initiatives to control the over-consumption of non-renewable natural resources and encourage the production of renewable energy resources. In this regard, we introduce an IoT powered integrated framework called as green home architecture (GHA) for green score calculation based on the usage of natural resources for household purpose. Green score is a credit point (i.e.,10 pts) of a family which can be calculated once in a month based on the utilization of energy, production of renewable energy and pollution caused. The green score can be improved by reducing the consumption of energy, generation of renewable energy and preventing the pollution. The main objective of GHA is to monitor the day-to-day usage of resources and calculate the green

score using the proposed green score algorithm. This algorithm gives positive credits for economic consumption of resources and production of renewable energy and also it gives negative credits for pollution caused. Here, we recommend a green score based tax calculation system which gives tax exemption based on the green score value. This direct beneficiary model will appreciate and encourage the citizens to consume fewer natural resources and prevent pollution. Rather than simply giving subsidy, this proposed system allows monitoring the subsidy scheme periodically and encourages the proper working system with tax exemption rewards. Also, our GHA will be used to monitor all the household appliances, vehicles, wind mills, electricity meter, water re-treatment plant, pollution level to read the consumption/production in appropriate units by using the suitable sensors. These values will be stored in mass storage platform like cloud for the calculation of green score and also employed for billing purpose by the government agencies. This integrated platform can replace the manual billing and directly benefits the government.

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Contents

Chapter I

Introduction

In today's scenario of higher education, placement is the buzz word. Parents and students prefer colleges and institutions which arrange placement opportunities by conducting campus placement and placement readiness training. Every college and institution tries to maximize their placement ratio. During the last decade, the opportunities for graduates in various sectors have increased tremendously, especially for engineering students[1]. Institutions organize on-campus and off-campus placement and job fair by pooling students from various institutions, wherein companies recruit students in large number. However there are many graduates who are not able to get through the recruitment process and jobs.

UNESCO[2] observes that, Globalization has increased the pressure on companies to effectively manage their workforce and also their clients. This demands their focus on development of (a) generic skills; (b) application skills; and (c) soft skills or life skills apart from proficiency in their subjects. It involves oral and written communication skills, basic computer skills (MS Office, Internet, etc), and a good workplace attitude (commitment and teamwork). These skills are pre-requisites for employability of students.

Globalization has also increased the standards of education and career profiles. Multi national companies are opening in India and are looking for well trained employable individuals.[3] Employers want much more than academic grades. At the least they expect the skills for team work, interpersonal relationship and good analytical ability. Today these soft skills are the most important qualification for any individual to communicate well and to get jobs. But it is a fact that even those graduates who are good at academic performance are not good in communication skills, and that is a hurdle for their career opportunities[4].

1.1 Engineering Talent Pool

Every year India intakes around 3, 50,000 engineering graduates making India the second largest talent pool for engineers across the world. Dating back to the tech boom in the late 90's in India when IT companies

About the Author

Dr.S.CHANDRASEKAR is presently working as Chief Executive Officer of EGS Pillay Group of Institutions, Nagapattinam, Tamilnadu. He has completed his dual post graduation M.Com with Distinction from Government Arts College, Coimbatore and MBA from Bharathiar University, Coimbatore. He has also completed his research programe M.Phil in Commerce and Holds a Doctor of Philosophy in Commerce from Bharathiar University, Coimbatore. He has more than 21 years of teaching, Research, Administration, Placement experience in both India and abroad.

He was instrumental in promoting the spirit of entrepreneurship among the students and motivated 65 students to start their own business venture. He has visited more than 150 colleges as Chief guest, Resource person, Judge etc in Coimbatore, Pollachi,Palani,Dindugal,Andrapradesh, Kerala and Karnataka.

He is an recipient of Inspiring Minds Award by Aspiring Minds at National Employability Conclave, Best Coordinator Award by ICT Academy of Tamilnadu and Star Performer Award by Virtusa

He has rich experience in Training and Placement and has been instrumental in designing the skill based and industry oriented curriculum for effective placement of young students. He has been instrumental in enhancing employability skills of students in many colleges.

He was heading the Entrepreneurship Development Cell at CIMAT and organized more than 100 Entrepreneurship Awareness Camp, Business Plan Competition, Business Skill Development Programme EDP and many programmes on entrepreneurship.

He is a certified faculty to teach entrepreneurs by Stanford University, Entrepreneurship Development Institute of India, and has been recognized by Micro Small and Medium Enterprises as mentor to council and guide budding entrepreneurs in preparing business plan and opportunity identification.

As an entrepreneur he runs an event organizing company- Disha, Trust member of Sri Amman Industrial Training Center and Managing Partner of CNS Computer Education center.

He was also the past president of Junior Chamber International Coimbatore Cosmo an organization of worldwide federation of young entrepreneurs and leaders.

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PERFORMANCE EVALUATION OF MULTILEVEL INVERTER FOR GRID-CONNECTED SOLAR SYSTEM WITH OPTIMUM SWITCHING TRANSITIONS

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Professor, Department of Electrical and Electronics Engineering, E.G.S. Pillay Engineering College (Autonomous), Nagapattinam, India-611002

Abstract:

In this paper a new asymmetrical multilevel inverter topology is proposed. The proposed asymmetric multilevel inverter generates eleven- levels with reduced number of power switches than conventional symmetric multilevel inverters. The asymmetrical distribution of the voltage sources produce more levels when compared with symmetrical topology. Finally, in order to do performance evaluation the proposed seven-level multilevel inverter topology is simulated and the output voltage and current are verified with the hardware results.

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MULTILEVEL INVERTER TOPOLOGYWITH REDUCED SWITCHING TRANSITIONS

S.Thiruvathiraikkannan, V.Mohan, T.Suresh Padmanabhan,

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Abstract:

Multilevel inverters (MLI) are now becoming an important element for medium-voltage high- power applications. A low switch count MLIs are more popular due to their high efficiency, low cost, and easy control for the output having a higher number of levels. A new MLI topology for single-phase applications based on switched dc voltage source with reduced switch count is proposed in this paper. The proposed topology is developed with the constraints of lesser blocking voltage of the switches with a higher number of levels at the output using a lower number of components. The proposed topology works in the asymmetrical configuration and produces more levels when compared to existing symmetrical topology. The simulation and experimental results are presented to confirm the performance of the proposed topology.

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A NOVEL MULTILEVEL INVERTER TOPOLOGY WITH OPTIMUM POWER SWITCHESFOR PV APPLICATIONS

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Professor, Department of Electrical and Electronics Engineering, E.G.S. Pillay Engineering College (Autonomous), Nagapattinam, India-611002

Abstract:

Power electronic converters are used to nullify the input fluctuations from a renewable sources link solar and wind and to make the terminal voltage grid compatible with the desired frequency. The conventional two-level converters suffer from low power quality and high voltage stress. In this article, a new multilevel inverter topology called Hybrid Multilevel Inverter (H-MLI) with fewer power switches is proposed. It can operate in symmetric and asymmetric operating modes with cascading. This reduces the switching components required to produce several levels in the staircase voltage waveform. The dynamic behavior of the system under step change observed through the simulation output in MATLAB environment. The comparison of the suggested scheme with its conventional counterpart in the aspects of components required, cost and efficiency, are verified through the hardware prototype. The proposed topology generates thirty nine levels with reduced number of power switches than the existing topology.

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DESIGN AND PERFORMANCE EVALUATION OF LOTUS STRUCTURED SOLAR TREE FOR OPTIMAL POWER GENERATION THOURGH BLACK BODY RADIATION

G. Ganesan @ Subramanian, S. Agathiyan, V. Sivaramakrishnan

Associate Professor, Department of Electrical and Electronics Engineering, E.G.S. Pillay Engineering College (Autonomous), Nagapattinam, India.

Merchant Navy, India.

Professor, Department of Mechanical Engineering, E.G.S. Pillay Engineering College (Autonomous), Nagapattinam, India.

Abstract:

In this modern era, the demand for electricity is par increasing day by day and to meet out this in 2030 makes a tremendous challenge in future prospects. A small contribution to this, implementation of solar powered generation through a novel structure called "LOTUS STRUCTURE", a fountain / waterfall has been operatedin day/night to complete this work.Added feather to the crown, 10WSolar panels of considerable number in being implemented and to make lotus structure covered with X-ray sheets in order to observe theblack body radiations which normally enhances the efficiency of the panel and thereby the power generation through the panel also to the increases in a considerable percentage.

Also, an analysis is carried out and both in day and as well as in night time observing the efficiency plot,voltage /current plot with respect to time domain.Experimental and analysis part contributes and matches the increase / enhancement of performance in solar panels.

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A STUDY ON EMPLOYEES PERCEPTION ABOUT ORGANIZATIONAL HR PRACTICES AND CULTURE AT PREETHI ENGINEERING ENTERPRISES-TRICHY

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Final year MBA, E.G.S. Pillay Engineering College Nagapattinam

Assistant Professor, Department of Management Studies, E.G.S. Pillay Engineering CollegeNagapattinam

bstract:

This study investigates workplace support and employees' work motivation and their tual relationships in a healthcare setting. It attempts to partly test Eisenberger's theory of ceived organizational support in the given context. A total of 20 questionnaires were collected n a large public-sector healthcare organization. Chi-square, percentage analysis and frequency ribution was applied to analyze the data. Results showed an association between the variables high degree of consistency with that of previous studies. The study also confirmed "flexible s" as a viable dimension of workplace support which was not delineated by earlier studies. study was mainly conducted to find out the causes and sources of grievance, the time taken he efforts of trade union to resolve the grievance, the behavior and the attitude of supervisor, he remedial measures so as to reduce the rate of grievance. The study is based entirely upon ary data, which was obtained through direct interview and structured questionnaire. The dary data are collected from the company records. The sample sizes about 130 employees considered. The data were analyzed and tabulated in a sequential manner and interpretations ven along with the tabulation. This project helps the organization to know their current es regarding absenteeism, suggests ideas to improve in a better prospect and result in the zational development

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Article

Energy efficient routing algorithm in wireless body area networks for smart wearable patches

February 2020 · Computer Communications 153(2)
DOI:10.1016/j.comcom.2020.01.069

Authors:

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... Cluster-based hierarchical routing protocols, on the other hand, have attracted significant research in recent years for various healthcare applications [19], [20], [21] . These protocols operate at the network layer and are highly scalable, adaptable, self-configurable, and have the ability of self-healing [21]. ...

... Cluster-based hierarchical routing protocols, on the other hand, have attracted significant research in recent years for various healthcare applications [19], [20], [21]. These protocols operate at the network layer and are highly scalable, adaptable, self-configurable, and have the ability of self-healing [21] . These unique features make them an ideal option for adaptation in smart healthcare environments because the patient's vital signs cannot tolerate network connectivity issues, require fault-tolerant features, and, at the same time, demand a higher level of QoS. ...

A Centralized Cluster-Based Hierarchical Approach for Green Communication in a Smart Healthcare System

Article Full-text available

May 2020

Guojie Yang · Mian Ahmad Jan · Varun G. Menon · Mohammad Alshehri

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... This ensures that the energy consumption is uniform, and the lifetime of the nodes can be extended as all the nodes bear the same energy in themselves [18]. Sundar Rajina et al [11] suggested that network operations be managed using a load saver system with a opportunistic energy-efficient routing with load balancing (OE2-LB) that eliminates data collection delays and avoids data collection. They used smart wearable points to move loops efficiently. ...

... A Fit i Clustering represents the clustering fitness function for the gateway and is calculated as in equation (11) . ...

Multi-Objective Spider Monkey Optimization for Energy Efficient clustering and Routing in wireless sensor networks

Preprint Full-text available

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Duraimurugan Samiayya · Avudaiammal Ramalingam

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... It is the first-ever approach that addresses the multi-hop based communication for WBANs to make the whole network scalable and can be implied to various large scale healthcare applications. 6. NEEMA is compared against Energy-Aware Routing Protocol (EARP) for WBAN, 9 Intelligent-Routing Algorithm for WBAN (I-RAW), 10 Dual sink approach using clustering in WBAN (DSCB), 11 Opportunistic Energy-efficient routing with Load Balancing (OE2-LB), 12 and Multiple sink-based GA-based Optimized Clustering (MS-GAOC). 4 In addition, the simulation analysis for the enhanced network dimensions is also performed to empirically demonstrate the scalability of the proposed work. ...

... The proposed protocol is also examined for its scalable characteristics by considering two network scenarios. The proposed work is compared against the competitive protocols namely, EARP, 9 I-RAW, 10 DSCB, 11 OE2-LB, 12 and MS-GAOC. 4 ...

A Novel Energy Efficient hybrid Meta-heuristic Approach (NEEMA) for wireless body area network

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Sep 2022 · INT J COMMUN SYST

Smita Sharma · V M Mishra · Madanmohan Tripathi

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... Later, Li et al. [31] put forward a lightweight authentication scheme with anonymity for two-tier WBAN. In comparison with earlier counterpart schemes, their scheme was more energy-efficient [32][33] [34] [35], computation savvy and lightweight [35]. Still, the scheme was found to