Artificial Intelligence and Network Security

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Selected Papers of Bilingual International Conference on Information Technology: Yesterday, Today, and Tomorrow

19-21 February 2015

Editorial Team

Sudhanshu Bhushan, A. Saravanan, Alka Bansal, Anitha Saravanan and Phuldeep Kumar

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PREFACE

With the advent of technological era in 21st century, every application area, right from education to industries, have evolved in their operational paradigms and the most indispensable part of this evolution has been the embedding of Information technology (IT) wherever possible.

It is evident that IT has grown tremendously in all these years and still have a large potential not only accelerate the economic growth but also global economic development. To realize this prediction as truth, governments need to take specific measures to promote IT use and make it accessible to every section of the society, along with improving infrastructure, strengthening training and education system and flexible labor laws.

Information technology should be used as a tool to improve the living standards of common people and enriching their lives. IT literacy needs to be enhanced so that ordinary people can derive benefits, both economically and socially. Full potential of IT industry can be strained only when we realize and understand the future perspectives of the industry keeping the past and present in mind.

DESIDOC has organised 'Bilingual International Conference on Information Technology: Yesterday, Today, and Tomorrow' during 19-21 February 2015. The objectives of the Conference are to provide a roadmap which Information technology and its developers have followed in order to make it compatible with every day-to-day activities of the user.

The Conference was extensively publicized on the web and print media. More than 400 papers have been received from all over India and abroad. The Editorial Committee reviewed them thoroughly and short-listed paper based on originality, content and presentation. About 160 papers have been accepted after review and included in the Three Books entitled; Electronic Resources and Digital Services, Artificial Intelligence and Network Security, and Managing Information Technology. With a view to involve upcoming professionals and to motivate them, it was decided to give sufficient space to them to present their views.

Present book entitled as Artificial Intelligence and Network Security, contains 63 selected full-text research papers and review papers on Artificial Intelligence, Cryptanalysis, Communication, Networking, Cyber Security, and Network Security.

Artificial Intelligence consists of 11 papers which covers different subcategories of the topic. A large number of paper deals with a new and optimized approach to the existing systems like frequent pattern matching, modeling for spatial databases, robotics system and different algorithms.

Cryptanalysis covers 10 papers which discusses different areas. These papers highlights the encryption methods for the security of messages, issues that comes while encoding, key management and also the applications and recent developments in the Homomorphic encryption.

Communication includes 8 papers that cover digital signal processing for speech signals, basic principles for communication, optimizing satellite channel for capacity and efficient resource utilization in mobile devices.

Networking contains 7 papers on different subtopics. These sub topics covers wireless sensor network, mobile ad-hoc networks, congestion control mechanism, national knowledge network and wide area organizational networks.

Cyber Security cover 8 papers which deals with the issues and perspective of cyber warfare, intelligent unified model, camouflaging honeypot deployment, online banking security, challenges in cyber security and detection of distributed denial of service attacks.

Network Security consists of 6 papers on different issues like image security, RFID, matrix based key pre-distribution schemes for

Wireless Sensor Network (WSN), covert social network, Ant colony optimization and swarm intelligence in WSNs and Q-LEACH protocol for energy minimization for WSN.

As the title of the Conference is 'Bilingual International Conference on Information Technology: Yesterday, Today, and Tomorrow', an attempt has been made to provide translation of Title, Abstract, and Conclusion in Hindi language also. Some authors has provided Translation in Hindi but in most of the cases it was done by professionals.

The Editorial committee acknowledges with profound gratitude, the immense efforts of the contributors and hope that the ideas generated in these papers would be deliberated during the conference for further enriching the future application of Information technology for well being of human being.

10 February 2015 **Editorial Committee**

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An Efficient Graphical Approach for Frequent Pattern Mining

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सारांश

डाटा माइनिंग बड़े डाटाबेस से उपयोगी जानकारी निकालने की एक विधि है। यह वर्गीकरण, क्लस्टरिंग, भविष्यवाणी, संघ विश्लेषण जैसे कई कार्य करता है। डाटा माइनिंग के क्षेत्र में अधिकांश शोधकर्ताओं का मौजूदा ध्यान केन्द्र आवृतित पैटर्न खनन है जो उपरोक्त सभी कार्यों में महत्वपूर्ण भूमिका निभाता है। आवृतित पैटर्न की सबसे बड़ी खामी यह है कि इसमें आवर्तित पैटर्न को ड्रिल करने के लिए एक फाइल को कई बार स्केनिंग करने की आवश्यकता पड़ती है और विशेष रूप से बड़े पैटर्न के साथ भारी आवर्तित पैटर्न का उत्पादन हो सकता है, उपरोक्त समस्या का परिष्कृत समाधान अधिकतम आवृतित पैटर्न एम एफ पी है यह आवर्तित पैटर्न पीढ़ी के लिए एक सबसे छोटा प्रतिरूप वाला सेट है, एमएफपी आवर्तित पैटर्न हैं जिसका सुपरसेट आवृतित नहीं हो सकता। इस पत्र में आवृतित पैटर्न का उत्पादन करने के लिए एक ग्राफिकल विधि का प्रस्ताव है। यह विधि दो नये गुणों को प्रस्तुत करती है, एक ग्राफ संरचना मुख्य ग्राफ कहलाती है और दूसरा मुख्य ग्राफ माइनर एल्गोरिथम। प्राइम ग्राफ एक सरल ग्राफ संरचना है जो प्राइम संख्या सिद्धांत का प्रयोग करके अनुप्रस्थ द्वारा एक स्केन से खुद ग्राफ के रूप में आवृतित पैटर्न उत्पादित करते हुए अनुकूलन डाटा परिवर्तन तकनीक का उपयोग करके पूरी जानकारी ले सकता है।

ABSTRACT

Data mining is a method to extract useful information from large databases. It performs many tasks such as classification, clustering, prediction, association analysis[1]. Presently focused area of most of the researchers in data mining field is frequent pattern mining, which plays vital role in all the above mentioned tasks. One of the major drawback of frequent pattern mining is that it requires multiple scanning of a file to drill out the frequent patterns and may produce enormous frequent patterns especially with elongated patterns, the refined solution of the above problems is maximal frequent pattern (MFP) it is the smallest representative set for frequent pattern generation, MFP's are the frequent patterns whose superset cannot be frequent[2]. This paper proposes a graphical method to produce frequent patterns. This method introduces two new properties; a graph structure called as Prime graph and a PG Miner algorithm. Prime graph is a simple graph structure by traversing it by one scan can produce frequent patterns as the graph itself captures the whole information about the transactions by using an optimizing data transformation technique which uses prime number theory. PG Miner is the proposed algorithm which traverses the prime graph and prunes the infrequent items. The efficiency of the proposed method is proved with the help of experimental results.

Keywords: Data mining, frequent pattern mining

1. INTRODUCTION

With large database there is a need of developing a tool which can drill down the useful information from the database with ease. Knowledge discovery of data (KDD) is a process to extract useful patterns from the database. Data mining is an important step of KDD, which is used to drill out useful information and can be implemented in many areas like data bases, artificial intelligence, knowledge discovery in neural networks etc. Frequent pattern mining is used to extract frequent patterns based on minimum support or confidence value.

Interesting co-relations are mined with the help of Association rule, It comprises of two steps: first is Frequent pattern mining, in this the patterns which satisfy the threshold is frequent otherwise infrequent[14]. Many algorithms are been devised to mine frequent patterns. They basically fall in two categories:

(a) With candidate generation
(b) Pattern growth (without candidate generation).

Methods with candidate generation like Apriori[16], Partition based[21], Incremental based[17,19], suffers from many problems like multiple database scans and candidate generation. Many extensions are made to

the previous algorithm but still it encounters the above problems. And method without candidate generation like pattern growth[20] or FP-growth is an improvement over candidate generation algorithms. Two scanning are required to extract the frequent patterns from the database; several optimizations are made to minimize the number of scanning and lessen the time taken and the search space to produce frequent patterns[3].

This paper proposes a graphical method for mining frequent patterns. However, most of the times some changes are made in graph structure, pruning or traversal technique. This method uses simple graph structure to keep the transaction information and a graph miner algorithm to traverse the graph to find the frequent patterns and prunes the infrequent patterns. This method uses data transformation technique to convert data into prime number format which reduces the size of data sets significantly, then construction of prime-graph takes place and with the help of PG Miner algorithm frequent patterns can be mined and it prunes all in frequent item sets from the data set, in one database scan, as all the useful information related with the transaction is stored in prime-graph, by traversing the graph once only frequent patterns can be mined. Various experiments have been performed on the web log data set to justify the correctness of the proposed work.

2. PROBLEMS AND RELATED WORK

2.1 Problems of FPM Algorithms

In a data set the items which satisfies user defined threshold are frequent otherwise infrequent.

- It is time consuming to find frequent patterns especially when data set is highly populated.
- It is a tedious task to decide the threshold value as low threshold may produce large number of patterns destroying the accuracy of mining and the high threshold will only produce very less patterns leaving even some of the frequent item sets.
- Algorithm with candidate generation may generate large number of candidates to produce frequent patterns which require more space and database scans and make complete process expensive.
- The major problems with this algorithm are of multiple database scan and the search space[6].

2.2 Related Works

To overcome the problem of previously proposed algorithms many extensions are being made to increase the efficiency like Aclose[10], CHARM[8], Cobbler[11], Carpenter[11], AFOPT[12] and etc, are the extensions of Apriori which is a method based on candidate generation. FP-growth[20] is a method based on without candidate generation was proposed It is advancement over prefix tree. FP-tree merges the links which have same value. It compacts the data and enhances the performance by increasing the speed. It requires large memory space for parsley populated data set where common path is very low. There is another method known ELCAT[7] which uses vertical data format rather than horizontal data format, it prove much more efficient then Apriori as it uses Boolean power set lattice theory which requires less space to store information about the transaction. The refined solution proposed in our method is to derive frequent patterns from MFP, many algorithms have been devised which generates frequent patterns from MFP, But still they still require two database scans like Pincer search algorithm[4,13]. It makes use of both top-down and bottom-up traversal to mine MFP. Depth project is another method to mine MFP which uses depth first traversal[15] and both pruning techniques and moves in lexicographic order to traverse. This is an efficient method to mine frequent patterns. The extension of depth project is MAFIA[5]. Rymon's set enumeration is used by above methods which avoid counting the support of all frequent patterns[18,20].

But the major drawback is it needs the huge amount of memory to store the information about item sets.

3. METHOD PROPOSED

3.1 Data Transformation Technique

First and foremost step of data mining is data pre-processing. It comprise of data cleaning, data reduction and data transformation[22]. In the proposed method data transformation is used to reduce the size of data set significantly. In this method the web log dataset is transformed with prime based compaction which reduces the size of dataset. Each complete transaction is transformed into prime multiplied value (PMV) a positive integer. During prime graph construction transaction given T= (Pid, Z) where Pid is the ID of transaction and Z= {an……am} is the item set of Z. Prime Multiplied Value Pid is computed with the help of Eqn. 1

$$Mod\ [(PMV, Pr)] \quad (1)$$

Where Pr is the number of item set of Z.

With the help of above Eqn. (1) data can be transformed into contracted form. In fact data transformation is an abstracted form of transactions. This is explained with the help of an example in table 1 there shows eight transaction of website login and page number. In which page number is then transformed into prime numbers and then prime multiplied value is calculated.

When this transformation is applied to the real web log data result will be in drastic compaction. It reduces the size of data set more than half. This process is independent of size and type of data set, any data set can be reduced like P=(4,{8,6,20,11})

and P0 = (4,{8884,990,7123,1234}) are transformed to the same value 770.

Table 1. The website page no. and its prime multiplied values

Login	Page no.	Prime transformation	PMV
1	5, 8, 6, 11,20	3, 2, 11, 5, 7	2310
2	8, 9, 20, 11, 5	2, 13, 7, 5, 3	2730
3	5, 8, 6	3, 2, 11	66
4	8, 6, 20, 11	2, 11, 7, 5	770
5	11, 9, 20	5, 13, 7	455
6	20, 9, 8, 11	7, 13, 2, 5	910
7	8, 20, 11	2, 7, 5	70
8	9, 11, 20	13, 5, 7	455

3.2 Prime Graph Construction

Graph structures are efficient as they make use of dual techniques that is compression of complete database and pruning of infrequent data.

Proposed method introduces a simple graph structure called prime graph (prime-number compressed graph). Prime graph uses the concept of prime number theory for transformation. This method improves the performance by reducing the number of scanning and also minimizes the time taken to extract frequent patterns.

A prime graph includes number of nodes which consist of prime number allotted to the item set of transaction *(P1….n)* and on the other hand some nodes consist of Prime multiplied value i.e. *PMV1…m*. There are different fields to store current state of transaction. PMV is getting stored in the variable field. During insertion of current PMV local field set by 1 if function *[mod (PMVm,P1….n)]* = 0 or no remainder. The global field keep track of all P's which contained in particular PMV.

Global register keep track on all logins and hit pages to record the page count which can be further used for mining, according to the user defined threshold. Inward and outward edges of the node are tracked by link field; value of status field is oscillates between 0 or 1 depending upon the PMV's and P's. Fig. 1 & 2 shows the construction of Prime graph based on table 1 login data. The construction operation based on creating and inserting nodes PMV(s) and *P1…n* into prime graph based on definitions below:

Definition 1: Links through PMV and Pn will be connected depending upon the formulated equation *[mod (PMVn,P1…n)]=0 or 1*. Each and every value of PMV get modulo divided by P. If there is no remainder or 0 that means PMV is completely divisible by P, then there will be a link form between from that P directed towards PMV and local-count increased by 1.

Definition 2: Link from one PMV to other PMV is formed when one PMV is completely Divisible by other PMV.

Definition 3: A self loop to a node of PMV is form when same value of PMV is repeated more than one time i.e. same subset of item set is been repeated more than once in a whole set of transaction.

3.2.1 Working of Prime Graph for Elementary Page Logins

This can be easily illustrated with the help of table 2 Where PMV arrange in columns and pr in rows, putting value in the formula

Mod [(column, row)]

If answer equals to 0 or no remainder than 1 will be placed on the respective position otherwise 0. Like *Mod [(2310, 2)] =0* than 1 will be placed at a11.

Table 2. Detail of elementary page logins

PMV→ Pr↓	2310	2730	66	770	455	910	70	455
2	1	1	1	1	0	1	1	0
3	1	1	1	0	0	0	0	0
5	1	1	0	1	1	1	1	1
7	1	1	0	1	1	1	1	1
11	1	0	1	1	0	0	0	0
13	0	1	0	0	1	1	0	1

The count of the edges which directed from P towards PMV's or the out degree of a *P* is the total frequency of the appearance of *P* in complete set of page logins. It is shown with the help of a Fig. 1. And the calculated frequency is shown by the Table 3.

3.2.2 Working of Prime Graph for Subset Page Login

The count of the edges which directed from one PMV towards other PMV or the same PMV is the total frequency of the appearance of particular subset

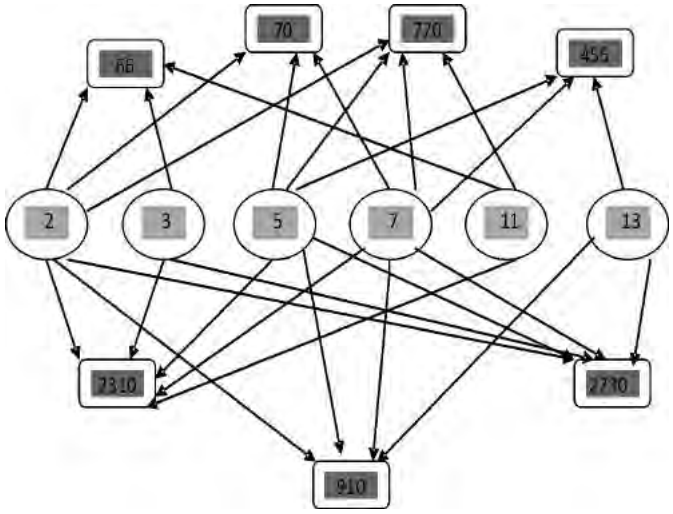

Figure 1. Prime graph for elementary page logins.

Table 3. Page frequency and prime transformation

Page no	Prime transformation	Page frequency
5	3	3
6	11	3
8	2	6
9	13	3
11	5	6
20	7	6

Table 4. Detail of subset login

Prime multiplied value	Page subset frequency
66	1
70	4
455	3
770	1
910	1
2310	0
2730	0

of pages in a complete set of login that is to find out the frequency that how many time a different users hit the same pages of a website in a sequence (subset of pages). It is shown below with the help of Fig. 2.

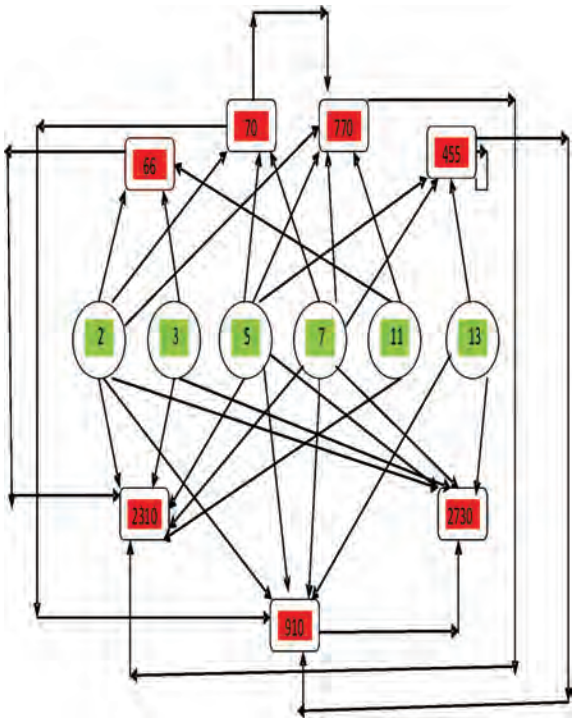

Figure 2. Prime graph construction for page subset login.

Again, consider table 1 where PMV are calculated {2310, 2730, 66, 770, 455, 910, 70, 455}. However, it is noticeable that some of the values are repeated, this concept of repeated value is used for the construction of graph for subset page login. Formula is used

Mod [(PMV, UPMV)]

where UPMV is the unique prime multiplied value. Where row contains unique transactions arranged in ascending order and column contains the all PMV arranged in arbitrary order, putting values in the formula

Mod [(column, row)]

If it equals to 0 or no remainder, then 1 will be placed on particular position otherwise 0. Like *Mod [(2310, 66)] = 0*, so 1 will be placed on a11 and so on.By counting number of 1's in the row as shown in Table 4 (decrementing the total value by 1, as every number is divisible by itself) frequency of subset can be calculated and the calculated frequency is shown in Table 5.

Table 5. Frequency of website page login

PMV→ UPMV↓	2310	2730	66	770	455	910	70	455
66	1	0	1	0	0	0	0	0
70	1	1	0	1	0	1	1	0
455	0	1	0	0	1	1	0	1
770	1	0	0	1	0	0	0	0
910	0	1	0	0	0	1	0	0
2310	1	0	0	0	0	0	0	0
2730	0	1	0	0	0	0	0	0

3.3 Prime graph Miner Algorithm

Different registers are used, during construction of prime graph

a) count- which stores the frequency of particular items.
b) Local-count- Keeps the value of current PMV.
c) Global-counting-keep track on the frequency of frequent and infrequent items.
d) Status

*Step1.*Traverses the graph in top-down direction

*Step2.*Calculate the frequency of each elementary transaction and Compare the frequency of the elementary itemset (pages) to the user defined threshold

Step3. Prunes the infrequent itemsets

Step4. Matches the subset of the transactions with one another with the help of PMV

Step5. Compares the frequency of repeated subset transaction with the user defined threshold.

Step6. Results gives the frequent elementary itemset of the frequent page numbers and the frequent subsets of the transactions that are same set of pages repeated in more than one transaction.

The PG Miner algorithm scans the constructed prime graph to drill out the frequent patterns from tip to toe. Hence, generation of frequent pattern is

completed in one scan as prime graph is capable enough to hold the information of complete data set. The miner algorithm prunes the infrequent itemsets, which increases the computation speed and enhances the efficiency.

4 EXPERIMENTAL RESULTS

All experiments were performed in an Intel 2.80 GHz PC in 2 GB RAM. All the algorithms are implemented using Matlab and SQL 6.0 on web log sparse dataset http://fimi.ua.ac.be/data/.

First experiment is performed on synthetic web log datasets. To reduce the complexity the complete transaction dataset is divided in the ratio of 50:12 that is the number of hit pages are 12, the average transaction page Logins are 50 and the number of transaction increased from 50 to 100 to evaluate size reduction through data transformation. Fig.3 shows the comparative analysis of the size of original and transformed prime compressed dataset.

Second experiment is performed to record the comparative analysis of the performance of the PG Miner and PC Miner on the web log dataset. Firstly, it plots all transactions using Prime graph and PC-Tree separately. Time taken by six random sets of 50 transactions of 12 logins are recorded to plot a comparative graph between PC-Miner and PG Miner. By repeating the same process frequent patterns are generated. The efficiency of PG Miner over PC Miner can be examined with the help of Fig. 4.

Hence, this is proved by the experiments that proposed method is a better option to find frequent patterns as it requires only one database scan. The experimental result verifies the compactness and the efficiency of Prime graph method.

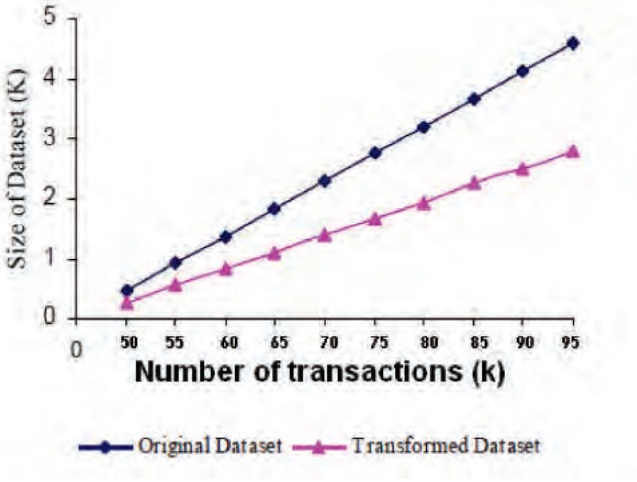

Figure 3. Size comparisons of datasets

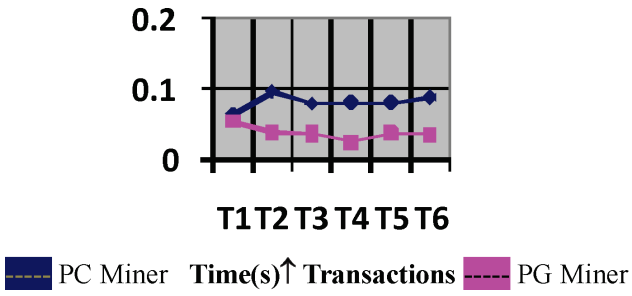

Figure 4. comparative analyses of PC Miner and PG Miner.

5. CONCLUSION AND FUTURE WORK

This Proposed method concludes that Prime graph method is a technique based on without candidate generation so it does not produce any frequent candidates to generate further frequent patterns. Single scanning of data set is required to drill out the frequent patterns as all the useful information about the transaction stores in the Prime graph itself. It requires less search space as Miner algorithm Prunes the infrequent itemsets which reduces the size of dataset up to an extent. It is time efficient, as time required in constructing PC-Tree is much greater than the time needed to plot a Prime graph with the same set of data.

This method is an improvement over previous methods in terms of time, space and speed. This method has an advantage over other methods that it is independent of size of dataset, whatever be the size of transaction it can be transformed into prime number and it gives frequency of both elementary itemsets as well as subsets[2]. Our proposed method, is simple to implement, easy to understand and does not includes any complex structures.

This graphical method can extended up to wide applications for enhancing performance of the particular like the prime transformation technique can be embedded with many frequent pattern algorithms like with incremental mining where data sets keeps on changing and operations like update, insert, delete can be easily be performed with the help of prime graph or can be used with interactive mining where new relations can change the value of threshold. This method can be used for large graph structures with unique nodes and can be applied to gaint data sets to find out the particular subset repetition of the transaction which can be useful to avoid frauds as well as can be useful in discovering knowledge for artificial intelligence based applications.

निष्कर्ष

इस प्रस्तावित विधि से यह निष्कर्ष निकलता है कि मुख्य ग्राफ विधि गैर पदान्वेशी उत्पत्ति (Without Candidate Generation) आधारित एक तकनीक है इसलिए यह आगे नियमित पैटर्न उत्पन्न

करने के लिए किसी नियमित उत्पत्ति का उत्पादन नहीं करती। नियमित पैटर्न ड्रिल आउट करने के लिए डाटा सेट की एकल स्कैनिंग आवश्यक है चूंकि सभी कार्य संपादन संबंधी आवश्यक सूचनाएं स्वयं मूख्य ग्राफ में संचित होती हैं। माइनर एल्गोरिथ्म प्रून्स अनियमित आइटेमसेट्स के रूप में इसे कम अनुसंधान स्थल की आवश्यकता होती है जो एक हद तक डाटासेट के आकार को कम कर देता है। डाटा के एक ही सेट के साथ एक प्रमुख ग्राफ की रूपरेखा बनाने के लिए आवश्यक समय की तुलना में अधिक पीसी ट्री के निर्माण में अपेक्षित समय के रूप में यह विधि समय–प्रभावी है।

यह विधि समय, स्थान और गति के मामले में पिछली विधियों पर एक सुधार है। इस विधि का अन्य दूसरी विधियों की अपेक्षा यह फायदा है कि यह डाटाबेस का एक स्वतंत्र आकार लिये हुए है, कार्यसंपादन संबंधी जो भी आकार है उन्हें प्राइम संख्या में तब्दील किया जा सकता है और यह प्राथमिक आइटमसेट के साथ साथ सबसेट दोनों का ही आवृति frequency देता है। हमारी प्रस्तावित विधि लागू करने में सरल और समझने में आसान है और किसी भी जटिल ढांचे को शामिल नहीं करती।

इस ग्राफिक विधि को प्राइम परिवर्तन तकनीक की तरह प्रदर्शन को बढ़ाने के लिए व्यापक अनुप्रयोगों तक बढ़ाया जा सकता है, प्राइम परिवर्तन तकनीक को वृद्धिशील माइनिंक के साथ जैसी कई नियमित एल्गोरिथ्म के साथ एम्बेडड किया जा सकता है जहां डाटाबेस को बदला जा सकता है और अद्यतन करने, डालने और हटाने जैसे कार्यों को प्राइम ग्राफ की मदद से आसानी से किया जा सकता है या इंटरेक्टिव माइनिंग के साथ प्रयोग किया जा सकता है जहां नये संबंध सीमारेखा के मूल्यों को बदल सकते हैं। इस विधि को अद्वितीय नोड के साथ बड़े ग्राफ संरचानाओं के लिए इस्तेमाल किया जा सकता है और कार्यसंपादन की विशेष सबसेट पुनरावृत्ति का पता लगाने के लिए बड़े डाटाबेस पर लागू किया जा सकता है जो धोखाधड़ी से बचने के लिए उपयोगी होने के साथ साथ अनुप्रयोग आधारित कृत्रिम बुद्धि के लिए ज्ञान की खोज में उपयोगी हो सकते हैं।

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आर्टिफिशियल इंटेलिजेंस के लिए एल्गोरिथ्म जनरेटर
Algorithm Generator for Artificial Intelligence

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सारांश

यह लेख एक एल्गोरिथ्म जनरेटर प्रोग्राम के बारे में विचार देता है, जो हमारे दिन–प्रतिदिन की गतिविधियों को करने के लिए गाइड के रूप में एल्गोरिथ्म की गणना करता है और सामान्य संगणना के लिए भी प्रयोग होता है। पायथन प्रोग्रामिंग भाषा के कोड को लिखकर और नैचुरल भाषा प्रोसेसर की मदद से इसको कार्यान्वित किया जा सकता है। हम एक आवाज की इनपुट देते हैं और परिणाम काम करने के लिए निदेशों का एक सेट है या अंकगणितीय इनपुट के मामले में एक संख्यात्मक परिणाम है या वेबसाइट के सर्च से संबंधित क्वेरी है तो वेबसाइट के लिए लिंक हो जाता है।

ABSTRACT

This paper gives an idea about an Algorithm Generator program which computes algorithm to act as a guide for doing day-to-day activities and also for general computations. This can be implemented with the help of a Natural Language Processor and set of other codes written using Python Programming Language. We give a voice input and the result is a set of instructions to do a task or a numerical result in case of an arithmetic input, or a link to a website if the query is related to the search of a website.

Keywords: Artificial intelligence, natural language processing, syntactic analysis, semantic analysis, pragmatic analysis, python programming language

1. INTRODUCTION

The information technology in the development of mankind has brought many innovative changes leading to the growth of contemporary techno-world. People look upon technology which automatically senses their needs for reducing the burden and time spent for their jobs. With the technology growing day by day, people expect the machine, i.e., normally an artificial equipment to do something in favour of his/her well being. A computerized system with an automatic algorithm generator could make this come true.

Algorithm generator is based on the computation which acts as a guide for doing day-to-day activities and also for general computational problems. For example, a person who is suffering from certain discomfort can obtain a set of instructions on what to do. If the discomfort is manageable, then it lists a set of medicines that can cure his/her pain immediately, otherwise, it lists a set of doctors that the user can consult. Consider another example, a person who wants to search a piece of information in the internet can instead give his/her input to the Algorithm Generator and the system gives a set of instructions and a link for the most appropriate website that contains necessary details for the user. Consider an example for performing numerical computation, if a user who is in need of generating Fibonacci series, gives his/her input. The system knows what input is required and prompts the user for the input. Then, it provides a set of instructions on how the computation was done and the numerical result. A great advantage of having this system is that it saves manual effort for obtaining a solution for a task. Based on the command given by the user, the system searches its library to find a more appropriate and easy solution.

This can be implemented with the help of a Natural Language Processor (NLP) and a set of other codes written using Python Programming Language. It includes the three stages of syntactic, semantic, and pragmatic analyses on the voice detected. The possible tools used to bring out this advanced facility includes: A computerized voice recognition system, a hardcore processor, Python programming paradigm, and an embedded code.

2. LITERATURE SURVEY

Siri in Apple IOS allows you to use your voice to send messages, schedule meetings, place phone calls, and more. But the functionalities of Siri are less than what everyone would imagine. For example, we can't ask Siri to compute an arithmetic value if a numerical input is given or ask for an optimised solution to a problem. Most importantly we can't add new functions as needed in Siri but it is possible in our innovation. The book on the Natural Language Processing with Python by Steven Bird, Ewan Klein and Edward Loper tells you how Python Programming language is simple and powerful for including excellent functionality for processing linguistic data.

3. MATERIALS AND METHODS

3.1 Materials Required and Feasible Environment

The Algorithm Generator utilized the following components: a workable computer with Operating System that supports Python Programming Language, a Python platform with version 3.4.2, which includes the library PyBrain for machine learning, a microphone and a Python program to implement the Algorithm Generator. This could be used in any environment which the computer prefers and also without any need for training. The instrument could be used anywhere from home, office, college and other institutions. No precautions are to be taken and people need not to memorise and speak the exact words. Instead, they can give a meaningful instruction for which we can get an answer [1].

3.2 Program Design

The Natural Language toolkit, or more commonly NLTK, is a suite of libraries and programs for symbolic and statistical natural language processing (NLP) for the Python programming language. It segments the sentences and tags these according to the part of speech. The program can be designed in the language that is suitable to the tablet device and which properly incorporates the Natural Language Processing Toolkit. The Bluetooth specification and characteristics are similar to the existing Bluetooth Technology. There are three major aspects of any natural language understanding theory: The syntax describes the form of the language. It is usually specified by a grammar. The semantics that provides the meaning of the utterances or sentences of the language. Although general semantic theories exist, when we build a natural language understanding system for a particular application, we try to use the simplest representation. The pragmatic component explains how the utterances relate to the world. To understand language, an agent should consider more than the sentence; it has to take into account the context of the sentence, the state of the world, the goals of the speaker and the listener, special conventions, and the like.

Machine learning is the science of getting computers to act without being explicitly programmed.[2] Machine learning is a scientific discipline that explores the construction and study of algorithms that can be learned from data. Such algorithms operate by building a model based on inputs and using that to make predictions or decisions, rather than following only explicitly programmed instructions. This plays a very important role in including different algorithms for implementation.

A useful data type built into Python is the dictionary. Unlike sequences, which are indexed by a range of numbers, dictionaries are indexed by keys, which can be any immutable type; strings and numbers can always be keys. Tuples can be used as keys if they contain only strings, numbers, or tuples; if a tuple contains any mutable object either directly or indirectly, it cannot be used as a key. A pair of braces creates an empty dictionary: {}. Placing a comma-separated list of key: value pairs within the braces adds initial key: value pairs to the dictionary; this is also the way dictionaries are written on output. The main operations on a dictionary are storing a value with some key and extracting the value given the key. It is also possible to delete a key: value pair with DEL. If you store using a key that is already in use, the old value associated with that key is forgotten. It is an error to extract a value using a non-existent key. The keys() method of a dictionary object returns a list of all the keys used in the dictionary, in arbitrary order (if you want it sorted, just apply the sorted() function to it). To check whether a single key is in the dictionary, use the "in" keyword [3].

All machine learning algorithms (the ones that build the models) basically consist of the following three things:

- A set of possible models to look thorough,
- A way to test whether a model is good,
- A clever way to find a really good model with only a few test with which any function can be included[4].

3.3 Methodology

The computer is installed with a Python version 3.4.2 and tested. Then the following algorithm is employed for the Algorithm Generator.

```
procedure ALGORITHMGENERATOR
begin
Input:
Accept input
if input not clear then
  begin
```

Prompt the user to give the input again
end
else
goto Process

Process:

Syntactic Process:
Do Tokenisation
if successful then
begin
analyse the meaning of each words tokenised
if the meaning is unclear then
begin
goto Input
end
else
goto Semantic Process
end
else
goto Syntactic Process

Semantic Process:
Analyse the true meaning of the word and data sufficiency
if data is insufficient then
begin
save the input
goto Specific Input
end
else
goto Pragmatic Process

Specific Input:
Accept input by prompting the user to give the additional information
if input not clear then
begin
goto Specific Input
end
else
goto Process

Pragmatic Process:
Call the corresponding function based on the given input
if found then
begin
do
begin
switch word of input
case 'Web search': PROVIDEWEBLINK
case 'Numerical Operation': DONUMERICALOPERATION
default: PRINTSTATEMENT
end
while(input!='\0')
end
else
goto Machine Learning

procedure PROVIDEWEBLINK
begin
This function provides a set of instructions in addition to the link to the webpages to the corresponding input and exits.
end{PROVIDEWEBLINK}

procedure DONUMERICALOPERATION
begin
This function provides a set of instructions along with the result of the numerical computation and exits.
end{DONUMERICALOPERATION}

procedure PRINTSTATEMENT
begin
This function provides a general set of instructions with some suggestions and exit.
end{PRINTSTATEMENT}

Machine Learning:
Include the new case in the Dictionary using Machine Learning Modules
goto Pragmatic Process

end{ALGORITHMGENERATOR}

This algorithm includes logic for the algorithm generator and the machine learning module and is implemented using the Python Programming Language with the corresponding functions and cases for the

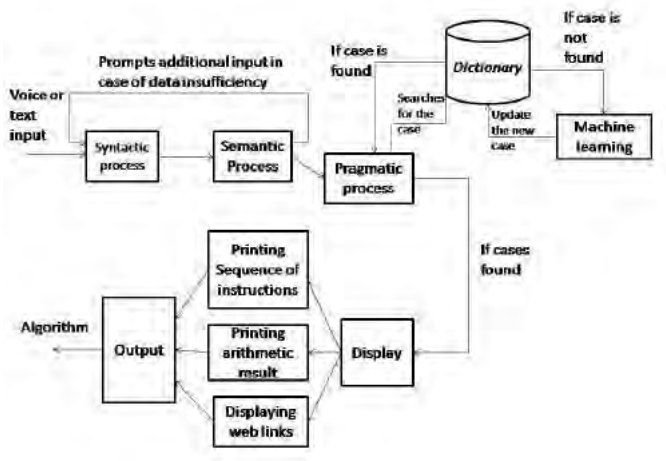

Figure 1. Working diagram of algorithm generator.

dictionary included. This program can be executed in the computer and it can run in the computer or any mobile if additional coding is executed.

The input is given in the form of a voice or text. The program first tokenises the sentence into words. Then the meaning for each and every word is analysed. If the meaning of each words is correct, then it goes to semantic stage else it asks the input to be given properly again. In the semantic analysis, the words are collectively analysed for the true meaning and if the data given as input is sufficient to go forward then it proceeds to the pragmatic stage. The pragmatic stage fetches the necessary functions from the Python Dictionaries if the function is already present else the new function is generated using the Machine Learning module implemented in python using the library PyBrain. If the function is found then a set of statements is printed with suggestions or a numerical result or a link to a webpage or a website.

3.4 Problems Faced

There are no major problems in the implementation of the algorithm. But efficiency of Natural Language Processing in real world implementation is not exactly 100 percent perfect. But it is just about accurate for the system to understand and generate an algorithm. The few issues faced during this implementation are as follows. The easily or mostly solvable problems include Spam Detection, tagging, named entity recognition. Further problems include Sentiment analysis, Co-reference resolution problem, and Word sense disambiguation problem, Parsing, Machine Translation and Information Translation. These problems are solvable if proper research is done and corresponding implementation is included. Some of the problems which are almost impossible to solve are summarization of input and implementation of a dialog system that prompts a related query to the input if the input is ambiguous. Our system simply reacts by saying something like 'I do not understand you. Come again'.

4. RESULTS

We considered the input case 'I am suffering from cold'. It performed tokenisation and separated the words 'suffering' and 'cold' and meaning was found to be correct. Then the semantic analysis was carried out by the computer to realise the full meaning. The program realised that the information was insufficient to conclude the type of cold. So the syntactic and semantic process was repeated again to get the detailed information from the user. This time the computer asked 'What is the severity?' and the reply was '104 C'. Then the pragmatic analysis was carried out to call the function that prints the statements that instructs the user what to do along with the names of Doctors within the region that the user can consult.

It is also applicable in the area of Defence.

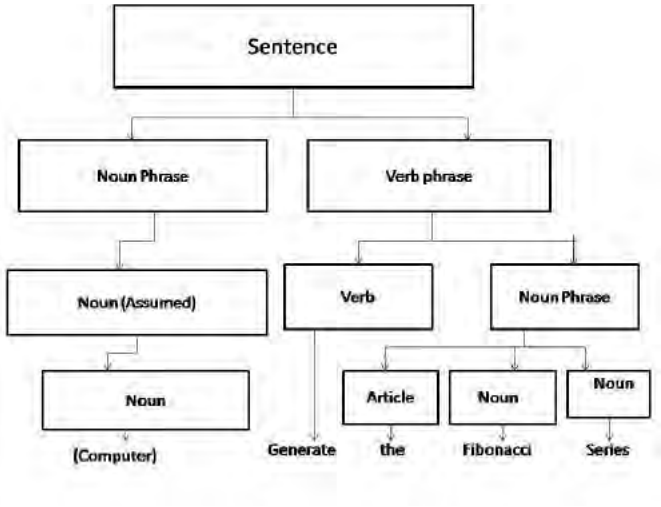

Figure 2. Syntactic and semantic parse tree.

Suppose a soldier wants to find out the enemies within the region he is located. It employs a GPS Tracker to know the location of the terrorists (Many modern technologies employ thermal imaging for this purpose). And it provides a set of instructions to not only know the location of the terrorists but also specifies an optimised way of reaching them.

5. CONCLUSION

An automated system with an algorithm generator helps us in many ways. A person with disability, a person in urgency, a person who wishes to do his/her task with the aid of a machine and many more can be benefited with the evolution of this system. It is helpful for taking the world to the next level of technology where work is done according to the needs with automation and without manpower. In technical usage, the time spent on doing tasks manually and the computational work can be greatly reduced by the implementation of this system. The technique would even create revolution in the fields of medicine, engineering, mathematics, finance, tourism, Internet, and many more.

Moreover anything which is automated will save energy, resources and work on it which leads to a successful developing environment. It provides a basic platform for the in-depth development of Artificial Intelligence towards science. As Albert Einstein said "A creation which reduces man's burden defines a true technological development", this system would be a breakthrough in the world of competition and survival. It is clearly proved from the above facts and proofs that this system, which would be in full-existence in the near future, will be a landmark in the path of modern science.

निष्कर्ष

सशक्त पुस्तकालय उपयोगकर्ता अवधारणा एक वास्तविकता है। उपयोगकर्ताओं की आवश्यकताओं पर अधिक ध्यान दिया जा रहा है और पुस्तकालयाध्यक्षों को विविध प्रकार के उपयोगकर्ताओं की और उनकी बढती हुई सूचना संसाधनों की मांग को पूरा करने के लिए डोमेन विशेषज्ञता को विकसित करना होगा। आज और कल की समस्याओं को राष्ट्रीय स्तर पर संसाधन के बंटवारे से ही हल किया जा सकता है और मुक्त स्त्रोत संसाधन सूचना के प्रचार–प्रसार में महत्वपूर्ण भूमिका निभाते हैं। आज सूचना प्रौद्योगिकी आधारित सेवाएं पुस्तकालय कर्मियों के लिए अवसर और चुनौतियाँ दोनों प्रदान कर रहे हैं। प्रमुख आईटी संसाधनों में न केवल प्रौद्योगिकी शामिल है अपितु लोग, कंटेन्ट और अर्थशास्त्र भी है। पुस्तकालय पेशेवरों को प्रौद्योगिकी आधारित शिक्षा और सेवाओं की क्षमता समझकर वर्तमान आईटी परिदृश्य में पूरा लाभ उठाना चाहिए।

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विश्लेषणात्मक पदानुक्रम प्रक्रिया का उपयोग करके गेहूँ भण्डारन गोदाम के लिए गुणवत्ता मॉडल और बीपी तंत्रिका नेटवर्क

Quality Assessment Model for Wheat Storage Warehouse using Analytic Hierarchy Process and BP Neural Network

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सारांश

गेहूँ भण्डारन गोदाम की गुणवत्ता का अधिकारियों द्वारा मेन्युअल तरीके से मूल्यांकन किया गया और यह पाया गया कि भारत में ऐसा कोई वैज्ञानिक मॉडल मौजूद नहीं है। इस लेख में हमने विश्लेषणात्मक पदानुक्रम प्रक्रिया 'Analytical Hierarchy Process' और वापस प्रचार तंत्रिका नेटवर्क 'Back Propagation Neural Network' का प्रयोग करते हुए गुणवत्ता के आंकलन के लिए एक मॉडल विकसित किया है। मेटलेब MATLAB सोफ्टवेयर में अनुकरण किया जा रहा है और अनुमानित परिणामों का बाद में पता चलेगा। परिणाम और वास्तविक परिणाम के बीच सःसंबंध और अनुमानित परिणाम विकसित मॉडल की वैधता को दिखाते हैं। यह कम समय में और एक निर्धारित वैज्ञानिक मॉडल के साथ गुणवत्ता का आंकलन करने के लिए एक प्रभावी तरीका प्रदान करता है।

ABSTRACT

In India the quality of the wheat storage warehouse is assessed manually by officials and there is no scientific model present for the same. In this paper we have developed a model for the quality assessment using the Analytical Hierarchy Process and the Back Propagation Neural Network. The simulations are carried out in MATLAB software and the results are deduced thereafter. The results and the correlation between actual results and the deduced results show the validity of the developed model. It provides an effective way to assess the quality in short time and with a prescribed scientific model.

Keywords: Consistency ratio, analytic hierarchy process, AHP, back propagation neural network, BPNN

1. INTRODUCTION

India is one of the largest wheat producing country in the world, still hunger is prevalent in many parts of the country. One of the major factors is inefficient scientific storage warehouses, i.e., the quality of the warehouses is not considered good as per required parameters. There is not any scientific model in effect and the quality is assessed manually. But the shortage of officials is hindrance in the path.

So the paper first decides on the parameters affecting the quality. Then using the comparative analysis of AHP we have developed model by taking inputs from the industry experts. The comparative analysis leads in deciding the weights of the parameters to be included in the BPNN input and hidden layer. Then sample training data is provided to the BPNN and the trained Neural Network is used for depicting the results of the inputs given.

2. PARAMETERS FOR QUALITY EVALUATION

After the study of concerned literature and taking inputs from the industry experts we have come to decide following seven factors on the basis of which the overall quality of a warehouse is assessed: physical factors, structure of the warehouse, mechanical factors, chemical factors, biological factors, risk control and the staff. All of these factors are again influenced by some sub factors as shown in Fig. 1.[1-3]

2.1 Analytical Hierarchy Process

This technique given by Thomas L. Saaty is a mathematical tool for decision making when the decision is based on various criteria's which may be qualitative and quantitative both. The beauty of the process is that it assigns a numerical value to all the parameters based on the one to one comparisons

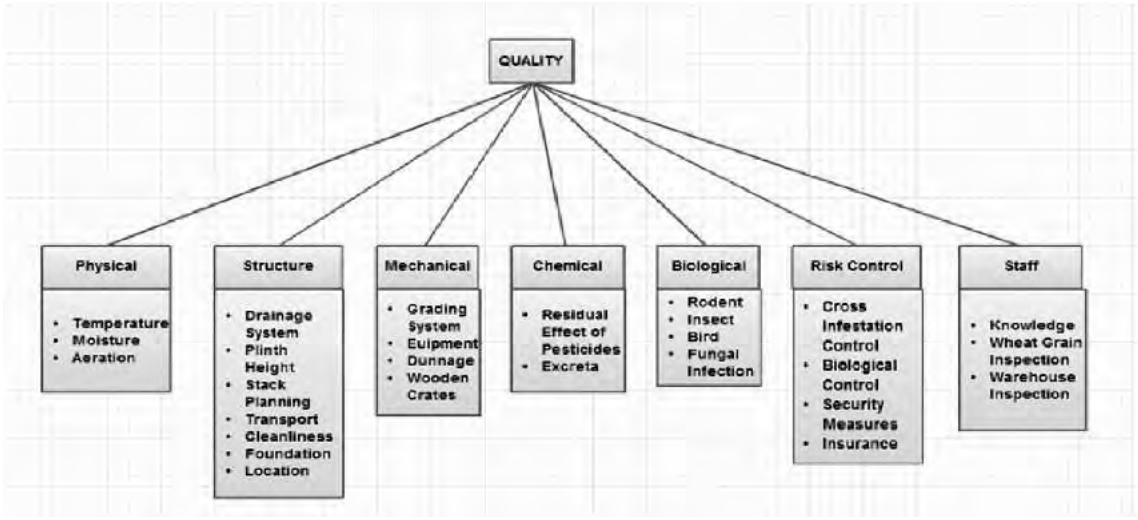

Figure 1. Factors impacting quality of warehouse.

made between them based on the Saaty scale. Then different alternatives to the final goal or decision are considered and they are compared with each other for different criteria involved which give the priority of the different alternatives. And the alternative having highest priority is selected.

The first step in AHP process is to decompose the problem at hand into sub problems and create a hierarchy. For instance as shown in Figure 1 for our case and the rest of the procedure discussed above then follows. AHP has been extensively used in decision making processes like health care, business, government, education and others[4].

2.2 Back Propagation Neural Network

Neural networks is one of the most used soft computing technique used for approximate reasoning with high optimum output rate. Neural networks are the computing techniques inspired by working of biological neuron where learning takes place from experience which is training in artificial neural network. Among neural network the BPNN is most widely used technique because of its easy convergence with less error. The BPNN is applied on a feed forward neural network which consists of at least one hidden layer. Literature review supports the fact that a single hidden layer is enough for getting appropriate results when used with back propagation as it is sophisticated enough to map the non linearity of the inputs to the outputs and it is not very complex to understand or to take more time. In BPNN, the error is back propagated to the hidden layer and the layer weights are changed first. Then the error is propagated to the input layer and correspondingly the input weights are changed for better convergence to the minima where the error is minimum in mapping inputs to their respective targets. BPNN is most widely used because of the positive results it has shown so far[5].

3. AHP BPNN MODEL FOR QUALITY ASSESSMENT

3.1 AHP Calculations

After dividing the main goal of quality assessment into seven distinct criteria's the comparison matrix is formed for main goal and for sub-criteria too. For instance here we are showing the comparison matrix for main goal criteria drawn by inputs from industry experts. Now using Table 1 we can calculate the Priority Vector which is as shown in Table 2. We can see from the table that CR for each comparison matrix is less than 0.1; hence the comparisons can be considered consistent.

Table 1. Pair-wise comparison matrix of different factors relative to quality

Q	H1	H2	H3	H4	H5	H6	H7
H1	1	5	1	5	5	3	5
H2	1/5	1	1/5	1	1/5	1/3	1/3
H3	1	5	1	5	1	1	3
H4	1/5	1	1/5	1	1/3	1/5	1/3
H5	1/5	5	1	3	1	½	2
H6	1/3	3	1	5	2	1	5
H7	1/5	3	1/3	3	1/2	1/5	1

3.2 AHP-BP Neural Network Design

The neural network hence designed is as shown in Now the lambda (max) calculated is 7.4642. The CI (Consistency Index) and CR (Consistency Ratio) are 0.0774 and 0.0586 respectively. Since CR<0.1, hence we consider the comparisons are consistent not any random value. Now similarly carrying out the calculations for sub criteria, the neural network developed is shown in Table 3 and in Figure 2. We have used this NN for calculating actual output with linear activation function at both hidden and output layer because of ease of calculation and saving time.

Table 2. Priority vector for different factors

H1	0.3207
H2	0.0409
H3	0.2008
H4	0.0398
H5	0.1318
H6	0.1893
H7	0.0767

3.2.1 Input Layer

The input layer consists of 27 nodes as we have 27 parameters on the basis of which the quality is to be accessed. The input weights are decided in the basis of AHP method. The corresponding weights are shown as sub factor weights in Table 3.

3.2.2 Hidden Layer

For actual output calculation we have used 7 nodes in hidden layer on the basis of AHPBPNN model. The corresponding layer weights are also calculated by AHP method and are shown as factor weights in Table 3. During simulation the hidden layer may vary depending upon the accuracy of output generated. We will be using hit and search method to find the number of hidden layer nodes.

Table 3. Weights for different factors

Goal	Factors	Factor weight	Sub factor	Sub factor weight	AHP consistency test
QUALITY	Physical Factors	0.3207	Temperature	0.6150	λmax=3.0027
			Moisture	0.2923	CI=0.0014
			Aeration	0.0926	CR=0.0024
	Structure of the Warehouse	0.0409	Drainage System	0.1476	λmax=7.4453
			Plinth Height	0.1805	CI=0.0742
			Stack Planning	0.1626	CR=0.0562
			Transport	0.0685	
			Cleanliness	0.1296	
			Foundation	0.1988	
			Location	0.1124	
	Mechanical Factors	0.2008	Grading System	0.0595	λmax=4.1443
			Equipment Availability	0.1782	CI=0.0481
			Dunnage Material	0.5728	CR=0.0534
			Wooden Crates	0.1896	
	Chemical Factors	0.0398	Residual Effects of Pesticides	0.8333	λmax=2
			Excreta	0.1667	CI=0.0
					CR=0.0
	Biological Factors	0.1318	Rodent	0.2927	λmax=4.0806
			Insect	0.3382	CI=0.0269
			Bird	0.0991	CR=0.0299
			Fungal Infection	0.2700	
	Risk Control	0.1893	Cross Infestation Control	0.3000	λmax=3.999
			Biological Controls	0.3000	CI=0.0
			Security Measures	0.3000	CR=0.0
			Insurance	0.1000	
	Staff	0.0767	Knowledge	0.0909	λmax=3
			Food Grain Inspection	0.4545	CI=0.0
			Warehouse Inspection	0.4545	CR=0.0

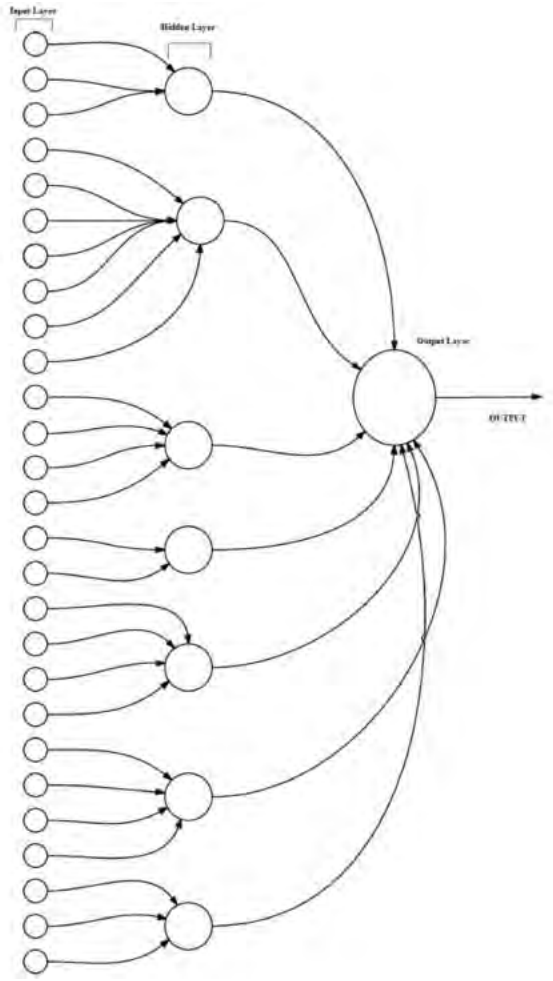

Figure 2. Neural Network Design for Actual Output Calculation.

3.2.3 Output Layer

There is only one node in output layer as shown in the figure where we get the actual result. The quality is decided upon the class in which the output lies. The range values are given below:

Class I (very good): 0.8=<Y<1.0
Class II (good) : 0.6=<Y<0.8
Class III (average): 0.4=<Y<0.6
Class IV (below average):0.2=<Y<0.4
Class V (poor quality): 0=<Y<0.2

4. EMPIRICAL STUDY

4.1 Training Data

The sample training data to train the neural network used is show in Table 5. Total of 13 sample data are taken for training.

4.2 Simulation and Testing

The simulation is carried out in MATLAB. feed forward net command is used for creating the network. 70 per cent, 15 per cent and 15 per cent data is chosen for training, testing and validation respectively. Sim is used for simulation purpose and perform for checking the performance of the BPNN with respect to target outputs. The data is shown in Table 5.

4.3 Results Comparison

The comparison of calculated result and NN result is done in Table 6. We can see that there are some differences but the accuracy improves as we add more training data. The correlation coefficient of NN result relative to calculated result is 91.75 per cent which proves the validity of the model.

5. CONCLUSIONS

In this paper we have proposed a model for quality assessment of wheat storage warehouse in India. The model is developed under the guidance of industry experts. The AHP technique is used to derive the weights for different parameters impacting the quality and then BPNN is used to test the validity of the model in MATLAB environment. The results proved the validity of the AHPBPNN model proposed.

निष्कर्ष

इस लेख के माध्यम से हमने भारत में गेहूँ भण्डारन गोदान की गुणवत्ता का आंकलन करने के लिए एक मॉडल का प्रस्ताव रखा है। मॉडल को उद्योग विशेषज्ञों के मार्गदर्शन के तहत विकसित किया गया है। गुणवत्ता को प्रभावित करने वाले विभिन्न मापदण्डों का प्रभाव weights प्राप्त करने के लिए एएचपी AHP तकनीक का प्रयोग किया जाता है और फिर मेटलेब MATLAB वातावरण में मॉडल की वैधता का परीक्षण करने के लिए बीपीएनएन BPNN का प्रयोग किया जाता है। परिणामों ने प्रस्तावित एएचपीवीपीएनएन AHPBPNN मॉडल की वैधता को साबित कर दिया है।

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Table 5. Sample training data

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	0.1	0.5	0.6	0.3	0.1	1	0.9	0.3	0.2	0.6	0.2	0.1	0.6
2	0.1	0.6	0.7	0.9	1	1	0	0.2	0.9	0.9	0.3	0.2	0.7
3	0.9	0.4	0.9	0.8	0.7	0.9	0	0.1	0.1	1	0.4	0.2	0.8
4	0.6	0.9	0.3	0.6	0.7	0.8	0	0.2	0.8	1	0.2	0.2	0.6
5	0.4	0.6	0.6	0	0.4	0.7	0	0	0.7	1	0.3	0.2	0.7
6	1	0.5	0.4	0.5	0.3	0.9	0.2	0.3	0.3	1	0.4	0.3	0.8
7	0.6	0.2	0.9	0.4	1	0.9	0.1	0.1	0.2	1	0.2	0.1	0.1
8	0.3	0.8	0.7	1	0.8	0.8	0.1	0	0.1	1	0.3	0.8	0.9
9	0.1	0.8	0.8	0.8	0.5	1	0.1	0.2	0.5	0.8	0.4	0	0.2
10	0.2	0.8	0.6	0.4	0	1	0	0.1	0.6	0.2	0.2	0	0.7
11	0.9	0.4	0	0.7	0.4	1	0.1	0.1	0.6	0.8	0.3	0	0.5
12	0.9	0.7	0.8	1	0.2	1	0.1	0.2	0.7	0.9	0.4	0.1	0.8
13	0.7	0.4	0.3	0.6	1	0.8	0.1	0.3	0.6	0.9	0.9	0.1	0.6
14	0.3	0.1	0.5	0.8	0.8	0.9	0.2	0.1	0.7	0.8	0.1	0.2	0.7
15	0.4	0.8	0.8	0.5	0.5	0.8	0	0	0.6	0.9	0.9	0.2	0.8
16	0.8	0.5	0.4	0.8	0.3	0.9	0.2	0.3	0.7	0.8	0	0.1	0.6
17	0.4	0.1	1	0.3	0.9	0.9	0.3	0	0.6	0.8	0	0.1	0.6
18	0.1	1	0.9	1	0.6	1	0	0.1	0.7	1	0	0.2	0.6
19	0.9	1	0.54	0.6	0.6	1	0.1	0.2	0	0.9	0.1	0.1	0.7
20	1	0.7	0.5	0.43	0.6	0.9	0.1	0	1	0.7	0.3	0	0.7
21	1	0.6	1	0.5	0.3	0.8	0	0.1	0	1	0.4	0	0.7
22	1	0.6	0.8	0.6	0.9	0.7	0.2	0.3	0	1	0.5	0	0.6
23	0.2	0.7	0.9	0.4	0.65	0.9	0.2	0.2	0.7	1	0.3	0.5	0.5
24	0.2	0.9	0.3	0.8	0.9	1	0.2	0.1	0.6	1	0.3	0.1	0.6
25	0.7	0.4	0	0.4	0.9	0.9	0.1	0.1	0.7	0.9	0.3	0.1	0.6
26	0.5	0.4	0.8	0.6	0.3	1	0.3	0.1	0.6	0.9	0.3	0.1	0.6
27	0.9	0.3	0.7	0.6	0.7	0.87	0.1	0.1	0.7	0.8	0.3	0.1	0.6

Table 6. Comparison of calculated and NN result

Input	Calculated result	Class	NN result	Class
1	0.48	III	0.48	III
2	0.54	III	0.57	III
3	0.66	II	0.66	II
4	0.58	III	0.58	III
5	0.58	III	0.58	III
6	0.91	I	0.66	II
7	0.26	IV	0.26	IV
8	0.19	V	0.18	V
9	0.49	III	0.61	II
10	0.85	I	0.65	II
11	0.36	IV	0.35	IV
12	0.14	V	0.13	V
13	0.64	II	0.64	II

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डेन्ड्रिटिक सेल एल्गोरिथ्म और बिलीफ फंक्षन का प्रयोग कर अतिक्रमण जांच की दर में सुधार और झूठी चेतावनी की दर में कमी

Intrusion Detection Rate Improvements and the False Alarm Rate minimisation Using Dendritic Cell Algorithm and Dumpster Belief Function

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सारांश

इस शोधपत्र में, हमने एक संशोधित डीसीए एल्गोरिथ्म पर आधारित एक फीचर चयन और फीचरों (सुविधाओं) में कमी की विधि का प्रस्ताव रखा है। प्रस्तावित एल्गोरिथ्म कम करने के लिए कई फीचरों का चयन करता है और घटाने का फीचर प्रतिभागी को पता लगाने की प्रक्रिया के लिए तैयार करता है। नेटवर्क फाइल की कम करने की विशेषता को डीसीए वर्गीकरण एल्गोरिथ्म द्वारा वर्गीकृत किया जाता है। डीसीए एल्गोरिथ्म में अगर डेटा का आकार बढ़ता है तो चयन की सुविधा की विशेषता प्रक्रिया के चयन से संबंधित समस्या को उठाती है। इस समस्या को सुलझाने के लिए सुविधा के पक्षपाती मूल्य में वृद्धि करने और फीचर सबसेट का चयन करने के लिए डम्पस्टर बिलीफ फंक्शन का इस्तेमाल किया जाता है,[1,2]। इस शोधपत्र में, हमने अनावश्यक जानकारी युक्त सुविधाओं को समाप्त करने के लिए तेजी से सुविधाओं का चयन करने की विधि का प्रस्ताव रखा है, जिसके परिणाम स्वरूप कमी करने वाले फीचर को हटाने की प्रक्रिया को सीखने में तेजी आती है। हमने सहसंबंध गुणांक, न्यूनतम वर्ग प्रतिगमन त्रुटि और अधिकतम सूचना संपीड़न सूचकांक सहित तीन सबसे सफल सुविधा चयन एल्गोरिथ्मों के साथ अपनी प्रस्तावित विधि की तुलना की है,[3]। प्रस्तावित एल्गोरिथ्म के सत्यापन और प्रदर्शन मूल्यांकन के लिए मैटलैब सॉफ्टवेयर और 10 प्रतिशत केडीडीसीयूपी 99 डेटासेट का प्रयोग किया जाता है। इस डेटासेट में लगभग 5 लाख उदाहरण निहित हैं। परिणाम की प्रक्रिया से बेहतर वर्गीकरण का पता चलता है और यह विशेषता में कमी करने की बजाय समय में कमी करता है।

ABSTRACT

In this paper, we proposed a feature selection and feature reduction method based on a modified DCA algorithm. The proposed algorithm selects multiple features for reduction and the reduce feature set participant for the process of detection. The reduce feature of network file is classified by DCA classification algorithm. In DCA algorithm, if the size of data is increasing, the selection of attribute process raises problem related to feature selection. For solving this problem Dumpster belief function is used to increase the biased value of feature and feature subset selection[1,2]. In this paper, we proposed a very simple and fast feature selection method to eliminate features with no helpful information, which results in faster learning in process of redundant feature omission. We compared our proposed method with three most successful feature selection algorithms, including Correlation Coefficient, Least Square Regression Error and Maximal Information Compression Index[3]. For the validation and performance evaluation of proposed algorithm, MATLAB software and KDDCUP99 dataset 10% was used. This dataset contains approx. 5 lacks number of instances. The process of result shows better classification and reduce time instead of another feature reduction.

Keywords: IDS, AIS, HIS, DCA

1. INTRODUCTION

The Internet has become a major surrounding for disseminating malicious codes, in particular, through a web application. Internet Worms spread through computer networks by probing, attacking and infecting remote computers automatically. Computer security is defined as the protection of computer systems against threats to confidentiality, integrity, and availability. Confidentiality means that information is disclosed only according to policy, integrity means that information is not destroyed or corrupted, and that the system performs correctly, availability means that system services are available when they are needed. The cyber-attack detection system also referred to as the

intrusion detection system (IDS)[9]. It continuously monitors the computer/network system to identify the cyber attacks while they are attempting to attack on a computer/network system. Once an attack is detected, the cyber attack detection system alerts the corresponding security professional who then take a necessary action. In recent year, the computer systems using the principles of human immune system for the intrusion detection[11]. For half a century, some fairly successful IDSs have been implemented, but were not adapted due to issues of high false positive, poor adaptation and short self-monitored. A promising solution inspired by human immune system (HIS) is rising to meet this challenging problem.

2. HUMAN AND ARTIFICIAL IMMUNE SYSTEM

The human immune system (HIS) is quite complex, elaborate, a complicated collection of cells, organs and pathways. The defence of the HIS is organized in different layers, mainly the exterior defences, which are biochemical and physical barriers for example, skin or bronchi, the physiological barrier, where *pH* and temperature provide inappropriate living conditions for pathogen system[3,4]. Every layer has different defence mechanisms and acts on different types of pathogens. The working process of human immune system is the innate immune system The innate immune system, also known as non-specific immune system and first line of defence, comprises the cells and mechanisms that defend the host from infection by other organisms in a non-specific manner. And in another way, the adaptive immune system response provides the vertebrate immune system with the ability to recognize and remember specific pathogens to generate immunity and to mount stronger attacks each time the pathogen is encountered[6]. Artificial Immune System (AIS) is a new bio-divine model, which is applied to resolve various problems in the field of information security. Artificial Immune Systems in the literature can be defined as "Artificial immune systems (AIS) are adaptive systems, inspired by theoretical immunology and observed immune functions, principles and models, which are applied to problem solving". There are two important terms that play an important role in Human immune system Antigens and antibodies. Antigens are foreign molecules on 'intruders' - that is, epitopes that are recognized by the immune system as foreigners. Antibodies are a part of the immune system which are responsible for detecting and binding to the antigens. The number of antibodies is very less than the number of antigens. In fact, the possible number of antigens is close to infinite; but the possible number of antibodies is not. Inspired by the success of biological immune systems, AIS-based systems also use the concept of antigen and antibodies, in which a small number of antibodies can detect a large number of antigens. Like HIS which protects the human body against the foreign pathogens, the AIS suggest a multilayered protection structure for protecting the computer networks against the unauthorized attacks.

There are similarities between AIS and IDS both of them use pattern recognition and anomaly detection which depends on them (respectively body and computer network) from security-based failures[5]. And this is the reason that IDS can be designed based on AIS. Both artificial immune system and intrusion detection system use signature and anomaly detection The signature detection part detects the known intrusions and the anomaly detection part is used to detect new types of intrusions. We can identify positive selection, negative selection and clonal algorithms as some pretexts for the artificial immune system. The most popular AIS models which used to design IDSs are negative selection models. An IDS which is based on AIS would be multilayered as we described before. This means that an intruder cannot be successful by crossing only one layer of IDS. Several layers will monitor on specific points of the computer network while each and every of them has a different architecture which makes it harder for intruders to attack[12]. Furthermore, a successful intrusion on one or more host will not help the intruder to get access to all hosts (because they use different configurations and the IDSs would be divers) and by this means, the speed of the attack will be reduced. Also an AIS based IDS would be disposable. It means that it is not dependent on a single component and its components can be replaced easily by other components.

3. PROPOSED METHODLOGY

In this paper, we proposed a feature selection and reduction-based intrusion detection system. The process of feature reduction and selection improves the detection and classification ratio of intrusion detection system. The feature selection process used for finding common feature for attacker participant and feature reduction processes used for unwanted feature for those who are not involved in the attack and normal communication. Dendritic cell algorithm (DCA) is used for the reduction of feature. The DCA function work on common feature correlation and generates similar and dissimilar pattern with the help of ACP algorithm. The reduction process reduces the large number of attribute and improves the detection of intrusion detection system. In the process of feature reduction various algorithms are used such algorithm are based on principle of component analysis and neural network.

3.1 Methdology Step

In this section we discuss the steps of methodology for improved intrusion detection using DCA function. In this proposed model we used following steps:

Step 1. With the help of Hybrid algorithm we estimate the nature of attack.

Step 2. Demister-Belief Theory is used to compute the probability of evidences that indicate support, which shows strings are normal and abnormal.

Step 3. After the detection, calculate the entropy of the string, if its entropy is high, treat as abnormal string. On the basis of calculated entropy we find the intruder. Higher entropy, is regarded as the "intruder", and alarm is raised.

4. EXPERIMENTAL RESULTS ANALYSIS

In this paper, we perform the experimental process of the proposed classification algorithm for intrusion detection. The proposed method is implemented in Matlab 7.14.0 and tested with very reputed dataset from UCI machine learning research centre. In the research work, we have measured detection accuracy, true positive rate, false positive rate, true negative rate, and finally false negative rate error of classification method. To evaluate these performance parameters I have used KDDCUP99 datasets from UCI machine learning repository namely intrusion detection dataset. Out of these datasets, we created five datasets in total number of instances is 7000 and create five different model sets.

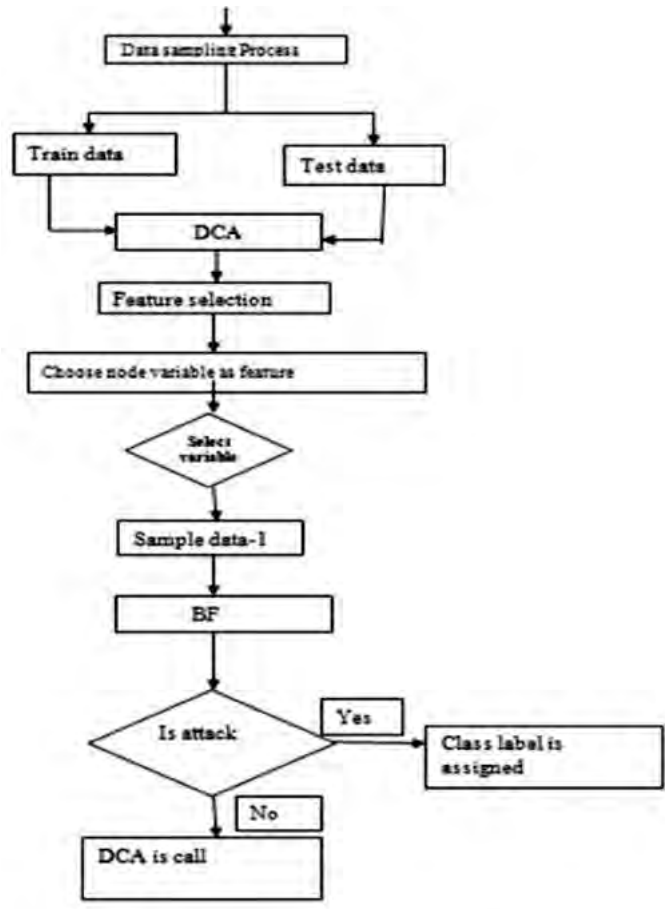

Figure 1. Proposed model for feature-based intrusion detection.

These are number of attacks falling into following categories

We have used parameters, i.e., Accuracy, Precision, Recall for datasets. So we can calculate the false positive and false negative rates of IDS, which are performance indicators of IDS.

Table 5.1 Number of attacks

Denial of service attacks	Back, land, neptune, pod, smurf, teardrop
User to root attacks	Buffer_overflow, loadmodule, perl, rootkit,
Remote-to-ocal attacks	Ftp_write, guess_passwd, imap, multihop, phf, spy, warezclient, warezmaster
Probes	Satan, ipsweep, nmap, portsweep

Precision measures the proportion of predicted positives/negatives which are actually positive/negative. Recall is the proportion of actual positives/negatives which are predicted positive/negative. Accuracy is the proportion of the total number of predictions that were correct or it is the percentage of correctly classified instances.

We are showing how to calculate these parameters by the suitable formulae. And also showing the graph for that particular dataset.

Precision = TP/(TP+FP)

Recall = TP/(TP+FN)

Accuracy = (TP+TN)/(TP+TN+FN+FP)

FPR= FP/(FP+TN), FNR= FN/(FN+TP)

For evaluation of performance, we used a different number of ratios of dataset for classification of intrusion data.

Figure 2 shows that data selection windows of all type the data type and initially load the dataset for intrusion detection classification

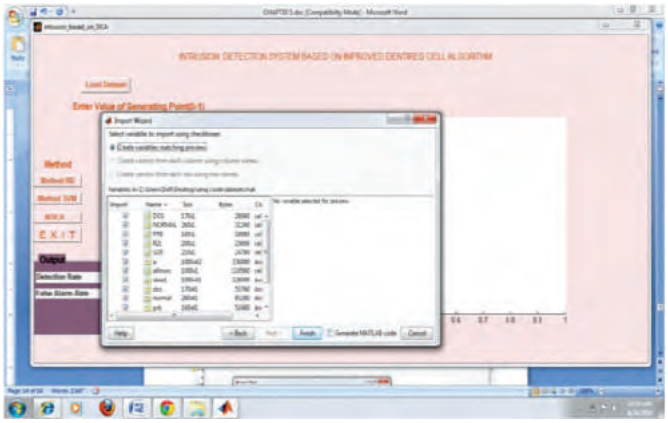

Figure 2. Loading dataset.

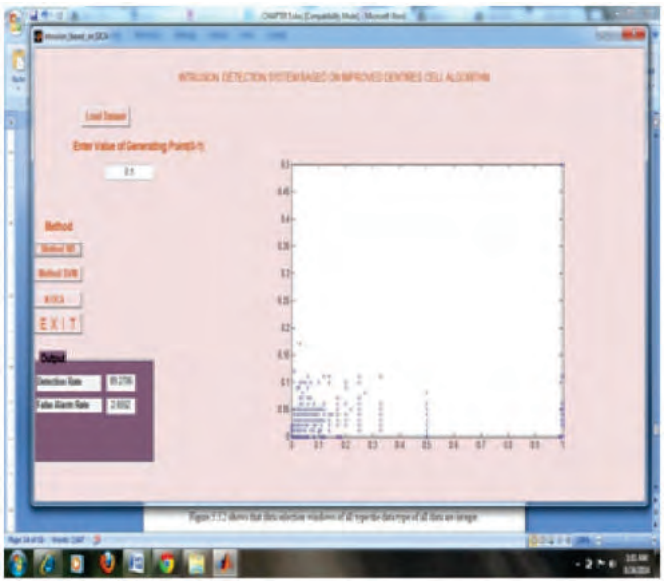

Figure 3. Data uploading process of the method M DCA for generating result value 0.1.

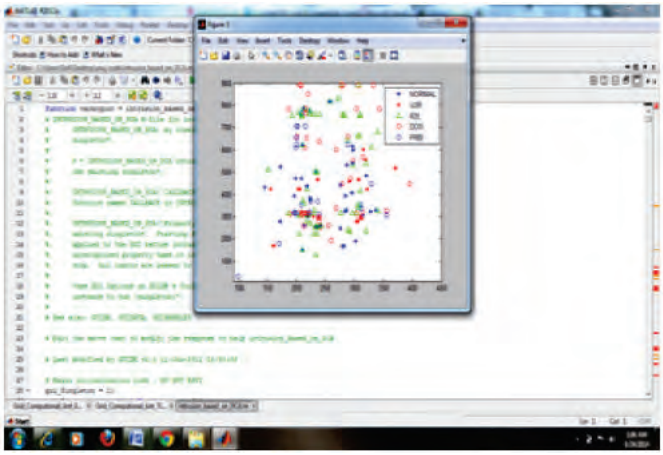

Figure 4. Data classification in attack categories

Figure 3 shows that data uploading process for intrusion data classification of the method M DCA for generating result value 0.1.

Figure 4 shows data classifying in attack categories such as Normal, U2R, R2L, DOS and Probe by M DCA method for generating result value 0.1.

Figure 5 shows that data uploading process for intrusion data classification of the method M DCA for generating result value 0.5.

Figure 6,7 and 8 shows that the comparative result grpah for the intrusion detection classification on the basis of NB, SVM and M DCA for the generating value 0.1, 0.5, 0.8, and also shows that our proposed method DCA gives th better classifiacion detection rate and low false alarm rate.

5. CONCLUSION AND FUTURE WORK

In this we proposed a feature based intrusion data classification technique. The reduction process of feature attribute is performed by BF function along

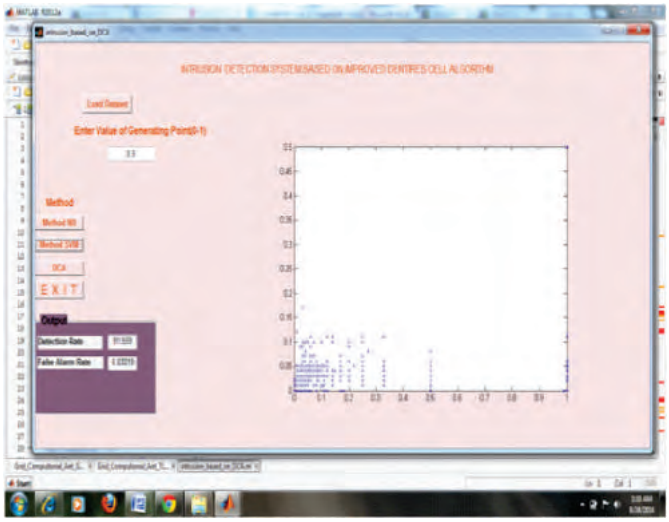

Figure 5. Data uploading process of the method M DCA for generating result value 0.5.

Table 1. Shows the performance evaluation of classification

Metric		DR	FAR
0.1	Method NB	89.270	2.665
	Method SVM	89.799	5.276
	Method M DCA	95.309	0.087
0.5	Method NB	91.192	5.576
	Method SVM	91.559	6.032
	Method M DCA	96.068	1.767
0.8	Method NB	91.876	3.658
	Method SVM	92.655	5.559
	Method M DCA	97.568	1.112

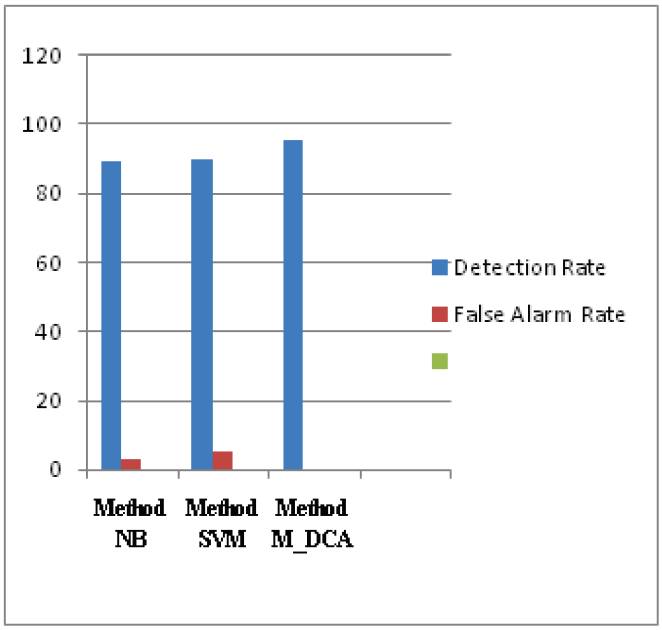

Figure 6. Comparative graph of NB, SVM And M DCA for the generating value is 0.1.

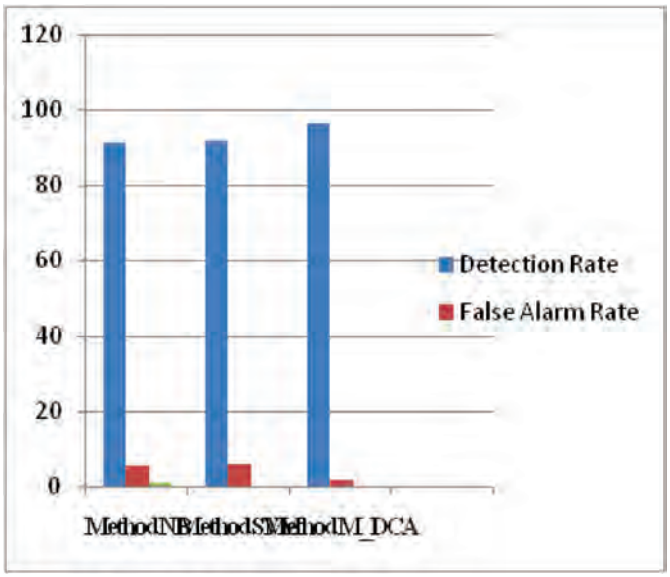

Figure 7. Comparative graph of NB, SVM And M DCA for the generating value is 0.5.

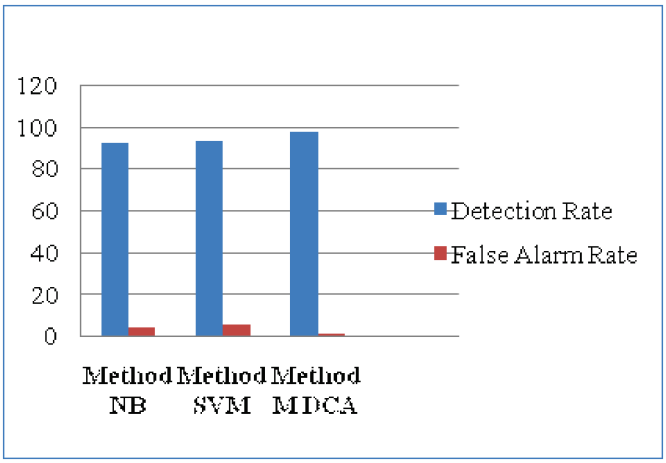

Figure 8. Comparative graph of NB, SVM And M DCA for the generating value is 0.8.

with feature correlation factor. The proposed method work as feature reducers and classification technique, because of this reduction of feature attribute, the execution time of classification also decreases. This decrease time increases the performance of intrusion detection system. Our experimental process gets some standard attribute set of intrusion file such as pot_type, service, sa_srv_rate, dst_host_count, dst_host_sa_srv_rate. These feature attribute are most important attribute in domain of network traffic area. The classification rate achieved in these attribute is 98 per cent.

In this paper, reduction computational time of feature selection process is main objective. With proposed technique, consumed time of each algorithm with different reject threshold measured is increased. As evaluation result shows, although FFR (Fast Feature Reduction) cannot defeat other methodologies in accuracy of classification and accuracy didn't changed very much, but in speed FFR outperformed all other feature selection method with great differences. We used DCA classifier with BF for developing efficient and effective IDS.

निष्कर्ष

इस में हमने एक फीचर आधारित अतिक्रमण डेटा वर्गीकरण तकनीक प्रस्तावित की है। फीचर विशेषता को घटाने की प्रक्रिया फीचर के सहसंबंध कारक के साथ बीएफ फंक्शन द्वारा की जाती है। प्रस्तावित विधि फीचर को कम करने और वर्गीकरण तकनीक के रूप में काम करती है, सुविधा विशेषता की इस कमी की वजह से वर्गीकरण के निष्पादन का समय भी कम हो जाता है। समय में इस कमी से अतिक्रमण का पता लगाने की प्रणाली का प्रदर्शन बढ़ जाता है। हमारी प्रयोगात्मक प्रक्रिया से पॉट टाइप, सेवा, एसए एसआरवी दर, डीएसटी होस्ट काउंट, डीएसटी होस्ट एसए एसआ. रवी रेट जैसी अतिक्रमण फाइलों की कुछ मानक विशेषता स्थापित हो जाती है। ये सुविधा विशेषताएं नेटवर्क यातायात क्षेत्र के क्षेत्र में सबसे महत्वपूर्ण विशेषताएं हैं। इन विशेषताओं से 98 प्रतिशत वर्गीकरण दर हासिल की गई है।

इस शोधपत्र का मुख्य उद्देश्य सुविधाओं के चयन की प्रक्रिया की संगणना के समय में कमी करना है, प्रस्तावित तकनीक द्वारा प्रत्येक एल्गोरिथ्म के द्वारा लिये जाने वाले समय की मापी गई विभिन्न अस्वीकार सीमा बढ़ी है। मूल्यांकन के परिणाम से पता चलता है कि हालांकि, एफएफआर (फास्ट फीचर कटौती) वर्गीकरण की सटीकता में अन्य तरीकों को नहीं हरा सकता और सटीकता में बहुत बदलाव नहीं आया है, लेकिन गति में एफएफआर ने अन्य सभी सुविधा चयन विधियों से बेहतर प्रदर्शन किया है। हमने कुशल और प्रभावी आईडीएस के विकास के लिए बीएफ साथ डीसीए वर्गीकरण का इस्तेमाल किया है।

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शब्द के अर्थ बहुविकल्पी मशीन लर्निंग का प्रयोग : इस समय
Word Sense Disambiguation Using Machine Learning : Timeline

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सारांश

मानव भाषा की पूरी शब्दावली में, कई शब्दों के एक से अधिक अर्थ है, जो अलग अर्थ वाले शब्द है वे वर्तमान में एक प्रासंगिक अस्पष्टता प्रदर्षित करते हैं। कई भाषा आधारित समस्याओं का समाधान क्षेत्रों की जरूरत के अनुसार हैद्य इसका उपयोग मशीन अनुवाद, सूचना निष्कर्षण तक सीमित नहीं है, यह सवाल का जवाब देने, सूचना पुर्नप्राप्ति, पाठशास्त्रीयकरण और पाठ संक्षिप्तीकरण के लिए भी इस्तेमाल किए जाते हैं। यहां तक कई शोधकर्ताओं ने हालांकि काफी योगदान दिया है, फिर भी इस क्षेत्र में और बेहतर तरीकों को इस्तेमाल करने की जरूरत है। जैसे जटिलता मानव ज्ञान के कई क्षेत्रों के आगमन के साथ बढ़ती है, सही व्यापक WSD दृष्टिकोण की एक विस्तृत श्रृंखला का उपयोग कंप्यूटर द्वारा भाषा को समझने और इसका सही अर्थ निकालने के लिए आवश्यक है। इस शोध कार्य में WSD के कार्य को कैसे Artificial Intelligence (AI) तकनीक के इस्तेमाल से Machine Learning के उपयोग से हल किया जां सकता है इसके बारे में विस्तार से वर्णन किया गया ह।

ABSTRACT

In the whole vocabulary of human language many words have more than one meaning. These words having more than one meaning thus present a contextual ambiguity which is one of the many language based problems that needs procedure based resolution. Many areas of approach include but not limited to machine translation, information extraction, question answering, information retrieval, text classification, and text summarization, etc. In the process many emerging subtasks like reference resolution, acquisition of sub-categorization patterns, parsing, and, obviously, semantic interpretation needs to be tackled not in isolation of the defined tasks. Even though many researchers over time contribute substantially, yet this area remains unexplored. As the complexity grows with the advent of many areas of human knowledge, accurate broad based Word Sense Disambiguation (WSD) need to be developed using a wide range of approaches.

Keywords: Word sense disambiguation, machine translation, natural language processing

1. INTRODUCTION

The task of Word Sense Disambiguation (WSD) is a historical one in the field of Natural Language Processing (NLP). In fact, it was conceived as a fundamental task of Machine Translation (MT) as far as 1940's. At that time, researchers had initiated works on various aspects of WSD, such as the context in which a target word occurs, statistical information about words and senses were available, knowledge resources, etc., were accessed. The limited means available then for carrying out the computational tasks, it was evidenced that WSD was a very difficult problem. Indeed, its acknowledged hardness was one of the main obstacles to the development of MT in the 1960s. During the 1970s the problem of WSD was attacked with AI approaches aiming at language understanding. However, generalizing the results was difficult, mainly because of the lack of large amounts of machine-readable knowledge. In this respect, work on WSD reached a turning point in the 1980s with the release of large-scale lexical resources, which enabled automatic methods for knowledge extraction. The 1990s led to the massive employment of statistical methods and the establishment of periodic evaluation campaigns of WSD systems, up to the present day. Natural language processing (NLP) is defined as the capability assigned to computer program(s) or software/ group of software.

Natural language processing (NLP) is defined as the capability assigned to computer program(s) or software/ group of software to interpret and understand human words as they are pronounced. Artificial Intelligence (AI) techniques are the major tools employed for Natural Language Processing. The means of communication between man and machine is either the human voice fed into the computers or executing input programs via programming languages resulting in creation and implementation of NLP applications. The use and

creation of NLP applications thus remains one of the very fascinating field of computers. It is required that humans need to speak to them in a programming language that is not a common practice. Further, the communication between the man and machine need to be unambiguous, highly structured and/or, through a limited number of clearly-pronounced voice commands. Human speech, however, most of the times is not precise and often ambiguous whereas the linguistic structure can depend on many complex variables, including slang, regional dialects and contextual usages.

2. APPLICATIONS

- Machine Translation: This is the field in which the first attempts to perform WSDwhere carried out. There is no doubtthat some kind of WSD is essential for the proper translation of polysemous words.
- Information Retrieval: In order to discard occurrences of words in documentsappearing with inappropriate senses.
- Semantic Parsing: Some suggest the utility of WSD inrestricting the space of competing parses, especially, for the dependencies, such asprepositional phrases.
- Speech Synthesis and Recognition: WSD could be useful for the correct phonetisationof words in Speech Synthesis, and for word segmentation and homophone discrimination in Speech Recognition.
- Acquisition of Lexical Knowledge: many approaches designed to automaticallyacquire large-scale NLP resources such as, selectional restrictions (Ribas, 1995),subcategorisation verbal patterns, translation links have obtained limited success because of the use of limited WSD approaches.
- Lexicography: Some suggest that lexicographers can be not only suppliers of NLP resources, but also customers of WSD systems.

3. THE UTILITY OF WSD

WSD as a single module has not yet been used to make an effective difference among the applications. There are a few recent results that show small positive effects in, for example, machine translation, but WSD does not perform well as is the case in well-known experiments in information retrieval (IR). There are many reasons for the poor performance. First, the domain of word sense is very small and limited which an application requires (e.g., no one wants to see the tones of frequency sense of bass in a kind of fish sense), and so lexicons are being constructed accordingly. Second, is the accuracy, WSD is not much accurate enough to perform better and more over the sense inventory used is unlikely to match the specific sense distinctions required by the application. Third, seeing WSD as an individual component or module may be not true, as it is more tightly integrated as an internal process. It performs better only in integrated form. Fourth, Bioinformatics research requires the relationships between genetic and genetic products to be retrieved from the vast scientific literature; however, genes and their proteins often have the same name.

More generally, the Semantic Web requires automatic annotation of documents according to reference ontology.

4. APPROACHES TO WSD

4.1 Deep Approaches

They include accesses to a collective body of knowledge about world. Knowledge, such as "we can go for fishing" for any kind of fish, but not for low frequency sounds and music have low frequency tones as parts, but not kind of fish, is then used to determine in which sense the word bass is used. In practice these approaches are not very successful, mainly because such knowledge is not available in computer-readable format, outside of very limited domains. Also, there is a long tradition in computational linguistics, of trying such approaches in terms of coded knowledge and in some cases it is difficult to identify whether the knowledge involved is language related or world related knowledge.

4.2 Shallow Approaches

These approaches do not try to understand the text. They just consider the context words in the surroundings, using data such as if bass has context words river, sea or fishing in its context, it probably is in the fish sense; if bass has the words song or music in its context, it will be surely in sense of music. These senses are retrieved by the computer by its own method, using a tagged training corpus of words along with their senses. In practice, this approach is less effective than deep approaches, because computer's knowledge is limited. However, it can be confused by sentences like "The building of SBI bank is at the bank of river"which contains the word bank near both river and building.

Word Net[20] is a lexical set database of words having more than one meaning or we can call them synonymous words. It has a large vocabulary of nouns, verbs, adjectives and adverbs. If the word belongs to any of the category then it will display the corresponding senses from the database. It is mainly supported by the National Science Foundation (NSF) under Grant Number 0855157. NSF is fully responsible for any changes, views etc.

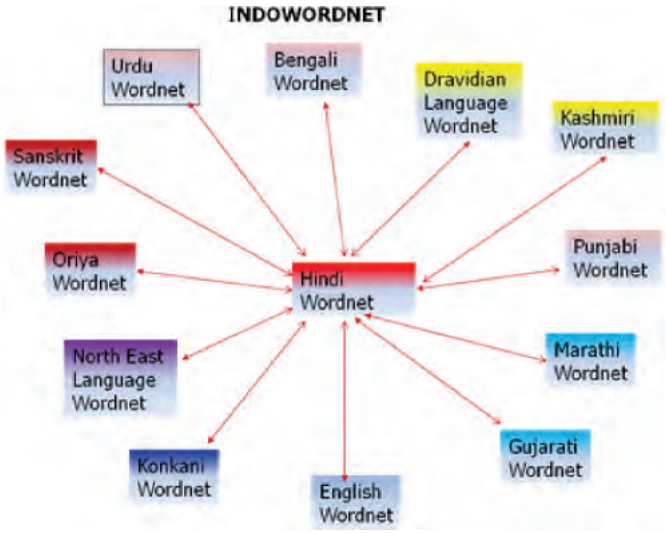

Figure 1. A Word Net for different languages.

5. MACHINE LEARNING

Learning can be defined as any change in a system that allows it to perform better the second time on repetition of the same task or on another task drawn from the same population. Depending on the amount and type of knowledge available to the system before the learning phase (system's a priori knowledge) it can be categorized in several situations as:

- The first and simplest form of learning is the situation when the full knowledge is available that is required for a particular type of task.
- Second type of learning is to store the data in the similar format and it is called rote learning. For example, filling a database.
- Third type is the process of knowledge acquisition in an expert system which is a kind of learning task where some predefined structures (rules, frames etc.) are filled with data specified or unspecified by an expert. In this case only the structure of the knowledge is known.
- Fourth type is the system in which a set of examples (training data) is given and it is required to generate a description of this set in terms of a particular language. This is advance knowledge of the system which is the syntax of any known language on syntactic basis. Possibly some characteristics of the domain from which the examples are drawn are taken (domain knowledge or semantic bias). This is a typical task for Inductive learning and is usually called Concept leaning or Learning from examples.

Another prevalent type of learning systems is Neural networks based which does not give a knowledge prior and can only react properly to the text. Neural networks actually use a kind of a predefined structure of the knowledge to be represented (a network of neuron-like elements), which however is very general and thus suitable for various kinds of knowledge.

As in human learning the process of machine learning is affected by the presence (or absence) of a teacher. In the supervised learning systems the teacher explicitly specifies the desired output (e.g., the class or the concept) when an example is presented to the system(i.e. the system uses pre-classified data).

In the reinforcement learning systems the exact output is unknown, rather an estimate of its quality (positive or negative) is used to guide the learning process. Conceptual clustering (category formation)and Database discovery are two instances of unsupervised learning. The aim of such systems is to analyze data and classify them in categories or find some interesting regularities in the data without using pre-classified training examples.

Machine learning studies computer algorithms for making the machine learn. For example, there are so many tasks which can be performed by the user like he/she might be interested in learning to complete a task, or to make predictions more precise, or to behave in intelligent manner. The learning that is being done is always based on some sort of observations or data, such as examples, experience, or instructions. So in general, machine learning is meant to do better in the future based on what was experienced in the past.

The importance of machine learning is based on automatic methods. In other words, the goal is to devise learning algorithms that do the learning automatically without human intervention or assistance. The machine learning paradigm can be viewed as programming by example. For a specific task in mind, such as E-mail filtering, rather than writing the programs to solve the task directly, in machine learning, the computer will work with its own program using the examples that already provided or feed. Machine learning is a main subfield of artificial intelligence. It is very unlikely that we will be able to build any kind of intelligent system capable of any of the facilities that we associate with intelligence, such as language or vision, without using learning to get there. These tasks are otherwise simply too difficult to solve. Further, we would not consider a system to be truly intelligent if it were incapable of learning since learning is at the core of intelligence. Although a subarea of AI, machine learning also intersects broadly with other fields, especially statistics, but also mathematics, physics, theoretical computer science and much more.

6. EXAMPLES OF MACHINE LEARNING PROBLEMS

There are many examples of machine learning problems. Here are several examples:

- Optical character recognition: To categorize images of hand written characters by the letters

represented.

- Face detection: To find faces in images (or indicate if a face is present)
- Spam filtering: To identify email messages as spam or non-spam.
- Topic spotting: To categorize news articles (say) as to whether they are about politics, sports, entertainment, etc.
- Spoken language understanding: To determine the meaning of something uttered by a speaker to the extent that it can be classified into one of a fixed set of categories (within the context of a limited domain).
- Medical diagnosis: To diagnose a patient as a sufferer or non-sufferer of some disease customer segmentation: predict, for instance, which customers will respond to a particular promotion.
- Fraud detection: To identify credit card transactions (for instance) which may be fraudulent in nature.
- Weather prediction: predict, for instance, whether or not it will rain tomorrow.

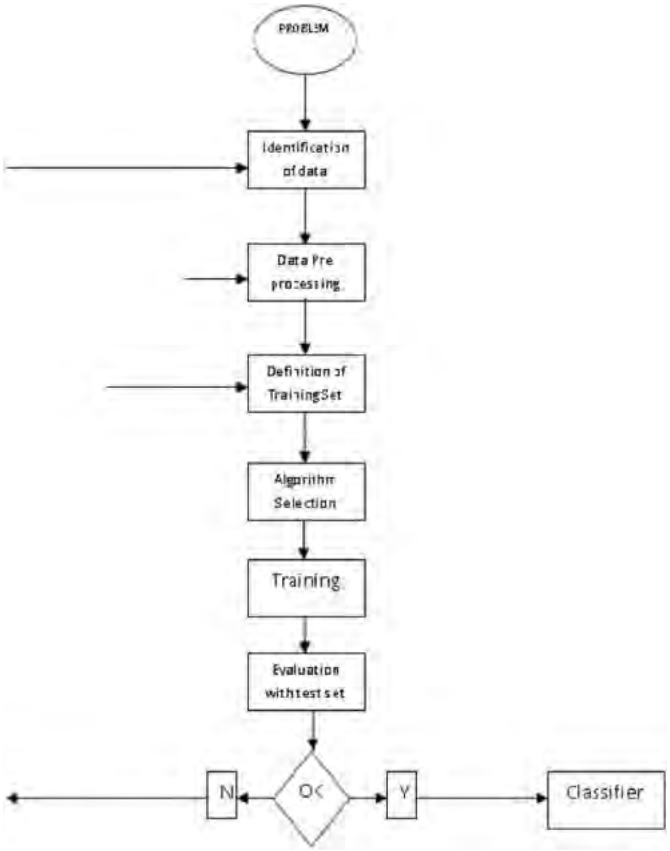

Figure 2. Flow diagram of supervised machine learning.

7. RELATED WORK

Azzini et al., [1] proposed a supervised approach to word sense disambiguation based on neural networks combined with some more algorithms. They have taken large datasets for every polysemous word senses and used some optimization method for neural network that has correctly disambiguates the sense of the given word by taken the context words in which it occurs into consideration. The feasibility of the approach has been shown through experiments carried out on a particular set of input polysemous words.

Rion Snow, et al[2], formulated a new method of merging of senses as a supervised learning problem, by using manually tagged sense clustering as training data. The data for training a disambiguating classifier has been derived from Word Net database, corpus-based proof data, and evidence from other lexical resources. The similarity measure performs much better than previously proposed automatic methods for sense clustering on the task of predicting human sense merging judgments, which yields an absolute

F-score improvement of 4.1 % on nouns, 13.6 % on verbs, and 4.0 % on adjectives. Finally, a model is devised for clustering sense taxonomies using the outputs of the classifier, and it is automatically clustered for senses taking data from Word Net.

Yoong Keok Lee et al[3], participated in the SENSEVAL-3 English lexical sample task and multilingual lexical sample task. They used a supervised learning approach with Support Vector Machines, on official data given by a company as training data. They have not used any other source for training data. The knowledge sources used were part of speech of context words, words in the surrounding context, local collocations, and syntactic relations.

Gerard Escude ro, et al[6], described an experiment for word sense disambiguation with comparison of two standard supervisedlearning methods, named as Naive Bayes and Exemplar based classification problem. The work is divided into two parts. First, it has tried to clarify the confusion in comparison of the two algorithms appearing in the related literature. Secondly, it gives several directions to explore the testing of the basic learning algorithmsand varying the feature space.

Dinakar Jayarajan[9] presented a new representation for documents based on lexical chains. Their work includes both the problems and achieves a better reduction in the dimensionality and results in the semantics as output present in the input data. They devised an optimized algorithm to compute lexical chains and generate feature vectors using these chains.

Yee Seng Chan et al[10], presented an experimental study to state that word sense disambiguation (WSD) systems can help to improve the performance of statistical machine translation (MT) systems. They successfully integrated a state-of-the-art WSD system into a state-of-the-art hierarchical phrase-based MT

system. They presented that integrating aWSD system improves the performance of a state-of-the-art statistical MT system on an actual translation task.

Andres Montoyo, Armando Suarez, German Rigau, Manuel Palomar[11] concentrated on the solving the problem of the lexical ambiguity when a given word is polysemous and has several different meanings. This specific way to solve the problem is called word sense disambiguation (WSD). The problem can be solved using the correct sense of words from electronic dictionary as the source of word definitions. They present two WSD approaches in this research area: a knowledge-based method and a corpus-based method. Their conclusion is that word-sense ambiguities require a number of knowledge sources to solve the semantic ambiguity of the words.

S.K. Jayanthi and S. Prema[13] performed a number of investigations in to the relationship between information retrieval (IR) and lexical ambiguity in webmining. The work is much exploratory. The results of these experiments lead to the conclusions that query size plays an important role in the relationship between ambiguity and IR in web content mining. Word Sense Disambiguation (WSD) is tested and analyzed for some of the existing Information Retrieval engines like Google, MSN, yahoo, Alta vista search using Brills tagger, and the derived results for the IR systems recommends how to accommodate the sense information in the selected document collection.

Antonio J, et al[14] devised an optimized approach for solving the comparison of performance of two algorithms namely graph-based approach, using the structure of the Meta thesaurus network and without thesaurus.

The combinatorial approach improves the performance over the individual methods. Yet, the performance is still below statistical learning trained onmanually produced data and below the maximum frequency sense baseline.

Tamilselvi P.[15], implemented word sense disambiguation system using three different set of features along with three different distance measuring functions combined with three different classifiers for word sense disambiguation. By exploiting Neural Networks approach with a number of features, Accuracy measure was achieved upto 33.93 % to 97.40 % for words with more thantwo senses and upto 75 % of accuracy for words with exactly two senses.

Nameh M., et al[17], presented a supervisedlearning method for WSD, which is based on Cosine Similarity. The work contains two parts, as the first part, two sets of features have extracted; the set of words that have occurred repeatedly in the text and the set of words neighboring the ambiguous word. They presented evaluation of the proposed schemes and illustration of the effect of weighting strategies proposed.

Rezapour A.R., et al[18], presented a supervised learning method for WSD, which was based on K-Nearest Neighbor algorithm. They extracted two sets of features; the set of words that were occurred frequently in the text and the set of words surrounding the ambiguous word. To improve the classification accuracy, they proposed a feature weighting strategy. The results are encouraging comparing to state of the art.

George A. Miller, et al[20], Word Net is an on-line lexical reference system whose designis inspired by current Psycho linguistic theories of human lexical memory. Englishnouns, verbs, and adjectives are organized into synonym sets, each representing one underlying lexical concept. Different relations link the synonym sets.

Wanjiku[21] addresses the problem of word sense disambiguation within the context of Swahili-English machine translation. In this work, the main purpose of disambiguation is to correctly select for translation of an ambiguous Swahili word in context. For disambiguation purpose a corpus based approach is used, where Naive bayes machine learning algorithm is applied to a corpus of Swahili, to perform disambiguation of information automatically. In particular, it has used the Self-Organizing Map algorithm to obtain a semantic categorization of Swahili words from data.

Manish Sinha,et al[22], have used Hindi language for developing Word Netat IIT Bombay. They have created a vast lexical knowledge base for Hindi. The main idea is same as comparing the context words in the sentence with the words in the sentences of senses from the Word Net and chooses the winner. The output contains a particular most appropriate meaning designating the sense of the word. The mentioned Word Net contexts are built from the semantic relationsand glosses, using the Application Programming Interface created around the lexical data. The evaluation has been done on the Hindi corpora provided by the Central Institute of Indian Languages and the results are encouraging.

Bartosz Broda, et al[24], focuses on the use of unsupervised algorithm namely some clustering algorithms for the task of Word Sense Disambiguation. They have used six clustering algorithms (K-Means, K-Medoids, hierarchical agglomerative clustering, hierarchical divisive clustering, Growing hierarchical Self Organising Maps, graph-partitioning based clustering) and five weighting schemes. For agglomerative and divisive algorithm thirteen criterion function were tested. They have achieved results which are interesting, because best clustering algorithms are close in terms of cluster purity to precision of supervised clustering algorithm on the same dataset, using the same features.

Ying Liu, et al[25], devised an automatic text

classification method for word sense disambiguation. 'hood' algorithm is used to remove the ambiguities from the sentences so that each word is replaced by its correct sense in the context. The nearest neighbor of the word senses of all the non-stop words in a give document are selected as the classes for the given document. The algorithm is applied on Brown Corpus database for sentences. The effectiveness is evaluated by comparing the classification results with the classification results using manual disambiguation offered by Princeton University.

Samir Elmougy, et al[24], used the rooting algorithm with Naive Bayes Classifier to solve the ambiguity of non diacritics words in Arabic language. The Experimental studyproves that using of rooting algorithm with Naive Bayes (NB) Classifier enhances the accuracy by 16% and also decreases the dimensionality of the training documents.

8. RESEARCH ISSUES

Word Sense Disambiguation is very challenging field of research. There are many researches challenges that have to solve out:

- Different dictionaries and thesauruses provide different division ofwords into sense. So it is difficult to choose a dictionary for the purpose.
- Sometimes the common sense is needed to disambiguate the meaning of words e.g.
  Sita and Geeta are sisters-(they are sister to each other)
  Sita and Geeta are mothers - (each is independently mother)
  It is very difficult to prepare a system which can understand such common sense.
- Word meaning is infinitely variable and context sensitive. It does not divide up easily into distinct or discrete sub meanings.
- To date there is no large scale, broad coverage, much efficient WSD system exists. Accuracy achieved by previous research is up to 60
- In last few years Word Net has been widely adopted as the senseinventory of choice in WSD, however sense inventory is too fine grained for many tasks and this makes the disambiguation very difficult.
- The comparative results of machine learning show that even most sophisticatedmethods have not been able to make a qualitative jump and get close to the solution of problem.
- The knowledge acquisition bottleneck is perhaps the major impediment to solving the WSD problem
- Word meaning does not divide up to discrete senses.

9. CONCLUSIONS

The above stated paper concludes that the problem of word sense disambiguation(WSD) can be solved more effectively using Machine learning technique for finding best sense of ambiguous word. In some papers two algorithms are combined to get more accurate results. In one other paper clustering technique is used to first make clusters of similar senses and then find best sense. Still there is much to do in finding best sense of ambiguous words. For some group of words using machine learning algorithm for WSD gives 86.74 % accuracy that is still below the standard accuracy value. In future it is required to perform even better to improve the accuracy

निष्कर्ष

ऊपर लिखित अध्ययन का निष्कर्ष यह है कि WSD को Machine Learning तकनीक के द्वारा और भी अधिक प्रभावी ढंग से सही अर्थ प्राप्त करने के लिए उपयोग किया जाता है। कुछ शोध में वे प्रदर्शन का अनुकूलन करने के लिए दो एल्गोरिदम संयुक्त रुप से इस्तेमाल किए गए हैं। कुछ शोधपत्र में वे प्रदर्शन में सुधार करने के लिए क्लस्टरिंग (clustering) का उपयोग किया गया है। लेकिन फिर भी शब्द का सही अर्थ समझने में सुधार करने के लिए बहुत कुछ करना बाकी हैद्य शब्दों के कुछ विशिष्ट समूह के लिए Machine Learning Algorithm का उपयोग 86.74% सटीक ज्ञान–आधारित दृष्टिकोण भी मानक WSD मानक से नीचे है, भविष्य में इस विषय पर और शोधकार्य कि आवश्यकता है जिससे कि इसे और बेहतर परिणाम प्राप्त किए जां सके।

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एडिट डिस्टेन्स और एन–ग्राम मैच का उपयोग करके अवधारणा एकीकरण
Concept Integration using Edit Distance and N-Gram Match

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सारांश

सूचना वर्ल्ड वाइड वेब (डब्ल्यूडब्ल्यूडब्ल्यू) पर अधिकाधिक तेजी से बढ़ रही सूचनाओं के लिए यह आवश्यक हो गया है कि इन सभी सूचनाओं को न केवल लोगों को बल्कि मशीनों को भी उपलब्ध कराया जाए। आंकड़ा संसाधन या सूचना संसाधन में शब्दार्थ विज्ञान को शामिल करने के लिए व्यापक रूप से ऑनटोलॉजी और टोकन का उपयोग किया जा रहा है। इस अवधारणा से औपचारिक रूप से विशिष्टताओं का अर्थ अभिप्रेत है जो एक तर्क–आधारित भाषा में कूटबद्ध होता है और स्पष्टतया ऐसी अवधारणाएं, विशेषताएं अभिप्रेत हैं कि विशिष्टताएं मशीन द्वारा पठनीय हो और यह अवधारणात्मक मॉडल भी कि लोग किसी खास विषय क्षेत्र की चीजों के बारे में कैसे सोचते हैं। आधुनिक परिदृश्य में, विभिन्न अलग–अलग विषयों पर और भी आन्टोलॉजी विकसित की गई हैं, जिसके परिणामस्वरूप विभिन्न ऑन्टोलॉजी के मध्य निकायों की विविधता बढ गई है। अवधारणा एकीकरण पिछले दशक में महत्वपूर्ण बन गया है और विविधता को कम करने और आंकड़ा संसाधन को सशक्त बनाने का साधन बन गया है। शब्दार्थ या वाक्य–रचना तुलन मान के आधार पर विभिन्न इनपुट स्रोतों से अवधारणाओं को एकीकृत करने के लिए अनेक तकनीकें हैं। इस पत्र में, अवधारणों को युग्म के बीच एडिट डिस्टेन्स या एन–ग्राम तुलन मानों का उपयोग करके अवधारणा (ऑन्टोलॉजी या टोकन) को एकीकृत करने के लिए एक तरीका प्रस्तावित किया गया है और एकीकरण प्रक्रिया को प्रभावित करने के लिए अवधारणा आवृत्ति का प्रयोग किया जाता है। प्रस्तावित तकनीक के निष्पादन की तुलना अवधारणाओं के विभिन्न आकारों के संदर्भ में रिकॉल, सटीकता, एफ–मेजर एवं एकीकरण दक्षता जैसे गुणवत्ता मानदंडों पर शब्दार्थ समानता आधारित एकीकरण तकनीकों से की जाती है। विश्लेषण दर्शाता है कि एडिट डिस्टेन्स मान आधारित इंटरएक्शन का निष्पादन एन–ग्राम एकीकरण और शब्दार्थ समानता तकनीकों से बेहतर है।

ABSTRACT

Information is growing more rapidly on the World Wide Web (WWW) has made it necessary to make all this information not only available to people but also to the machines. Ontology and token are widely being used to add the semantics in data processing or information processing. A concept formally refers to the meaning of the specification which is encoded in a logic-based language, explicit means concepts, properties that specification is machine readable and also a conceptualization model how people think about things of a particular subject area.In modern scenario more ontologies has been developed on various different topics, results in an increased heterogeneity of entities among the ontologies. The concept integration becomes vital over last decade and a tool to minimize heterogeneity and empower the data processing. There are various techniques to integrate the concepts from different input sources, based on the semantic or syntactic match values. In this paper, an approach is proposed to integrate concept (Ontologies or Tokens) using edit distance or n-gram match values between pair of concept and concept frequency is used to dominate the integration process. The proposed techniques performance is compared with semantic similarity based integration techniques on quality parameters like Recall, Precision, F-Measure & integration efficiency over the different size of concepts. The analysis indicates that edit distance value based interaction outperformed n-gram integration and semantic similarity techniques.

Keyword: Concept integration,ontology integration, ontologymatching, n-gram, edit distance,token, concept mining

1. INTRODUCTION

Data mining is a process of extraction the utilizable data from divergent perspective. Data mining also called as data or knowledge discovery[1]. Data mining provides the different kinds of mining techniques for gathering, grouping, and extracting the information

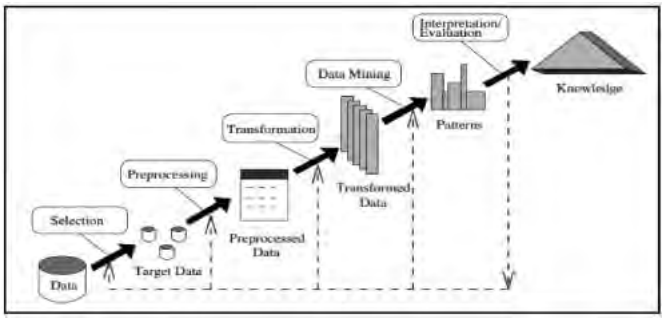


Figure 1. Data mining in knowledge discovery [1].

from substantial amount of data. Technically, data mining is a process of providing correlation or patterns between numbers of existing fields in relational database. Existing data is processed, the processed data is known as information. The processing of data is achieved through establishing some correlation among data items or patterns. Data mining is a special kind of data processing which established the fact that knowledge is always application-driven [8].

Data mining is an important aspect of knowledge discovery (KDD) in the database.There are various internal steps involves in KDD, e.g. Data selection, data cleaning, data transformation data mining and interpretation, as shown in Figure 1.

Ontologies are metadata schemas, providing a controlled vocabulary of concepts, each with an explicitly defined and machine process able semantics [1][7], by defining shared and common domain theories, ontology helps both people and machines to communicate precisely to support the exchange of semantics. Ontology language editors help to build semantic web[3-5]. Hence, the contemptible and efficientconstruction of domain specific ontology is crucial for the success of many data processing systems. In many data or information processing systems term ontology is refer as token or concept as well, as token and ontology refers to a term/word which represent a set of values, meaning, knowledge and both are identified based on the given input data, document, text etc [20][26]. In our approach Token or Ontology both are referred as term Concept for simplification on representation of proposed approach.

Concept enables the abstraction various data domains[23]. Token/Ontology bothprovide the vocabulary of concepts that describe the domain of interest and a specification meaning of terms used in the vocabulary[8]. In modern scenario, as data is growing rapidly, the main problem lies in the heterogeneity between that data and to integrate the data, so that heterogeneity can be minimize[6]. Concept integration plays an important role in minimizing heterogeneity among data items. Concept integration consists of various steps like Concept matching &Concept mapping[23]. Conceptmatching is a process that measures the

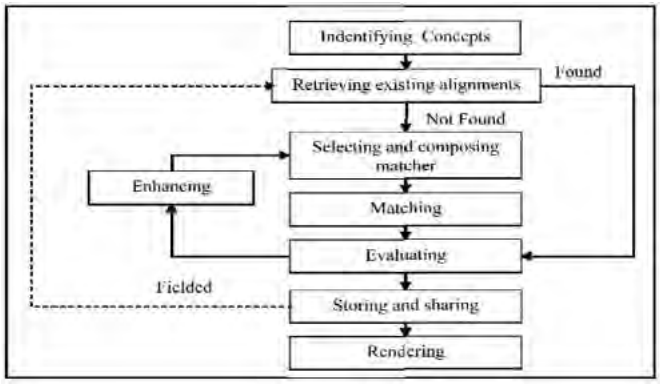


Figure 2. Concept (Token/Ontology) life cycle [9].

similarity of attribute between these concepts and provides a better result for conceptintegration.

A complete lifecycle of a concept is shown in Fig. 2, it describes step-by-step flow of activities[9], starting from concept identification to storing and sharing of concept. Matching through characterising the problem (identify the problem), selecting the existing alignment, selecting the appropriate matchers, running the matchers and select the appropriate results and correcting the choices made before (matchers, parameters), documenting and publishing good results and finally using them. The conceptmatching process is utilized to measures the homogeneous attribute between the two set of concepts [9].

In the area of data and information science, conceptis a formal framework for representing domain knowledge [19-20]. This framework primarily defines the semantics of data element of domain and then identifies the relationship among other. Conceptidentification is an important part of anytoken/Ontology integration system[21-22]; to identify conceptpreprocessing of input document/text is required[10]. Domain specific ontologies firstly identified for different sources of information/ document[11][12]. Text and then merges into single set of concept. In concept integration, there are two activities involved like token/Ontology identification and Token/ Ontology matching[6-[15]. Conceptsare a vital component of most knowledge based applications, including semantic web search, intelligent information integration, and natural language processing. In particular, we need effective tools for generating in-depth ontologies that achieve comprehensive converge of specific application domains of interest, while minimizing the time and cost of this process. Therefore we cannot rely on the manual or highly supervised approaches often used in the past, since they do not scale well.

In the field of artificial intelligence, data mining, data warehousing, semantic web, systems engineering, software engineering, biomedical informatics, library science, enterprise bookmarking, and information architecture[2].

2. TOKEN/ONTOLOGY INTEGRATION

Concept identification (token/Ontology extraction, token/Ontology generation, or token/Ontology acquisition) is the automatic or semi-automatic creation of ontologies, including extracting the corresponding domain's terms and the relationships between those concepts from a corpus of natural language text, and encoding them with an token/Ontology language for easy retrieval [23]. As building ontologies manually is extremely labor-intensive and time consuming, there is great motivation to automate the process[15] [24]. Concept matching plays critical role in concept integration, each source conceptis matched with each target concept based on the some matching function. In proposed approach the matching between source & target concept is based on edit-distance value or n-gram value. Finally,concept Integration, the various concepts are merged into single set of concept. By introducing concepts and their relations, ontologies provide a critical and necessary information structure that facilitates the processes of sharing, reusing, and analyzing domain knowledge in Semantic Web and other knowledgebased systems[17,18].

2.1 Motivation

Information/data integration has a wide range of application through token/Ontology integration. The integration of data and integration of schema has been attracted wide interest of researcher from research area like information retrieval, data mining & warehousing, Query processing, systems engineering, software engineering, biomedical informatics, library science, enterprise bookmarking etc. Ontology integration explains the process and the operations for building ontologies from other ontologies in some Ontology development environment. Ontology integration involves various methods that are used for building the ontologies using other set of Ontology[9].

The First motivation behind the Ontology integration is to use of multiple ontologies. For example: - suppose we want to build Ontology of tourism that contains information about transportation, hotels and restaurants etc. so we can construct this Ontology from initial but this take lot of efforts when the ontologies are huge. Ontology reusing is a concept of Ontology reuse, we can utilize previously created Ontology (already exist) on topics transportation, hotels and restaurant to build desired Ontology for tourism. These ontologies may share some entities, concepts, relations and consequently. The second motivation is the use of an integrated view. Suppose a university has various colleges affiliated to that university across the world. University needs information from the colleges about the faculty, academic etc. In this case, university can query the ontologies at various colleges

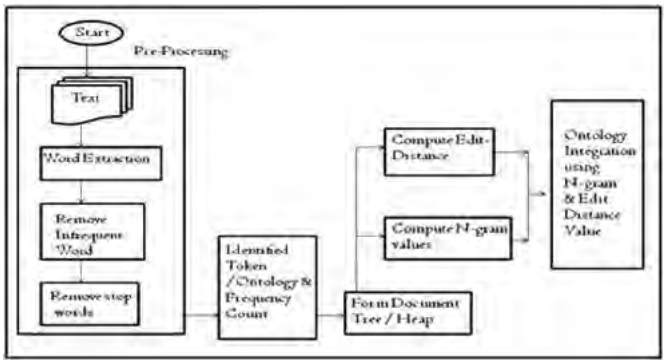


Figure 3. Schematic diagram of proposed method.

through proper on tologymappings, thus providing a unified view to the university. The third motivation is the merge of source ontologies. Suppose various ontologies are created on the same topic or concept and overlapping the information. Ontology merging is used to merge these ontologies and build a single Ontology, which consists various concepts, entities definitions from the local ontologies, for example, suppose several car companies are merged into a new car company, for which Ontology has constructed. This could be done by merging the existing ontologies of these companies.

2.2 Proposed Procedure and Example

For a given text/document, a document heap is created based on the tokens/ontologies frequency within input documents. A heap is a specialized tree-based data structure that satisfies the heap property: If A is a parent node of B then the key of node A is ordered with respect to the key of node B with the same ordering applying across the heap. Proposed algorithm consists of three activities for token/ontology integration mentioned below and schematic diagram is shown in Figure 3.

Step 1: Token/Ontology Identification and Construction of Token/Ontology Heap:-First step involves two important activities, firstly pre-processing of input document/text is done for the purpose of token/ Ontology detection, in this step word extraction, stop word removal & stemming are applied to indentify all possible Ontology in input document/ text. Another activity is to compute the frequency of each of the Ontology within document, frequency simply represent the number of appearance of the Ontology in the document or paragraph. The term frequency is used to construct the heap (max heap) for respective document, in which the Ontology with highest frequency appears on the top of heap. Similarly heaps are constructed for each of the document or the text document.

*Step 2:*Computation of Edit Distance and N-Gram match values[19]: For each pair of Concepts, edit-distance and n-gram matching values are to be calculated. The

Table 1. Edit distance and n-gram value of ontology pair

Ontology Pair	Edit Distance	N-Gram
(RESP, RESPONSIBILITY)	The number of editing changes that needs to convert one of these strings to the other is 10 either add the characters 'O', 'N', 'S', 'I', 'B', 'I', 'L', 'I', 'T', 'Y', to RESP or delete the same characters from RESPONSIBILITY. Thus the ratio of the required changes is 10/14, edit distance between these two strings; 1-(10/14) = 4/14 = 0.29	Let n = 3, means 3-grams.The 3-grams of RESP are 'RES' and 'ESP'. Similarly, there are twelve 3-grams of RESPONSIBILITY: 'RES', 'ESP', 'SPO', 'PON', 'ONS', 'NSI', 'SIB', 'IBI', 'BIP', 'ILI', 'LIT', and 'ITY'. There are two matching 3-grams out of twelve, giving a 3-gram similarity of 2/12 = 0.17

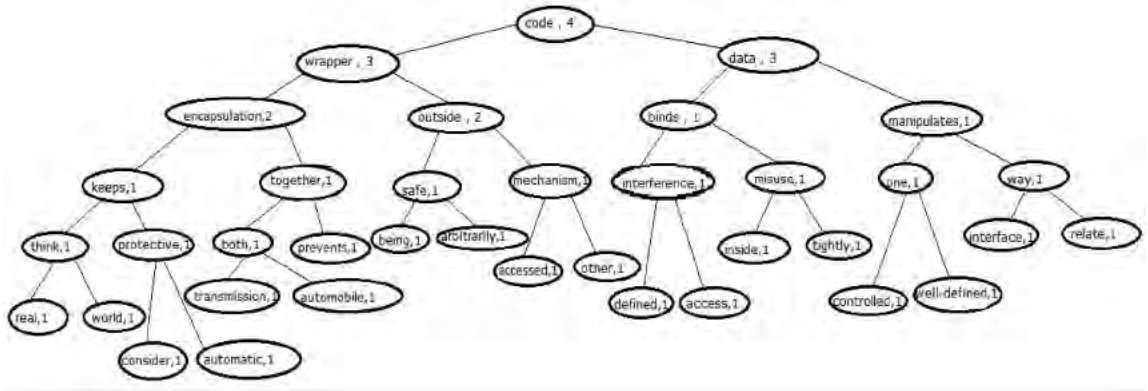
constructed heap's in step 1 are the input for this step and for each pair of concepts from participating heaps edit distance and n– grams value is been computed. The computed matching values are stored in 2-dimentional array and used in next step during the integration of the heaps.

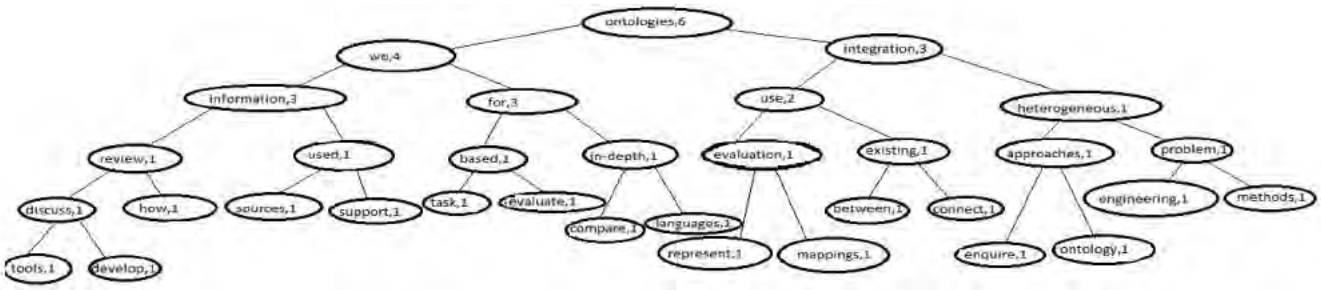
The edit distance between pair of token/Ontology determines the number of character modifications (additions, deletions, insertions) that one has to perform on one string to convert it to the second string. The n-grams of the two element name strings are compared. An n-gram is a substring of length n and the similarity is higher if the two strings have more n-grams in common.

Step 3: Concept Heap Merging/Integration: next step to integrate the various heaps-for integration/ merging, firstly algorithm decides the dominating heap from the participatingheaps. The heap with highest values of concept frequency become the dominating among the pair of heaps and will play as the basis for the integration process, other participating heaps are merged into the dominating heap during the integration/ merging process. Integration of the merged nodes position heaps base on the edit distance of n-gram matching value between pair of ontologies from pair different heaps, eg. Oii of Hi is integrated with Ojk of Hj, which has highest edit distance or highest n grams matching values. The resultant heap will retain both Ontology in the node and position of the node is determined on basis of best position among participated ontologies (Oii, Ojk). The integration results into creation of merged node and best position for newly created will be based on highest values of frequency among participating concept.

Example

Input 1: Encapsulation is the mechanism that binds together code and the data it manipulates, and keeps both safe from outside interference and misuse. One way to think about encapsulation is as a protective wrapper that prevents the code and data from being arbitrarily accessed by other code defined outside the wrapper. Access to the code and data inside the wrapper is tightly controlled through a well-defined interface. To relate this to the real world, consider the automatic transmission on an automobile. It encapsulates





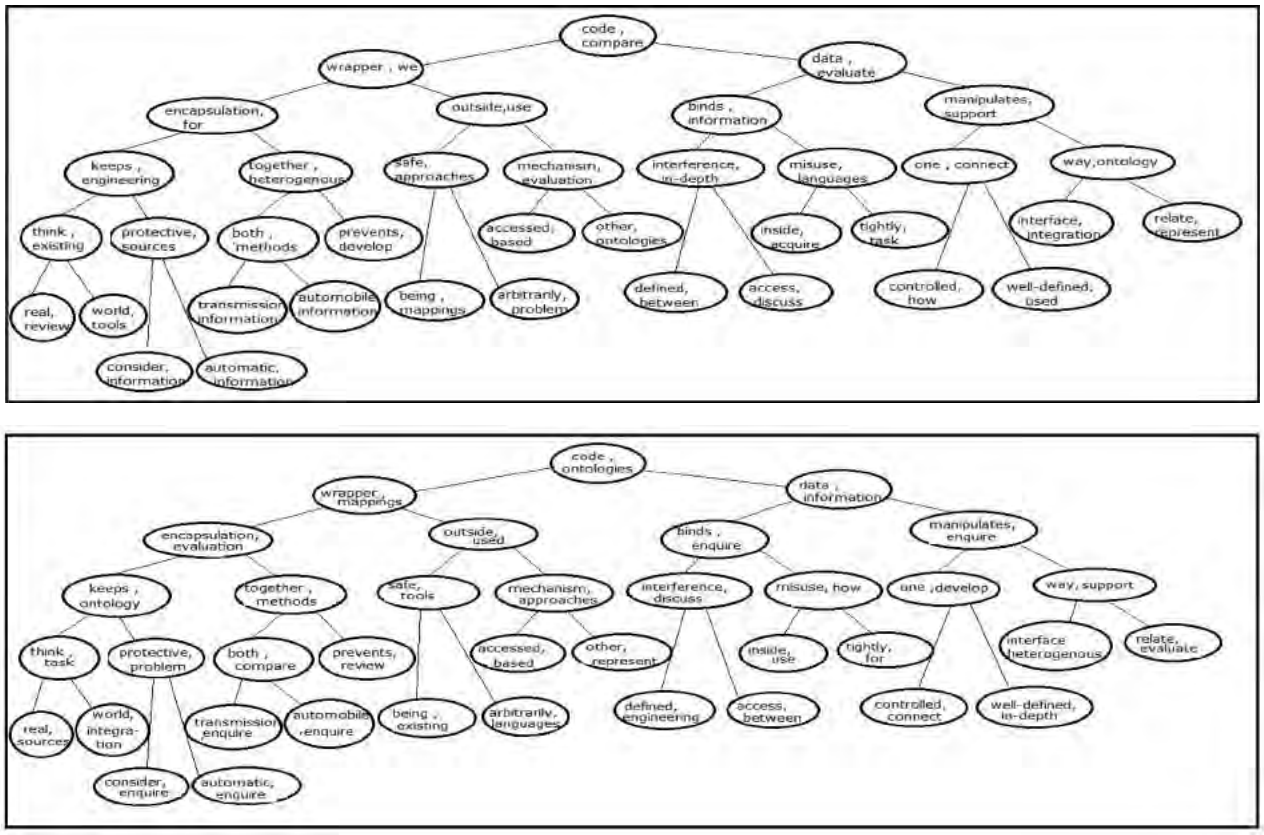


Figure 4. Integrated/merged concept of input 1 and input 2 using (a) edit distance technique (b) n grams technique.

hundreds of bits of information about your engine, such as how much you are accelerating, the pitch of the surface you are on , and the position of the shift lever .

Input 2: We review the use on ontologies for the integration of heterogeneous information sources. Based on an in-depth evaluation of existing approaches to this problem we discuss how ontologies are used to support the integration task. We evaluate and compare the languages used to represent the ontologies and the use of mappings between ontologies as well as to connect ontologies with information sources. We also enquire into ontology engineering methods and tools used to develop ontologies for information integration.

2.3 Algorithm

Input: input documents/input text

Output: Integrated/ merged single concept heap

Step1: Ontology identification after scanning each of the input documents

Collect Input documents/text (Di) where i=1, 2, 3….n;

For each input Di;

Extract Word (EWi) = Di; // apply extract word process for all documents i=1, 2, 3…n in and extract words//

For each EWi;

Stop Word (SWi) =EWi; // apply Stop word elimination to remove all stop words like is, am, to, as, etc. //

Stemming (Si) = SWi; // It create stems of each word, like use is the stem of user, using, usage etc. //

For each Si;

Freq_Count (WCi)= Si; // for the total no. of occurrences of each Stem Si. //

Return (Si, WCi);

Step2: Construct Max Heap for each of input documents for each (Di, Si, WCi); where i =1, 2, 3….n;

Construct_HEAPi (Hi)= (Si, WCi);

Step 3: Evaluate Match value for each (Di, Sj, WCj); where i j=1, 2, 3….n;

Using edit distance

EDistance_array [i][j]= (Hi, Hj); //2-Dimensional array of edit distance between pairs of ontologies//

Using n-grams

ngram_array [i][j]= (Hi, Hj); //2-Dimensional array of ngram between pairs of ontologies//

Step 4: Ontology integration for each

Based on edit distance match values

Merge_Heap(Hi ,Hj)

{

Search_max_edistance (EDistance_array[i][j]); for each i,j=1,2, 3…n

Merged_Onto_node= = (pair_of_max_edistance_ Ontology),

Merged_node_Postion = = Max(Oi (WCi), Qj(WCj))// highest values ofOntology frequency will be the position of merged node//

}

Based on n-grams match values

Merge_Heap(Hi ,Hj)

{

Search_max_ngram (ngram_array[j][j]); for each i,j=1,2, 3…n

Merged_Onto_node= = (pair_of_max_ngrams_ Ontology),

Merged_node_Postion = = Max(Oi (WCi), Qj(WCj)) // highest values of Ontologyfrequency will be the position of merged node//}.

As shown in example, the pair of ontologies form different document heap, the matching values calculated and integrated trees are formed. In the paper Ontologyintegration based on the edit distance and n-gram values has been done. The performance analysis for both approach are based on the parameters like Precision, Recall, F-measure and efficiency of the approach.Precision, recall and f-measure indicate the quality of matchand quality of integrated Ontology and efficiency parameters represent the execution efficiency to generate and integrate the ontologies form various source ontologies.

Precision is a value in the range[0, 1]; the higher the value, the fewer wrong merging computed[5-11].Precision is determines as the ration of number of correct found alignment/ matching with total number of alignment found. Recall is a value in the range[0, 1]; the higher this value, the smaller the set of correct mappings which are not found. The ratio of number of correct found alignment with total number of alignment. The F-measure is a value in the range[0, 1], which is global measure of matching quality. F-Measure used the mean of precision and recall[11]. The values for F-measure is computed by '2*Precision*Recall' with ratio of 'Precision*Recall'. The comparison graph between three methods, e.g Semantic Similarity based, Edit distance based & N-Gram based integration techniques are shown over the range of different values of Precision, Recall & F-Measure, in figure 5. The graph depicts edit distance based techniques as the winner among three, as integration of concept are having better recall, precision & f-measure values.

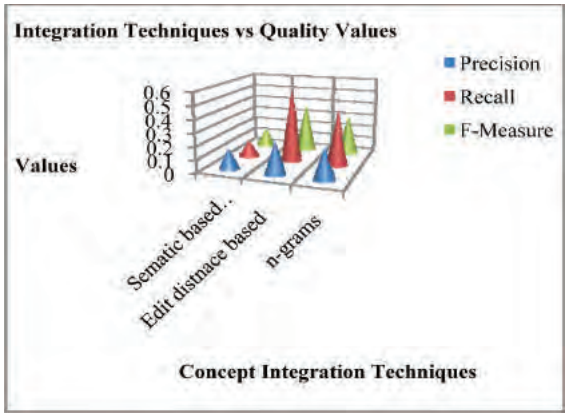


Figure 5. Concept integration technique vs quality values.

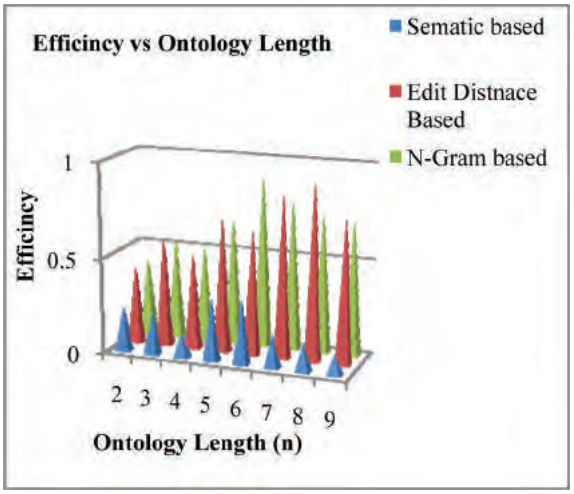


Figure 6. Concept integration technique efficiency vs ontology length.

In Figure 6, effect of ontology length over the overall efficiency of integration techniques are depicted.

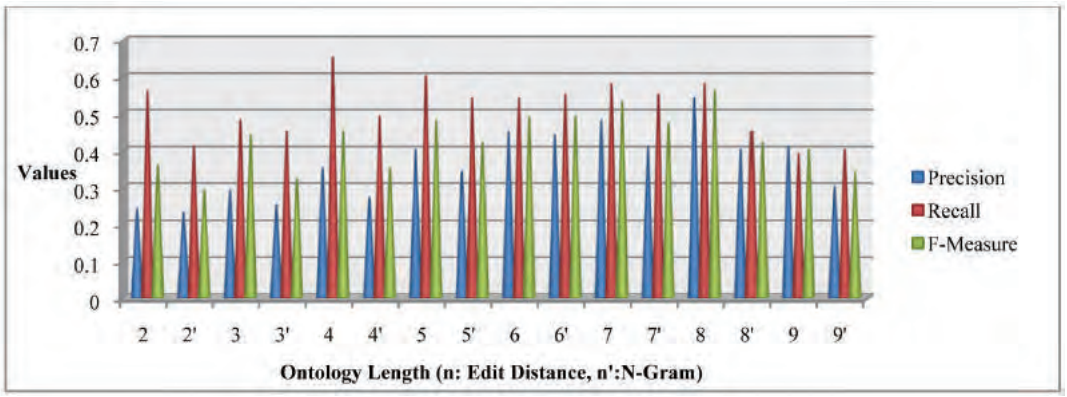


Figure 7. Quality values vs ontology length on edit distance and n-gram technique.

For ontology length 7 and 8, both edit distance and n-gram based integration method are close on their efficiency while semantic similarity based techniques is outperformed by the both techniques. Finally, in Figure 7is for comparative analysis is depicting the performance (quality values delivered) comparison between edit distance techniques & n-gram techniques while integrating ontology length. The comparison is performed under range of ontology length and quality parameters values are kept in the observation. The overall performance of edit distance techniques is consistent and significant performance is delivered on ontology of length 7 or 8 while for n-gram integration techniques the better result delivered for the ontology of length 6 or 5. Few conclusion from the experimental analysis is drawn like, edit distance perform better than n-gram & semanticsimilarity based integration techniques for different size of ontology. The edit distance technique performsbetter andshows potential to carry good values of all quality parameters, which affects the quality of results during processing.

3. CONCLUSION

In the area of data and information science, token/ Ontology is a formal framework for representing domain knowledge. This framework primarily defines the semantics of data element of domain and then identifies the relationship among other. Information/ data integration has a wide range of application through token/Ontology integration. The integration of data and integration of schema have been attracted wide interest of researcher from research area like information retrieval, data mining and warehousing, Query processing, systems engineering, software engineering, biomedical informatics, library science, enterprise bookmarking, schema integration, E-R diagram integration, graph integration (web semantic based graph), etc.

Ontology integration explains the process and the operations for building ontologies from other ontologies in some Ontology development environment. There are various existing techniques for ontology integration, in this paper an approach is proposed for the ontology integration using match values based on the edit distance and n-gram. Edit distance determines match values among pair of concepts based on the changes required in participating concepts, in order to align them. In case of n-gram method, the matches are the count of n-length substrings of participating ontology are matching. Concept integration using both methods are implemented on wide range of input document/ text. The performance comparison is through over the existing method, Semantic similarity based with edit distance and n-grams method is done.

The ontology length has proportional effect on overall efficiency of the techniques, as ontology of length 6 to 8 edit distances outperform all other integration techniques while for smaller length of ontology n-gram and semantic similarity perform better. Few conclusion from the experimental analysis is drawn like, edit distance perform better than n-gram and semantic similarity based integration techniques for different size of ontology. The edit distance technique performs better and shows potential to carry good values of all quality parameters, which affects the quality of results during processing.

निष्कर्ष

आंकड़ा और सूचना विज्ञान क्षेत्र में, टोकन/ऑन्टोलॉजी डोमेन ज्ञान को निरूपित करने के लिए एक औपचारिक संरचना है। यह संरचना मुख्यतया डोमेन के आंकड़ा तत्व के शब्दार्थों को परिभाषित करती है और तत्पश्चात् अन्य के बीच संबंधों की पहचान करती है। सूचना/आंकड़ा एकीकरण टोकन/ऑन्टोलॉजी एकीकरण के माध्यम से अनुप्रयोगों का व्यापक रेंज रखते हैं। आंकड़ों के एकीकरण और ढांचे के एकीकरण ने सूचना पुनर्प्राप्ति, आंकड़ा खनन एवं भंडारण, प्रश्न संसाधन, प्रणाली इंजीनियरिंग, सॉफ्टवेयर इंजीनियरिंग, बायोमेडिकल सूचना विज्ञान, पुस्तकालय विज्ञान, उद्यम बुकमार्किंग, ढांचा एकीकरण, ई–आर आरेख एकीकरण, ग्राफ एकीकरण (वेब शब्दार्थ आधारित ग्राफ) इत्यादि जैसे अनुसंधान क्षेत्रों से अनुसंधानकर्ताओं की व्यापक रूचि को आकर्षित किया है। ऑन्टोलॉजी एकीकरण किसी ऑन्टोलॉजी विकास परिवेश में अन्य ऑन्टोलॉजिस से ऑन्टोलॉजिस को बनाने के लिए प्रक्रिया और प्रचालनों की व्याख्या करता है। ऑन्टोलॉजी एकीकरण के लिए विभिन्न विद्यमान तकनीकें हैं, इस पत्र में एडिट डिस्टेन्स एवं एन–ग्राम पर आधारित तुलन मानों का उपयोग करके ऑन्टोलॉजी एकीकरण के लिए एक तरीके का प्रस्ताव किया गया है। एडिट डिस्टेन्स प्रयुक्त अवधारणाओं में अपेक्षित परिवर्तनों के आधार पर अवधारणाओं के युग्म के मध्य तुलन मानों का निर्धारण करता है ताकि उन्हें संरेखित किया जा सके। एन–ग्राम पद्धति के मामले में, प्रयुक्त ऑन्टोलॉजी के एन–लम्बाई के सबस्ट्रिंग्स की संख्या की तुलना की जाती है। व्यापक रेंज के इनपुट दस्तावेज/पाठ पर दोनों पद्धतियों का उपयोग करके अवधारणा एकीकरण को कार्यान्वित किया जाता है। निष्पादन तुलना विद्यमान पद्धति के माध्यम से होती है, एडिट डिस्टेन्स और एन–ग्राम पद्धति पर आधारित शब्दार्थ समानता की जाती है। तकनीकों की समग्र दक्षता पर ऑन्टोलॉजी की लंबाई का आनुपातिक प्रभाव पड़ता है क्योंकि 6 से 8 एडिट डिस्टेन्स की ऑन्टोलॉजी अन्य सभी एकीकरण तकनीकों से बेहतर निष्पादन करती है जबकि कम लंबाई की ऑन्टोलॉजी के लिए एन–ग्राम और शब्दार्थ समानता बेहतर निष्पादन करते हैं। प्रायोगिक विश्लेषण से कुछ निष्कर्ष निकाले गए हैं जैसे, एडिट डिस्टेन्स विभिन्न आकार की ऑन्टोलॉजी के लिए एन–ग्राम और शब्दार्थ समानता आधारित एकीकरण तकनीकों से बेहतर निष्पादन

करता है। एडिट डिस्टेन्स तकनीक बेहतर निष्पादन करती है और सभी गुणवत्ता मानदंडों के अच्छे मान रखने की संभावना दर्शाती है, जो संसाधन के दौरान परिणामों की गुणवत्ता को प्रभावित करते हैं।

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डिज्कस्ट्रा कलन विधि का उपयोग कर वायुवाहित (एयरबोर्न) लिडार के लिए क्षेत्र का अनुकूलन
Terrain Path Optimization for Airborne Lidar using Dijkstra Algorithm

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सारांश

यहां एआरसीजीआईएस सॉफ्टवेयर की मदद से वायुवाहित लिडार तकनीक का उपयोग कर इलाके की मैपिंग की जाती है और हमने किसी भी प्रकार के इलाके से गुजरने (नेविगेट करने) के लिए कृत्रिम बुद्धिमान प्रणाली के आधार पर सबसे उपयुक्त मार्ग डिज्कस्ट्रा लाइट प्राप्त करने के लिए पथ का अनुकूलन भी किया है। शोधपत्र में दी गई अवधारणा का उपयोग कर न्यूनतम बाधाओं के साथ एक सबसे छोटा और साफ मार्ग प्राप्त किया गया है। हमने यह निष्कर्ष निकाला है कि अनुकूलित डिज्कस्ट्रा एल्गोरिथ्मएक विशेष लिडार के संचालन के लिए प्रभावी मार्ग देता है।

ABSTRACT

Terrain mapping using airborne Lidar technique with the help of software ArcGIS is done here and also we have done path optimization to obtain 'best-fit path' DIJKSTRA lite based on artificial intelligent system to navigate through any type of terrain. A shortest and clear path with least number of hurdles has been obtained using this concept. It has been concluded that optimized Dijkstra algorithm gives effective path for a particular Lidar operation.

Keywords: Arcview, ArcGIS, D-star lite technique

1. INTRODUCTION

Light detection and ranging (LIDAR) is a new technological tool in which an active remote sensing technology designed to take advantage of the unique properties of laser that measures distance with reflected laser light. It was first developed in 1960 by Hughes Aircraft Inc. Lidar is typically used in very accurate mapping of topography with the help of modern computer and DGPS. A Lidar[1] system consist of a laser scanning system, global positioning system (GPS), and an inertial measuring unit (IMU).

Airborne[2] Lidar works by emitting billions of laser pulses from an aircraft. The bounce-back pulses are carefully measured with sensors. The laser pulses are refracted by the top of trees, giving the detailed information of forest cover. Some treetops are porous due to which some pulses penetrate deep into the forest cover while some pulses reach the ground and are reflected back from terrain surface. The accurate three-dimensional map of forest canopy and ground is being produced.

In this present work, we have focused on path planning for artificial intelligence in an unknown environment using the present algorithms. The proposed algorithm allows artificial intelligence like robot [4] to move through static hurdles, and reaching the destination without any collision. These algorithms provides the robot all the possible ways to reach from starting position to final destination position. The path finding strategy designed in a proposed algorithm is

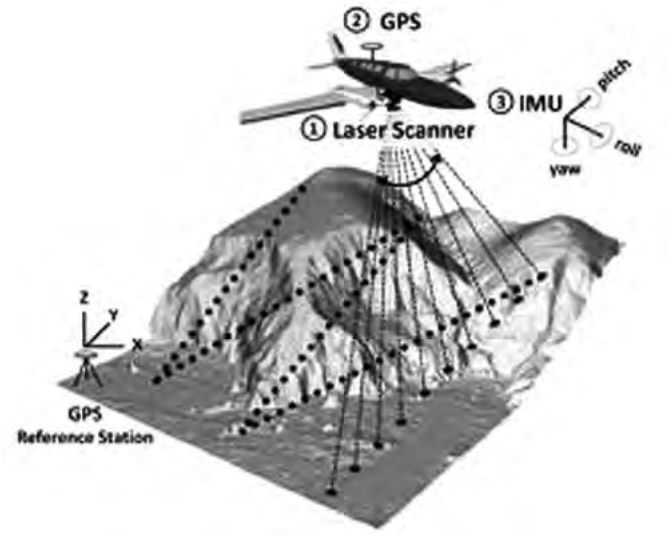

Figure 1. Working of lidar.

in a grid-map form of an unknown environment with unknown hurdles. The robot moves in that unknown environment by sensing and avoiding the obstacles coming in its way to reach its final position. The main motive of the research is to find an optimal or feasible path without any collision and to minimize the cost by reducing time, energy and distance. The proposed algorithm should make the robot able to achieve the given task, i.e., avoid obstacles and to reach its destination (target). The DIJKSTRA algorithm[5] is implemented here, whereby the environment is studied in a two-dimensional coordinate system.

2. PATH ANALYSIS OF CIVILISED AREA

The area selected for terrain analysis and path optimization, is a civilized area of Chamoli district, Uttarakhand, India, and there are roads and other constructions already done, with path for road work as shown in Fig. 2.

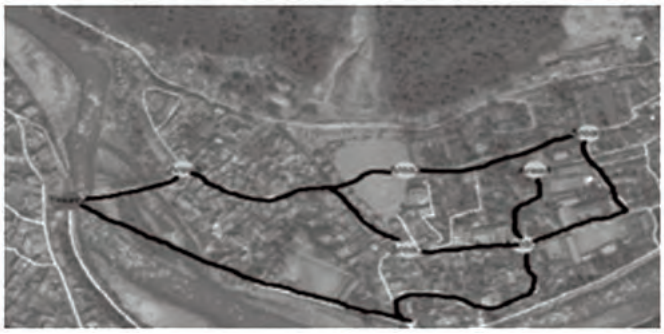

Figure 2. Aerial view of Chamoli district, Uttarakhand, India

2. USING DIJKSTRA'S ALGORITHM

Using the network demonstration of civilised area of Uttarakhand as shown in Fig. 3, we wish to find shortest path between sources (represented by S) to destination (represented by D) using Dijkstra's algorithm. Node source is designated as current node. We set cost (Source) =0 which indicates that we have found a path from s to s of total weight 0(the path with no edges). For any other vertex v we set distance (v) =infinite since we haven't even verified that an S-v path exists.

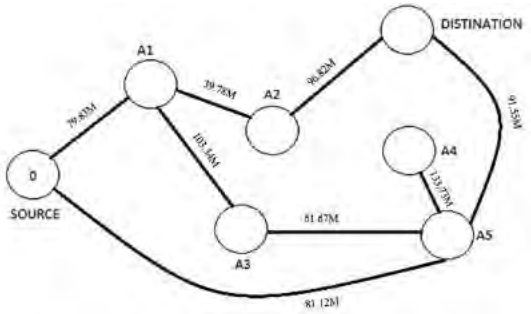

Figure 3. Network demonstration of civilised area of Uttarakhand.

The smallest cost in cost (source) =0, we remove source from Q.

We examine the edge that leave source. The edge Source to A1 gives us a path cost 79.83m from S to A1 so we change cost (A1) =79.83m. Likewise, we change cost (A5) =81.12m. The smallest value of distance is 79.83m, which happens at A1, so we follow source to A1 path. Thus darkening SA1 edge in Fig. 4.

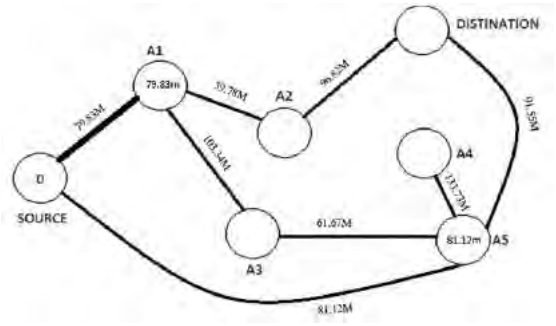

Figure 4. Darkening edge Source to A1.

The edge A1A2 has weight 39.78m, tells us we can get from S to A2 for a cost of Cost(A1) + distance between(A1A2) = 79.83+39.78 = 119.61 which is less than infinite so change the cost(A2) = 119.61m.

The edge A1A3 has weight 103.34m and the edge A3A5 has weight 61.67m, this tells that cost(A5) through A1 and A3 is Cost (A1) + distance between (A1A3) + distance between (A3A5) = 79.83+103.38+61.67 = 244.88m, which is more than 81.12m. The smallest distance is 81.12m, so edge SA5 is darken in Fig. 5.

Now we examine the distance from source to destination through A1, A2 and A5. The minimum occur through A5. Thus following that path.

The darken edges in Fig 6 gives the route from source to destination i.e. from S to D with the cost of 172.67m. The path is Sources(S) > A5 > Destination (D).

Graph of path analysis of civilized area using Dijkstra algorithm.

3. USING OPTIMIZED DIJKSTRA'S ALGORITHM

Let us now study what can happen to a packet as it travels from its source (Initials) to its destination

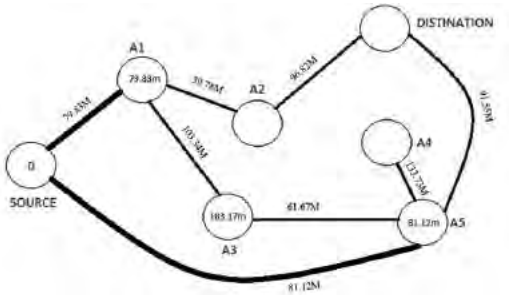

Figure 5. Darkening edge source to A5.

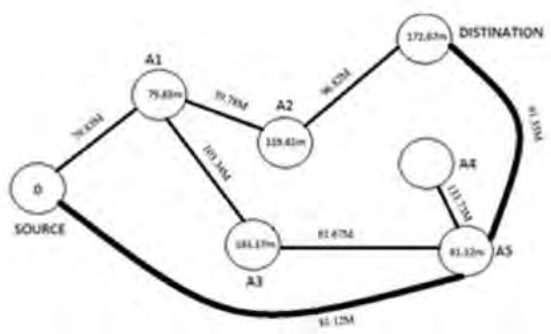

Figure 6. Final path using Dijkstra algorithm.

(Target) using optimized Dijkstra algorithm[7]. The packet travels through the series of routers and host. A packet starts in a host (the source), passes through a series of routers, and ends its journey in another host (the destination). As a packet travels from one node to the subsequent node i.e. from host to router and router to host, along this path, the packet suffers from several different types of delays[6] at each node along the path.

Delay Components

1. *Processing delay (dproc)*: integrity checking, routing, etc.
2. *Queuing delay (dqueue)*: Waiting in output buffer prior to transmission. Variable.
3. *Transmission delay (dtrans)*: Getting the entire packet out the door. Let packet contain L bits and link transmission rate be R b/s. Transmission delay is then L/R.
4. *Propagation delay (dprop)*: Time for one bit to traverse the medium between two switches.

dnodal = dproc + dqueue + dtrans + dprop

dqueue = dtrans * lqueue, where lqueue is length of queue.

Now the same network demonstration of civilised area of Uttarakhand after adding delay components as shown in Fig 8, is taken so that a comparison

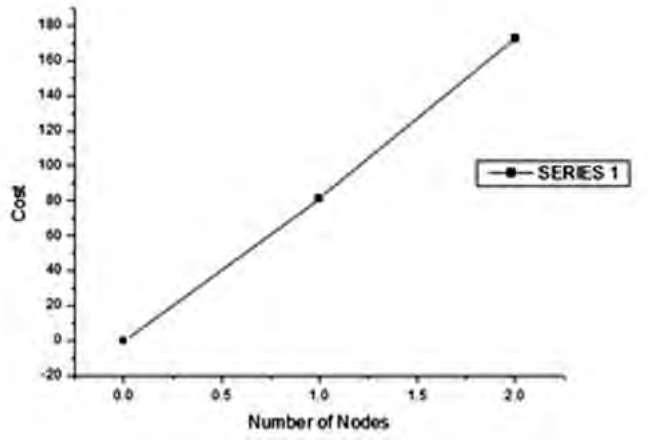

Figure 7. Plot between Cost Vs No. of nodes using Dijkstra algorithm.

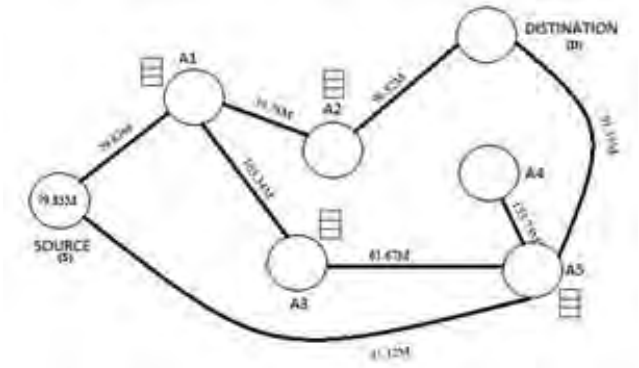

Figure 8. Network demonstration of civilised area of Uttarakhand after adding delay components.

can be made. But here queue length at each router is also specified. So as to calculate dqueue delay of each router.

Here, L = 7.5 Mbits; R = 1.5 Mbps; dtrans = L/R = 5 s

We examine the edges that leave S. The edge SA1 has cost 79.83 from S to A1, the queue length is 3 so we change cost (A1) = cost(S) + dprop + dqueue + dtrans = 79.83 + 79.83 + 3 * 5 + 5 = 179.66. Thus cost (A1) will change to 179.66. Likewise, we change cost (A5) from infinite to the smaller value 180.95. The smallest cost is 179.66, which is of A1 so follow S to A1 path. Thus darkening SA1 edge in Fig. 9.

Examine neighbor of A1: The edge A1A2 has weight 39.78, so the cost of A2 is cost (A1) + dnodal = 179.66+39.78 + 3 * 5 + 5 = 239.44. Change cost (A2) to 239.44. Likewise there is an edge from A1 to A3 and A3 to A5, so calculating the cost of A3 is cost (A1) + dnodal = 179.66+103.34 + 3 * 5 + 5 = 303. Change cost (A3) to 303 and calculating the cost of A5 is cost (A3) + dnodal = 303+61.67 + 3 * 5 + 5 = 384.67. Compare it with cost (A5) earlier which was 180.95, it is more than that so no change in it. The smallest cost is of 180.95, which is of A5. Thus darkening SA5 edge in Fig. 10.

Now we examine the distance from source to destination through Sources(S) > A5 > Destination

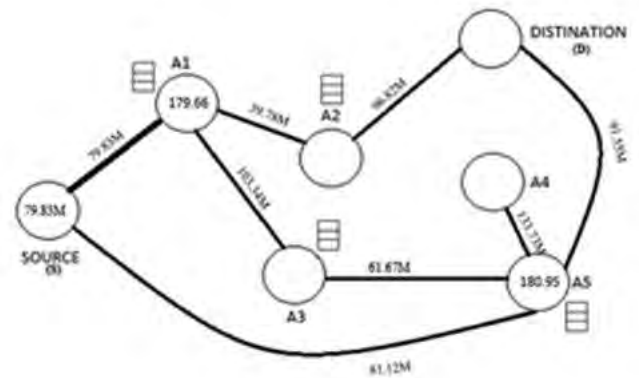

Figure 9. Darkening edge Source(S) to A1.

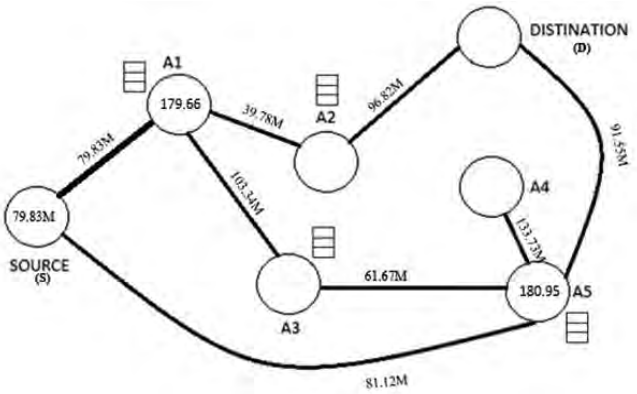

Figure 10. Darkening edge source(S) to A5.

(D) and Sources(S) > A1 > A2 > Destination (D).

Cost (D) through A1 and A2 is cost (A2) + dnodal = 239.44+96.82 + 3 * 5 + 5 = 356.26m.

Likewise, Cost (D) through A5 is cost (A5) + dnodal = 180.95+91.55 + 3 * 5 + 5 = 292.5m.

Compare it with cost (D) earlier which was 356.26m, it is more than that so no change in it. The smallest cost is of 292.5m. The minimum occur through A5. The darken edges in Fig. 11 gives the route from source to destination i.e. from S to D with the cost of 292.5 mm. The path is Sources(S) > A5 > Destination (D) as shown in Fig. 12.

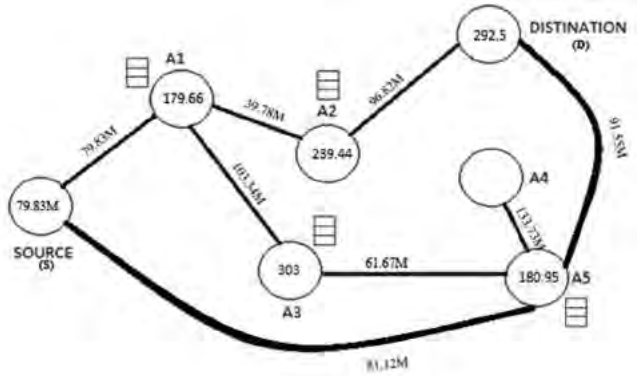

Figure 11. Final path using optimized Dijkstra algorithm.

Figure 12. Final optimized path of civilised area of Uttarakhand using optimised dijkstra algorithm.

5. COMPARISON BETWEEN DIJKSTRA'S ALGORITHM AND OPTIMIZED ALGORITHM

The optimization is based on nodal processing delay. Network implement complex protocol processing on routers which leads to significant increase in delay. Thus, one has to consider these delays for computing the optimized solution. By reducing the number of hops between the paths followed from source to destination the total amount of network resources are also reduced. As shown in Fig 13.

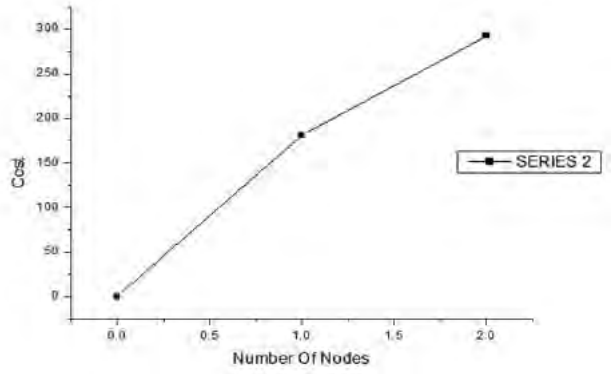

Figure 13. Plot between Cost Vs No. of nodes using optimized Dijkstra algorithm.

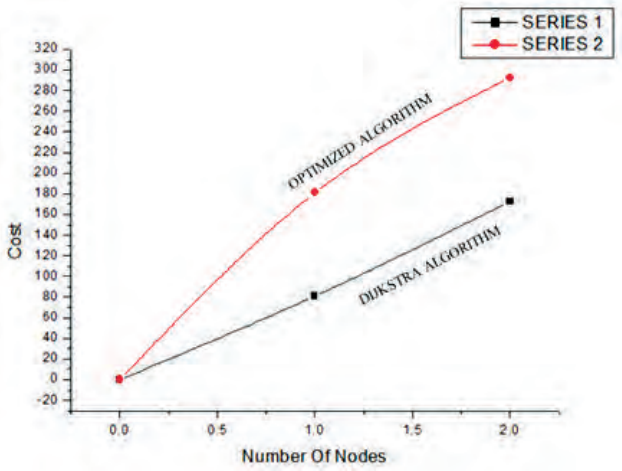

Figure 14. Plot between Dijkstra algorithm and Optimized Dijkstra algorithm.

6. CONCLUSION

The area selected for terrain analysis and path optimization, is civilized area of Chamoli district, Uttarakhand, India, and there are roads and other construction already done, with path for road work. The work has been done to analyze the path by our approach and then compared with the already mapped area by superimposing the derived path with the former geographic results. The path is successfully obtained and is also overlapping with the roads already constructed in the selected city.

निष्कर्ष

इलाके के विश्लेषण और पथ अनुकूलन के लिए चयनित क्षेत्र, भारत के उत्तराखंड के चमोली जिले का सभ्य क्षेत्र है और सड़क कार्य के लिए वहां पहले से ही सड़कों और अन्य निर्माण के कार्य को पूरा कर लिया गया है। यह काम मार्ग के हमारे तरीके से विश्लेषण करने और पहले से बनाए गए नक्शे के क्षेत्र के भौगोलिक परिणामों के साथ निकाले गए मार्ग के मिलान के साथ तुलना करने के लिए किया गया है। मार्ग सफलतापूर्वक प्राप्त किया गया है और यह चयनित शहर में पहले से निर्मित सड़कों के साथ अतिव्यापी है।

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मॉड्यूलर निर्देशयोग्य पदार्थ के आधार पर इंटेलिजेंट मिसाइल प्रणाली : क्यूबटोमिक मिसाइल प्रणाली
Intelligent Missile System Based on Modular Programmable Matter: Cubcatomic Missile System

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सारांश

आज पूरा विश्व काम की क्षमता बढ़ाने के लिए नैनो स्केल की तरफ अग्रसर हो रहा है। यह प्रोजेक्ट रोबोटिक्स, इंटेलिजेंट मिसाइल और नैनो विज्ञान के क्षेत्र में एक क्रांतिकारी विचार है। हम ये कह सकते है कि मिसाइल या मशीन अपने हिस्सो के सही व्यवस्थित व्यवस्था से बने है। मशीन का कोई भी हिस्सा किसी और मशीन की विशेषता को धारण नहीं करता हैं। यह इससे स्वतंत्र है। पाट्र्स परमाणुओं की व्यवस्था से बने होते हैंए लेकिन वे अनियमित प्रवर्ती के हो सकते हैं। यही इस मशीन और मशीन तत्वों के बीच में मुख्य अंतर है। ऐसी प्रणाली की कल्पना करो जिसमे पाट्र्स का हर तत्व एक छोटा सा रोबोट है जिसको किसी भी अन्य रोबोट से बदल सकते है। अब हम रोबोट के गुच्छों को एक जगह इकट्ठा करते ह और किसी विशेष मशीन के लिए प्रोग्राम को चलते हैए फिर रोबोट ऐसी व्यवस्था करेंगे कि मशीन के भागों का गठन होगा और अंत में मशीन बनेगी। इस प्रणाली में हर प्राथमिक रोबोट मदर मषीन की विशेषता अधिग्रण करेगा। रोबोटिक नैनोक्यूब द्वारा इकट्ठी की गई छोटी छोटी इकाइयों से मिसाइल बनाये जा सकते है, जो कि प्रोग्राम के आधार पर किसी भी आकार के गठन के लिए सक्षम हैं इन रोबोट मिसाइल/मशीन की व्यवस्था के द्वारा किसी भी बाधा को पार कर सकते हैं मिसाइल/मशीन दोषपूर्ण रोबोट के उन्मूलन के बाद पुनर्निर्माण के कारण कुछ प्राथमिक रोबोट की हानि के साथ काम कर सकते हैं।

ABSTRACT

Today's world is leading towards nanoscale to increase efficiency of work. This project is revolutionary idea in field of robotics, intelligent missiles and nanoscience. We can say that missile or machine is made up of a systematic arrangement of its parts. Part of any machine does not possess property of mother machine. It is independent of it. Parts are made up of arrangement of atoms, but they can be random in nature. This is the main difference between machine and machine elements. Imagine system in which every element of part is a small robot which can be replaced by any other robot. Now we gather a bunch of robots in a jar and run the program of particular machine, then robots will arrange themselves such that machine parts are formed and finally machine is formed. In this system every elementary robot will posses property of mother machine. Missile can be made up of small units assembled by robotic nanocubes who are capable of forming any shape depending on program operated to system. By arrangement of these robots missile/machine can penetrate any barrier. Missile/Machine can work with loss of some elementary robots due to rearrangement after elimination of faulty robots.

Keywords: Programmable matter, modular robotics, cubcatoms, catoms, claytronics, electromagnetism, missile, intelligent missile system

1. INTRODUCTION

In recent years technologyis leading towards automation and advanced robotics. Universities like CMU, Cornell, MIT, Harward are working with Intel on the project called Claytronics[1] in Claytronics, smallest individual, particle(robot) is called as catom(Claytronics atom).these catoms can interact with each other to form a 3-D object that user can interact with.

2. CURRENT RESEARCH

In today's design, robots are able to move towards or away from each other in 2D space. Due to this, it is impossible for some designer, to design whole machine in 2-D. Currently CMU made a cylindrical catom which moves using 24 electromagnets by engaging and disengaging with other[3,4]. Still they achieved movement in 3-D space with respect to each other .In future catoms will move in 3-D space to assemble themselves into a machine.

We made a model of catoms which can move in 3-D space to achieve any desired shape. Our catom is cubical in shape so we call it as Cubcatom (cubical Claytronics atom)[1]. Cubcatom is the basic elementary particle from which 3-D machine can be

Figure 1. Cubcatoms.

formed. Cubcatomic system is operated by advanced algorithm created for communication of cubes among themselves. By communicating with each other these can form desired shapes with desired cubes. It is a form of modular robotics (basic element).

2.1 Cubcatoms

1. 6 faces and 12 edges
2. Every face contains 4 metal plate with electromagnet in it
3. Metal plate is connected to a brushless stepper motor from which we can topple the cube from one face to another.
4. At every edge we connect motors from which plates can be rotated.
5. When two cubes come closer to each other electromagnets are activated such that these can attach to each other.
6. Cube can climb another cube by activating motor attached to connected plate.

3. INDENTATION AND EQUATION

Magnetic field created by electromagnets on plates, B= μNI Condition for toppling of cube: centre of mass of cube must be tilted more than 45 degree with respect to fixed edge of cube.

Electromagnetism: It is found that whenever a current carrying conductor is placed in a magnetic field ,it experience a force which acts in a direction perpendicular to both the direction of the current and the field.

Working: smallest element of this system is cubical robot. This moves in 3-D using two way transmissions.

A. Mechanical movement
B. Electromagnetic movement

By assembling multiple robots we can form parts of a machine. The elementary robot is cubical containing 6 faces. Each face contains 4 plates with motor connected to each of these, centre of each plate contains strong electromagnet[1].

A. Mechanical movement:

1. Whenever cube move independently from system it can use metal plates to create a toppling effect.
2. It moves by activating one of the four plates connected to motor on face Fig.
3. Whenever motor is activated cube starts to topple independent of system
4. Plate is moved till centre of mass rotates more than 45 degrees wrt edge.
5. Due to unbalanced torque cube is toppled.

B. Electromagnetic movement:

1. This movement is ‘movement of cube inside the system.
2. Whenever cube is near to another cube, electromagnet between these will be activated such that plates get connected to each other.
3. After connecting right plates to ther motors connected to these gets activated so that cube can climb or move on other cube to obtain a 3-D figure.
4. By using this movement cube can climb, join, and replace other cube.

4. ALGORITHM

A computer algorithm is made to provide every cube a particular number or name. After that every cube has its own unique identity. That can be used for communication of cubes among themselves. Every cube will contain sensor system which can determine distance between two cubes. Cubes can communicate with each other to form a particular shape depending upon requirement.

This algorithm works whenever reconstruction is required. Communication between cubes can be achieved by self-created wireless communication network.

5. CONCLUSION

This project opens whole new area of R&D in robotics and artificial intelligence. Application of this project:

A. Barrierinvasion:

Robot can pass through any obstacle independent of it’s shape. Missile can be divided into parts to pass through barrier and get assembled again. Missile can be made up of small elementary robots which are formed by assembly of Cubcatoms. Each elementary robot has its own power source as well as computing system. It will have self-flying system and control system. By using this, elementary robots get separated whenever needed. Missile’s every part can be made up of these tiny Cubcatoms.

Whenever it gets counter fired by another antimissile weapon, its algorithm of defence will get activated. Cubes will communicate with each other such that they

form group of elementary flying robots. As antimissile weapon approaches to them they will move to make room for passing of weapon through system. Any kind of weapon will not be locked on system since system does not have centre point to get locked. Any part of system will not get effected due to this system.

For example, we can see the group of fish attacked by shark. Group moves in such a way that shark is unable to target a particular fish.

B. Missile used as anti-weapon system:

Missile can be fired on incoming missile weapons to deviate from their path or to hack them. Whenever nuclear/chemical/hydrogen weapons approach to city we just can't blow it up with antimissile weapons. That might lead to explosion of matter inside it. So to prevent that we need a system to deviate weapons from their tracks. This weapon system will be fired such that its deviation algorithm gets activated. Missile will follow the incoming missile and when it approaches near it, Cubcatoms will move from their positions such that these capture missile inside the whole system. After this by activating power source missile can be deviated from its path or destroyed at safe position.

C. Other applications of this system:

- For making infrastructure in space: bunch of robots can be carried to space with aerodynamic shape from earth to transform their shape into desired shape. e.g. space station, satellite.
- Can be used in medical robotics for operation or diagnosis purpose.
- Used in surveillance purpose defence robotics. Big robot can be crawled in into any small place.

Machine is practically never going to fail due to failure of any part as every part is made up of same replaceable elementary cubes. If any part is damaged, then it can be replaced by other cubes.

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निष्कर्ष

इस परियोजना ने रोबोटिक्स और आर्टिफ़िश्यल इंटेलिजेंस में अनुसंधान एवं विकास के क्षेत्र खोल दिये हैं। इस परियोजना के अनुप्रयोगः

क) बैरियर आक्रमणः

रोबोट किसी भी बाधा को स्वतंत्र रूप से बिना उसके आकार पर आश्रित हुये पारित कर सकते हैं। बाधा के माध्यम को पारित करने और फिर से इकट्ठा करने के लिए मिसाइल को भागो मे बांटा जाता हैं। मिसा. इल छोटे प्राथमिक रोबोट से बना सकते हैं, जो कुब्क एटम्स द्वारा गठित होते हैं। प्रत्येक प्राथमिक रोबोट के पास अपनी खुद की शक्ति के स्त्रोत साथ ही साथ कंप्यूटिंग प्रणाली होती हैं। यह आत्म उड़ान प्रणाली और नियंत्रण प्रणाली होगा। इसके प्रयोग से, प्राथमिक रोबोट जरूरत पड़ने पर अलग हो जाते हैं। मिसाइल का प्रत्येक छोटा हिस्सा भी इन्ही कुब्क एटम्स से बना हैं ।

जब भी किसी एंटीमिसाइल हथियार से इसे काउंटर फायर करते तो रक्षा के इसका एल्गोरिथ्म सक्रिय हो जाएगा। क्यूब्स एक दूसरे के साथ इस तरह से बातचीत करेंगे कि वे प्राथमिक उड़ान रोबो. टों के समूह को बनाते है। जैसे ही एंटी–मिसाइल हथियार उन तक पहुँचती है वैसे ही वे इस प्रणाली के माध्यम से हथियार के गुजरने के लिए जगह बनाएँगे। जब तक सिस्टम का केंद्र बिंदु लॉक न हो तब तक किसी भी तरह का हथियार प्रणाली को बंद नहीं कर पाएगा। इस प्रणाली की बजह से प्रणाली का कोई भी भाग प्रभावित नहीं होगा।

इस बात के उदाहरण के लिए, हम देख सकते हैं कि शार्क ने मछली के समूह पर हमला किया हो। मछली का समूह इस तरह से चलता है कि शार्क एक विशेष मछली को लक्षित करने में असमर्थ हो।

ख) मिसाइल का हथियार–रोधी प्रणाली के रूप में इस्तेमालः

मिसाइल को आने वाली मिसाइल हथियारों को अपने पथ से विचलित करने के लिए या उन्हें हैक करने के लिए छोड़ा जा सकता है। जब भी कभी परमाणु/रासायनिक/हाइड्रोजन हथियार शहर की तरफ आते हैं तो उनको हम एंटि मिसाइल के साथ सिर्फ ऐसे ही हवा में नहीं छोड़ सकते। यह भी हो सकता है जो इससे कोई विस्फोट हो जाये। ऐसा न हो इसलिए इसे रोकने के लिए ऐसी प्रणाली की जरूरत है जो इन हथियारों को उनके पथ से हटा दे। इस हथियार प्रणाली को इस तरह से फायर किया जाए कि इसका विचलन एल्गोरिथ्म सक्रिय हो जाए। मिसाइल आने वाली मिसाल का पीछा करेगी और जैसी ही उसके पास पहुँचेगी, क्यूबटम अपनी स्थिति से हटकर पूरे सिस्टम के अंदर जाकर मिसाइल पर कब्जा कर लेंगे। इसके बाद शक्ति स्त्रोत सक्रिय कर, मिसाइल को उसके लक्ष्य से अलग कर सकते हैं या किसी सुरक्षित स्थान पर जाकर नष्ट कर सकते हैं।

ग) इस प्रणाली के अन्य अनुप्रयोगः

- अंतरिक्ष में बुनियादी ढांचे बनाने के लिएः ऐरो–डायनामिक आकार के साथ रोबोट के गुच्छों को उनके आकार को वांछित आकार में बदलने के लिए पृथ्वी से अंतरिक्ष मे ले जा सकते हैं। जैसे अंतरिक्ष स्टेशन, उपग्रह।
- ऑपरेशन या निदान के उद्देश्य के लिए चिकित्सा रोबोटिक्स में प्रयोग किया जा सकता है।
- रक्षा रोबोटिक्स में निगरानी उद्देश्य में इस्तेमाल किया गया है।
- बिग रोबोट किसी भी छोटी सी जगह में रेंग सकते हैं।

मशीन व्यावहारिक रूप से कभी किसी भी भाग के विफल होने से असफल नहीं हो सकती क्योंकि हर एक हिस्सा प्रतिस्थापन

योग्य प्राथमिक क्यूब्स से बना है। अगर कोई भाग नष्ट हो भी गया तो उसे अन्य क्यूब्स से प्रतिस्थापन किया जा सकता है।

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स्पाशियल डेटाबेस के लिए अस्पष्ट ऑब्जेक्ट ओरिएंटिड वैचारिक मॉडलिंग का नया दृष्टिकोण
A New Approach of Fuzzy Object Oriented Conceptual Modelling for Spatial Databases

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सारांश

अस्पष्ट तकनीक बड़े पैमाने पर असंक्षिप्त और अनिश्चित आंकड़ों को स्पष्टता से वर्णन करने और बदलने के लिए विभिन्न डेटाबेस मॉडल के लिए लागू की गयी है। ऑब्जेक्ट ओरिएंटिड डेटाबेस मॉडलिंग का फज्जी विस्तार, अस्पष्ट ऑब्जेक्ट डेटाबेस (एफओओडी) मॉडलिंग कहा जाता है, जो जटिल वस्तुओं और डेटा अशुद्धता को संभालने में सक्षम है। इस आलेख में, ऑब्जेक्ट ओरिएंटिड विचार के साथ इसे वर्णन करने के लिए विभिन्न प्रकार की अस्पष्टता को, भाव स्तर पर, ऑब्जेक्ट और क्लास के बीच, सब–क्लास और सुपर क्लास के बीच इत्यादि अस्पष्टता सहित शामिल किया और खोजा गया है। इसके अलावा, हमने आईएफ2ओ और अस्पष्ट ईईआर डेटा मॉडलिंग तकनीकों को शामिल किया है और प्रदर्शन विश्लेषण और दक्षता का तुलनात्मक अध्ययन किया गया है।

ABSTRACT

Fuzzy techniques have been extensively applied to various database models to explicitly represent and manipulate the imprecise and uncertain data precisely. The fuzzy extension of the object oriented database modeling, called Fuzzy Object Oriented Database (FOOD) Modeling is capable to handle complex objects as well as data inexactness. In this paper, multiple types of fuzziness have been introduced and investigated, including fuzziness at attribute level, between object and class, between sub class and super class etc to describe it with the concepts of object orientation. Also we have introduced IF2O and fuzzy EER data modeling techniques and a comparison for performance analysis and efficiency has been carried out.

Keywords: Fuzzy object oriented database (FOODB), IF2O model, EER model, aggregation, specialisation, generalisation, inheritance, UFO model

1. INTRODUCTION

Classical database models often suffers from their incapability to represent and manipulate imprecise and uncertain data that may be found in many real world and engineering applications. Since early 1980's, Zadeh's Fuzzy Logic[1] has been introduced to extend various classical data models to make these capable of handling information in exactness . Rapid advances in computing power have brought opportunities for databases in emerging applications, like CAD/CAM, multimedia, GIS applications, and spatial database. These applications characteristically require the modelling and manipulation of the complex objects and semantic relationships. Relational databases and their fuzzy extensions are not suitable to deal with complex objects needed for above applications. Such objects can be modelled and represented well using object-oriented modelling techniques.

2. RELATED WORKS

The next generation of the development of data modelling in databases have been concerned with the object oriented modelling and their fuzzy extensions. This section provides the latest review on different approaches regarding modelling and representing the imprecise and uncertain information in fuzzy object oriented databases. Yazici[2] introduced an extended nested relational data model, also known as NF2 data model, for representing and manipulating complex and uncertain data in the database. The extended algebra and extended SQL like query languages were hereby defined. But it is very difficult for NF2 data model to represent complex relationships among objects and attributes. Some advanced and innovative features, like class hierarchy, inheritance, super class/sub-class and encapsulation are not supported by NF2 data model. Therefore, to model complex valued attributes as well as complex relationships among

objects, the research preceded with the development of conceptual data models and object-oriented database models. Regarding modelling imprecise and uncertain information in object-oriented databases, Zicari[3] *et. al*. first introduced incomplete information named null values, where incomplete schema and incomplete objects can be distinguished.

Based on similarity relationship, George[4] et. al. introduced the concept to use the range of attribute values to represent the set of allowed values for an attribute of a given class. Depending on the inclusion of actual attribute values of the given object into the range of the attributes for the class, the membership degree of an object to a class can be calculated. Weak and strong class hierarchies were defined based on monotone increase and decrease of the membership of a sub-class in its super-class. Subsequently, a fuzzy object oriented data model is defined by Bordogna[5] *et. al*. based on the extension of graph based object data model. The notion of strength is expressed by linguistic qualifiers, which can be associated with the instance relationship as well as an object with a class. Fuzzy classes and fuzzy class hierarchies are thus modelled in FOODB.

The definition of graph-based operations to select and browse such a FOODB, that manages both crisp and fuzzy information, is Bordogna, G.[6] A UFO (Uncertainty and Fuzziness in Object Oriented Database) model was proposed by Gyseghen[7] *et.al.* to model fuzziness and uncertainty by means of fuzzy set theory, generalized fuzzy sets, and conjunctive fuzzy sets. Behaviours and structure of the object are incompletely defined result in a gradual nature for the instantiation of the object. Concepts of the partial inheritance and multiple inheritances are permitted in fuzzy hierarchies. A FOODB model was defined by Umano[8] *et. al.* that uses fuzzy attribute values with a certain factor and an SQL type data manipulation language. Based on the possibility theory, Dubois[9] proposed a concept to represent vagueness and uncertainty in class hierarchies, where the fuzzy ranges of the sub class attribute defined restriction on that of the super class attribute and then the degree of inclusion of a sub class in the super class is dependent on the inclusion between the fuzzy ranges of their attributes. Also, using the possibility theory [10], some major notions in the object oriented databases such as objects, classes, object–class relationship, sub-class/super-class, and multiple inheritances is extended under fuzzy information environment. In the subsequent development of the fuzzy object-oriented databases, a consistent framework based on the object data management group (ODMG) object data model have been proposed by Cross[11]. In an object oriented database modelling technique is presented using the concept of 'level – 2 fuzzy set' to deal with a uniform and advantageous representation of both perfect and imperfect real world information[12].

Fuzzy types are added into FOODBs to manage vague structure [13,14]. It is also presented how the typical classes of an FOODB can be used to represent a fuzzy type and how the mechanism of the instantiation and inheritance can be modelled using this kind of new type in OODB. A complex object comparison in a fuzzy context is developed[15]. Fuzzy relationship in object models have also investigated in[16,17]. A fuzzy intelligent architecture based on the uncertain object oriented data model introduced in[18] is proposed. The classes include fuzzy IF-THEN rules to define knowledge and the possibility theory is used for the representation of vagueness and uncertainty.

A simple theoretic model Akiyama Y.[19] has been proposed to understand the fuzzy objects for easier analysis and specification of the integrated computation by refereeing the object oriented approach. An approach is introduced by Lee,[20] *et.al.* for object oriented modeling based on fuzzy logic is proposed to formulate imprecise requirements along with four directions: fuzzy class, fuzzy rules, fuzzy class relationships and fuzzy association between classes. The fuzzy rules, rules with linguistic terms, are used to describe the relationships between attributes. Some special fuzzy object-oriented databases, like fuzzy deductive object oriented database[21,22] and fuzzy and probabilistic object bases[23] have been developed. Also this fuzzy object oriented databases have been applied for different areas such as geographical information system and multimedia systems[24,25].

A prototype of fuzzy object-oriented databases has been implemented using VERSANT and VISUAL C++ [26]. Nested fuzzy SQL queries have been introduced in a fuzzy database[27]. Unnesting techniques to process several types of nested fuzzy queries have been extended. An extended merge join is used to evaluate the unnested fuzzy queries. Recently, a new index structure namely FOOD Index (FI), to deal with different kinds of fuzziness in fuzzy object oriented databases and to support multidimensional indexing have been developed[28].

3. FUZZY CONCEPTUAL SPATIAL DATA MODELLING

The overall objective of the proposed models is to develop spatial temporal conceptual database model. Various kinds of data types and constructs are available for such a modelling.

3.1 Object Oriented Conceptual Database Modelling

The spatial temporal conceptual modelling . These are as follows:

1. *Object*: A real world entity is called object. The

same type objects are grouped and called objects types.

2. *Relationship*: This shows the connectivity (linking) to the different objects having multiple roles. The links with similar features are called relationship type.
3. *Attribute*: This is a real world feature. These features are related to both object types as well as relationship types.
   These attributes are of three types (i). Atomic attributes. (ii). Single valued attributes. (iii). Mandatory attributes.
   Atomic attributes have atomic values. Single valued attributes holds single values at a time. Multiple values may be hold by a multivalve attribute. Some characters (attributes) are mandatory for the existence of attributes as well as Object .
4. *Methods*:- Methods are the basically operations that activities the object types to perform some action. Normally, a method includes the code, return types and method names.
5. *Aggregation*:- To represent the relationship among relationships ,an aggregation method is used. It is considered as an abstraction through which relationships are considered as high level entities
6. *Generalisation/specialisation:* The super-class / sub-class relations among entities are described by generalisation and specialization.
   The generalisation creates a super-class from multi entity types, typically having common features. But multiple sub-classes are defined from entity types.

3.2 Spatial Data Types

As for as the spatial conceptual database modelling in concerned, the data types are point, line, and field region. Point is a data which considers the position only, but no focus on shape, size or other spatial properties. In line data, the length and shape are considered, but area factor is not considered. Often road and river are represented by lines. Field is data which varies continuously from one place to another place. The examples or field data are terrain, pollution cul, soil types, etc. Region data is considered as a geographical object, which focuses on size and shape of interest for example a state or country.

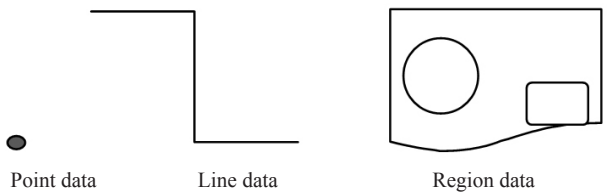

Figure 2. Point, line and region data.

These types of data items are represented by different diagrammatic representation. There are a lot of uncertainties available in geographical data type. Hence, for uncertainty representation fizzy logic has been applied.

3.3 Uncertainty Issues in Spatial Modelling

Different uncertainty issues are as follows:

1. The information about objects may consist of uncertainty. The occurrence of such types uncertainty may include,1. Missing data, 2. Uncertain data 3. Geostatic 4. Multi dimensional uncertainties and many others.
2. The region boundaries are uncertain in its nature. A fuzzy logic approach has been utilized to decide whether a particular region is included in the specified area or not.
3. Another issues of the uncertainty is with the querying of spatial data types, for ex."Find all the large in area A1?".

A proposal has been given to handle all the above uncertainty issues.

1. *Fuzzy integration with various data types:*
   (A) Point data: It is defined by point G. The location of G is represented by the co ordinates (x, y) in the spatial region and represented by G(x, y) where x and y are the latitudes and longitudes respectively.

The fuzzy representation of the above expression would be as follows:

$$G'=G[(x, \mu_G(x))(y, \mu_G(y))].$$

Here, $\mu_G(x)$ and $\mu_G(y)$ are the membership degrees respectively and

$$0\leq \mu_{G'}(x)\leq 1 \text{ and } 0\leq\mu_{G'}(y)\leq 1.$$

$$(x_1, \mu_{G'}(x_1), y_1, \mu_{G'}(y_1))$$

$$(x_2, \mu_{H'}(x_2), y_2, \mu_{H'}(y_2))$$

Figure 3. Fuzzy Line Data.

(B) *Fuzzy line data:* The line data in expressed generally by LINE (G, H)

where $G = G(x_1, y_1)$ and $H = H(x_2, y_2)$

In the fuzzy representation, $G' = G [(x_1, \mu_A(x_1)), (y_1, \mu_A(y_1))]$ and $H' = H [(x_2, \mu_A(x_2)), (y_2, \mu_A(y_2))]$

Now the fuzzy representation of LINE is as follows:

F-LINE = $((G', H'),\mu_L(x))$ where $\mu_L(x)$ is the degree which the inclusion of line in a particular region $0\leq\mu_L(x)\leq 1$

(C) *Fuzzy region data*: A region data is represented by

$R\ (a_1, a_2 \ldots\ldots a_n)$

where $a_1, a_2 \ldots\ldots a_n$ are the points which decides the geographical region associated with these points.

Now for fuzzy representation, all the $a_1, a_2 \ldots\ldots a_n$ are the geographical points represented by

$a'_1 = a_1\ [(x_1, \mu_{a1}(x_1)), (y_1, \mu_{a1}(y_1))]$

$a'_2 = a_2\ [(x_2, \mu_{a2}(x_2)), (y_2, \mu_{a2}(y_2))]$

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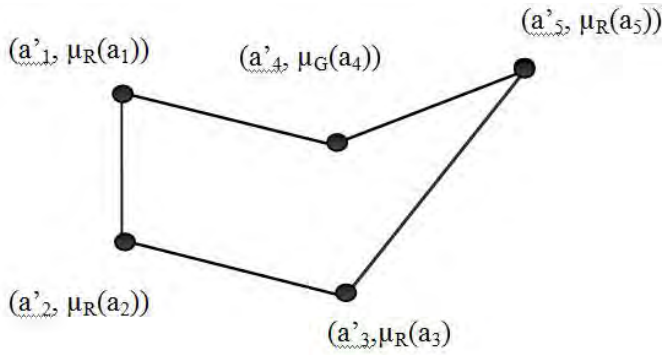
$A'_n = a_n\ [(x_n, \mu_{an}(x_n)), (y_n, \mu_{an}(y_n))]$

Also a conjunction can be defined including multiple regions with fuzzy membership degrees

$R' = (R_1, \mu_R(R_1)), (R_2, \mu_R(R_2)), (R_3, \mu_R(R_3)) \ldots\ldots (R_n, \mu_R(R_n))$

A graphical representation is as follow



where $a'_n = a_n\ [(x_n, \mu_R(x_n)), (y_n, \mu_R(y_n))]$

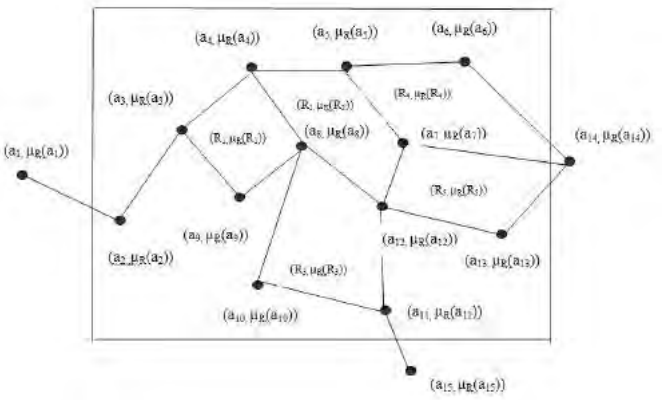


Figure 4. Fuzzy region data.

4. ROUTE IDENTIFICATION MODELLING IN TRAFFIC SYSTEM USING FUZZY CONCEPTUAL SPATIAL DATA MODELLING

This modelling example including three basic steps (i). Identification of region (ii). Identification of roads (Line Data) (iii). Identification of junctions (Point Data).

According to above points, a road network has been represented in Fig. 5.

The selection of route would depend on interest area whether someone wants to go and the distance costs. The area of interest would be varying and it would be shown by the fuzzy membership degree values

The membership degree of above point datas making line data are decide on basics of distance factor.

The route would be identification by these membership degrees. An example of route selection in the above as follows the route identification between a_1 to a_{15}.

These possible routes

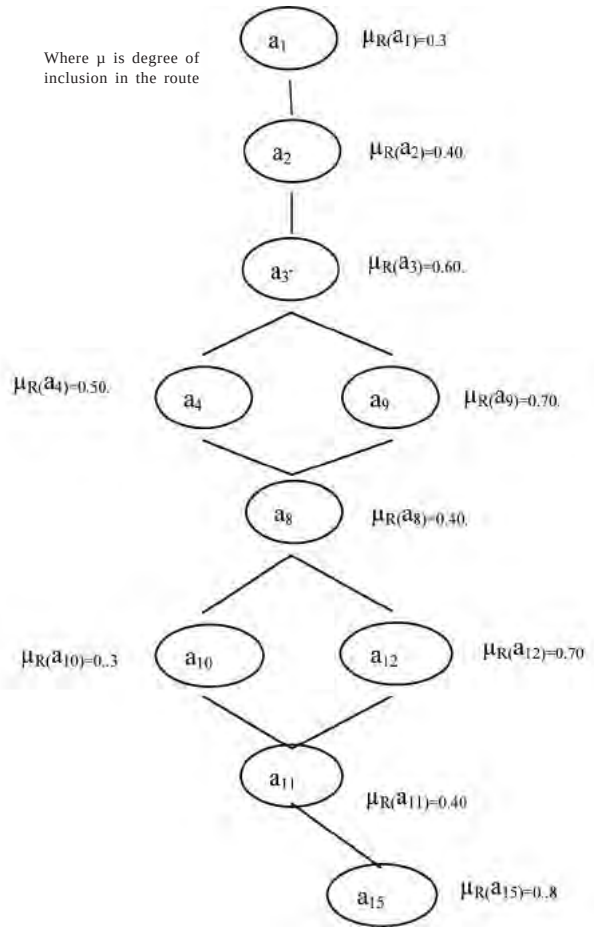
Route1. $\{(a_1,\mu_R(a_1)), (a_2,\mu_R(a_2)), (a_3,\mu_R(a_3)), (a_9,\mu_R(a_9)), (a_8,\mu_R(a)), (a_{12},\mu_R(a_{12})), (a_{11},\mu_R(a_{11})), (a_{15},\mu_R(a_{15}))\}$;

Route 2. $\{(a_1,\mu_R(a_1)), (a_2,\mu_R(a_2)), (a_3,\mu_R(a_3)), (a_4,\mu_R(a_4)), (a_8,\mu_R(a_8)), (a_{12},\mu_R(a_{12})), (a_{11},\mu_R(a_{11})), (a_{15},\mu_R(a_{15}))\}$

Route 3. $\{(a_1,\mu_R(1)), (a_2,\mu_R(a_2)), (a_3,\mu_R(a_3)), (a_9,\mu_R(a_9)), (a_8,\mu_R(a_8)), (a_{10},\mu_R(a_{10})), (a_{11},\mu_R(a_{11})), (a_{15},\mu_R(a_{15}))\}$;

Route 4. $\{(a_1,\mu_R(a_1)), (a_2,\mu_R(a_2)), (a_3,\mu_R(a_3)), (a_4,\mu_R(a_4)), (a_8,\mu_R(a_8)), (a_{10},\mu_R(a_{10})), (a_{11},\mu_R(a_{11})), (a_{15},\mu_R(a_{15}))\}$

Following schematic Diagram including all the four routes above discussed.The solution as follow The identified route is $a_1,a_2,a_3,a_4,a_8,a_9,a_{10},a_{11},a_{12},a_{15}$.



Figigure 5. Schematic diagram.

5. CONCLUSION

Spatial data modelling has lot of in exactness itself. To deal with the inexactness and to request it precisely a fuzzy-based conceptual modeling approach has been developed this paper. The application of proposed model is carried out in the route identification problem of traffic network.

निष्कर्ष

स्पाशियल डेटा मॉडलिंग में कई अशुद्धता है। अषुद्धता से निपटने के लिए और इसे ठीक से करने के लिए फज्जी आधारित वैचारिक मॉडलिंग इस आलेख में विकसित किया गया। एप्लीकशन को यातायात नेटवर्क के मार्ग पहचानने की समस्या में प्रस्तावित किया गया है।

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जीव–प्रेरित रोबोटिक प्रणाली अभिकल्पन के विभिन्न आयामों का मूल्याकंन
Aspect of Bio-Inspired Robotics System Design

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सारांश

प्रस्तुत आलेख में जीवों से प्रेरित रोबोटों के विषय में अपलब्ध जानकारियों का मूल्यांकन किया गया है। अभियंत्रिकी की इस विद्या में प्रकृति से सीखने पर बल दिया जाता है। इस आलेख में जीवों से प्रेरित रोबोटों के उदाहरण, प्रौद्योगिकी की अद्यतन स्थिती, अभिकल्पन प्रक्रिया, अनुसंधान प्रयास, तकनीकी चुनौतियां, तथा भविष्य की संभावनाओं पर प्रकाश डाला गया है।

ABSTRACT

This paper represents the review aspect of bio-inspired robots. It is a new method approach of learning from the nature and its application to solve the prevailing problems of engineering. This review mainly focuses on the research effort, technical challenge and the technologies developed in this field with challenge of bio-inspired and descriptive account of various type of bio-inspired robot, state-of-art, future scope, biologically-inspired design process.

Keywords: Bio-inspired, robots, BIONIS, MAV, surveillance

1. INTRODUCTION

Bio-inspired robotics is the new category of the design of bio inspired which is based onlearning from the nature and it applies to the real world engineering system[1]. Bio-mimicry is the act of copying from the nature and the design which is learned from the nature and making the system or mechanisms more effectively efficient and simple is called Bio-inspired design as shown in Fig. 1. These biological systems are generallymultifunctional but are especially design for specific tasks. It is also defined as transfer of natural technologies to other domains such as manufacturing engineering, material science, design etc. In last few decades significant advancement have been made in robotics artificial intelligence and the other fields allowing to make sophisticate bio mimetic systems. This interdisciplinary work has resulted in machines that can recognise facial expression, understand speech and locomotion in robust bipedal gacts similar to human. During the manufacturing of biologically inspired intelligent robots requires understanding the biological model as well as advancements in analytical modelling, graphic simulation and the physical implementation of the related technology[10]. The main focus is to improve the modelling and simulate the biological system which is based on the biological structure or process by gaining the knowledge from the nature and develop the new idea and technology[9].

This type of engineering does not focus only the design but it also concentrates on the linkage mechanism[10] and the material and it is used in biological characteristic of living organism as the knowledge base for developing the new robot design. Bio-robotics intersects the area of cybermatic, bionics, biology, physiology, and genetic engineering.

Figure 1. Bio-inspired design of organisms.

By using the complex dynamics networks,nonlinear dynamical control, self-assembling Nano-material self-organising behaviour, evolutioncharacteristics and natural selection. This field developed many of form disciplines include bio-mimetic as well as analysis of the way that living system form and function.

Bio-inspired engineering involves deep research into the way that living cell, tissue and organism built, control, manufacture, recycle, and conjure to theircircumambient. Bio-inspired engineering leverage this knowledge to innovation new technology and interpret them into products that meet real world challenge.

Recently, Bio-mimetic application of honeybee's replication through swarm behaviour robots by which autonomous less-priced micro-robots capable of replicating the behaviour of swarming honeybees if present in wide numbers[3].

2. BACKGROUND

A more or less bio-robotics can be traced starting at the end of nineteenth century with the advent of the new discipline of electrical engineering. A radio controller boat developed by Nikola Tesla in 1890s,a helicopter machine developed in 1918 (lobe). Breeder developed two boat in 1926 one is propelled by a flapping fin and other undulating fin, its concept come from fish. As shown in figure the bio inspired design or robotic fish is design from Zebrafish whose morphology, and colour pattern are inspired by Zebra fish[8].

Fifty years ago the advent of cybernetics saw the building of a series of electromechanical devices intended to explore aspects of animal behaviour, such as the 'Homeostat' machine (Ashby 1952) and the reactive 'turtle' (Walter 1961).The rich baseline of the bio-robotics stared to 20th century. Running robot developed at Massachusetts Institute of Technology's Lego Lab (Raibert 1986).

Figure 2. Comparison of the robotic-fish to a zebra fish individual.

Bio-inspired design area is appearing in the U.S.A in 1958 by the JackE Steele (Lloyd, 2008) [22849]. Leonardo the Vinci was probably the first systematic student of the possibilities of bionics. He realized that the arms of human were too weak to flap wings for a long time and hence developed several sketches of machines called ornitoplers. In 1948, Swiss engineer George de Mistral developed a bio-inspired design which is Velcro inspired by observing thistles and the way they got caught in his dog's tail and adhered to clothes.By the use of internal combustion engine and the propeller, human flight would be only possible in 20th century. During the second half of 20th century (Pernodet and Mehely 2000) coloni became Notorious by the use of biodynamic forms in products such as automobiles and airplanes. There are different methods to design a bio-inspired robot on the basis of environmental and economic sustainability.

A number of similar devices built around this time are described in Young (1969). Even within biology, analogy hypothesized animal control system continued to be simulation tool (1961, Harmon). The rich baseline of the bio-robotics star to 20th century. Running robot developed at Massachusetts Institute of Technology's Lego Lab (Raibert 1986).The field of artificially life (Langton 1989).

In recent time bio-robotics has been developed very rapidly. The concept has being implemented in the robotics device. Animals have long served as inspiration to robotics. Their adaptability flexibility of motion and great variety of behaviours has made them the benchmarks for robot performance. Now robots are capable to a limited degree of accurately mimicking the behaviours of animals. Used of microprocessor which increases the computational power and ever decreasing size tiny solid-state sensors, low power electronics, and miniaturised size mechanical components.It is new multidisciplinary field that encompasses the dual uses of bio robotsas tools for biologists studying animal behaviour and as test beds for the study and evaluation of biological algorithms for potential applications to engineering.

3. APPLICATIONS

The interest in bio-inspired design is accelerating since 2002 the BIONIS (the bio mimetic networks for industrial sustainability) has been actively promoting the application of Bio mimetic (design inspired by the nature) in products and services and its use in education and training. Biological systems are uses in broad areas in which the bio robotics contributes. Abio-inspired super-antiwetting interfaces with special liquid-solid adhesion[2] is as shown in Fig. 3.

Mainly the application of bio robotics is to expand the constraints of the world of animals. To manufacture

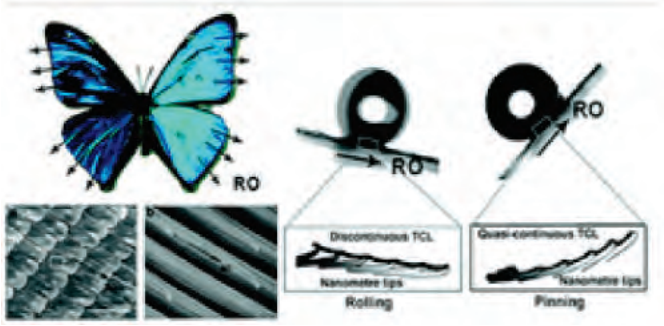

Figure 3. Bio-inspired design of organisms.

a useful robot one must have well defined problem and a workable solution to that problem.

During the study of robots and animals, there are mainly three issues which promoted to high relief in thinking of the person about projects involving biorobots. Firstly, the sufficient understanding of the organismsto ensure that a biorobotic implementation will lead to useful results, secondly what constitutes good measures of robot performance? And third issue is knowledge of the proper control algorithm to put a biological functioning in robot. The general application of bio-robotics includes defence, surveillance, automobile, exploration, medical, architecture, industrial design, materials system and process.

3.1 Architecture

Now in the field of architecture which is also comes in the modern bio-mimetic relatively recently compared with engineering and medicine. The development of powerful parametric software programs like Rhino and Grasshopper have enabled designers to form organic shapes within the constraints of digital building plans and to test stresses on these shapes. For prototyping laser sintering and contour crafting devices now available. A good example of bio-inspired design in architecture is the Great Court of the British Museum by Sir Norman Foster and Partners. The shape of the roof is torroid which was constructed over the court and links the central cylinder of the old library with the rectangular perimeter of the court. Strasbourg Lily house and London's Crystal a design from Joseph Paxton are bio-inspired constructions examples[8].

Now to save energy within the buildings is also enhance the designer to introduce on thermodynamic

Figure 4. Bio-inspired design of organisms.

Figure 5. Bio-inspired design of organisms.

forces, something natural capitalize organisms have been doing for billions of years. By the structure of an African termite mound the Eastgate's cooling mechanisms were inspired as shown in Fig. 5.

3.2 Industries

The robot, flexible body can be improvise for handling around extremely high bend, and the small cross-section allows too fit inside small piping and through small opening. Design is basically a process or mechanisms to generate new thing or to modify our environment. If our environment as our context at different levels and in different scales. The industrial design has been greatly influenced by nature. The 'Industrial' aspect of Industrial design has a 'strong link with engineering design and technology. Today fields of research such as bio mechanics, 'bio-engineering','bionics' ,'robotics' and 'biomimetic' are widely explored which are originated during the mid-twentieth century.

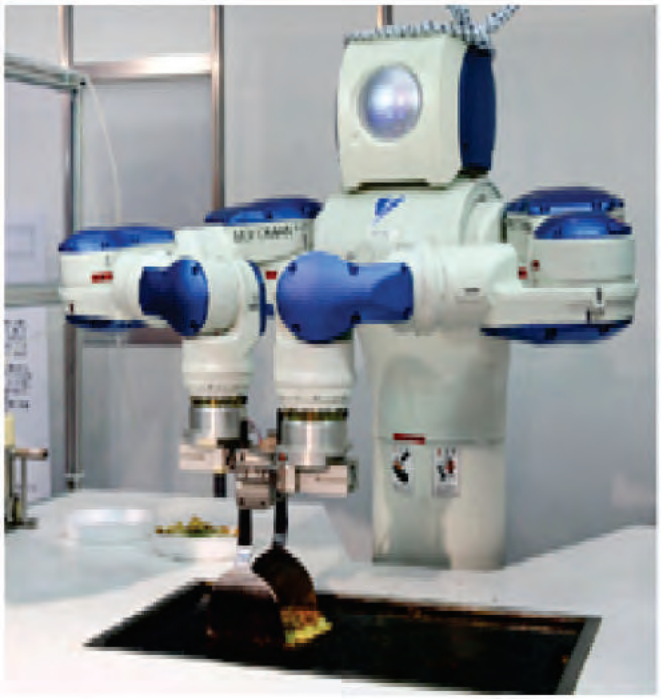

Figure 6. Humanoid robots industrial application.

3.3 In Surveillance

The spider robot can be deployed to quickly climb, walk through tunnels the suction is attached to the spider leg and it provided the view from the high point[10-11].

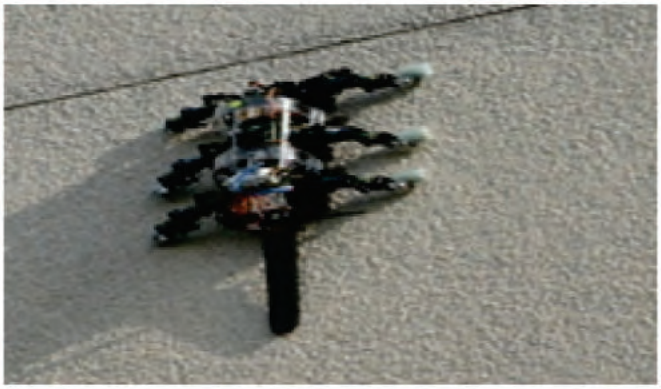

Figure 7. Bio-inspired design of organisms.

The use of smart cameras for search operations is spreading in a wide range of applications, play a crucial role in public, military and commercial scenarios. From last decades in the field of military and civilian wireless sensor network to collect information from the environment in a proper manner.

For the military and surveillance operations, there are inventions such as biologically inspired energy efficient micro air vehicle[12]. From last decades researchers concentrates on the design, development and deployment of unmanned systems for a variety of applications from intelligence and surveillance to border patrol, rescue operation, etc. These MAV are stable, cost effective and can be easily launched by the single or individual operators[26]. In confined space these bio-inspired MAV are easily land or travel. The design of these MAV is similar in shape and size of birds and insects. Birds can fly in dense flocks,executing rapid manoeuvres with g-loads far in excess of modern fighter aircrafts and yetnever

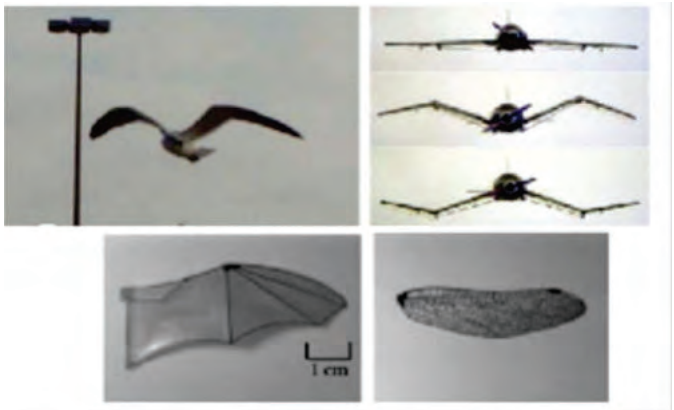

Figure 8. Bio-mimetic application of improving the performance of aeroplane model[4].

Figure 9. Bio-inspired design of organisms[5].

Figure 10. Bio-Inspired system design.

collide with each other.The nature of vehicle would help in battle field deployment as well, where such as a MAV would be made available to soldiers for proximity other application would include search and rescue operation and civilian law enforcement.

The nature's plans and perform action to create structure from nano-micro to mesoscale has inspired researchers to design artificial object with novel and extra ordinary properties. In the field of medical there are many process which learn from nature to design smart fabrics mimicking natural phenomena could revolutionise the textile industryfor the design of attractive materials. To design interactive clothing like biological entities many developments at micro-nanoscale provide tools and technique[16].

The features of lotus leaf provide an exalting influence for smart water repellent,dust free future apparel.For the touch emotions thedesign of touch sensitive mimosa leaves[14].

The bio-inspired design structure is also used tobond the top ceramic layer (Zirconia) to adetin like ceramic filled polymer substrate[15]. This type of material (FGM) is used to show higher or large amounts of loads over a wide range of loading rates. The application of microrobots based on the bio-

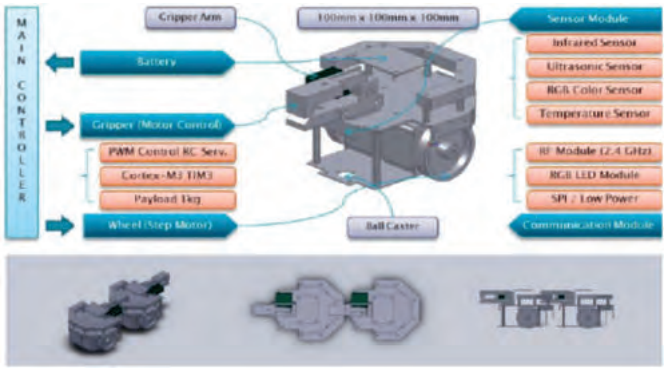

Figure 11. System configuration and mechanical design of ARTHROBOT.

inspired design which are used to navigate in viscous fluidic environments[17].

Cells in plants and animals upper epidermal cells mostly the skinareable of sensing mechanicaltouch and quickly respond to these signals and responds with a complex electric signal.

Our environments or nature has inspired numerous microrobotic locomotion designs which are suitable for propulsion generation at low Reynolds number[7]. Progress of medical technology has brought dramatic improvements in surgical outcomes and prognosis. Recently, minimally invasive surgery has been emphasised for reducing large invasiveness of traditional surgical techniques. In particular, robotic-assisted surgery is playing an important role in minimally invasive surgery. Minimally invasive robotic surgery has been applied in the cardiothoracic, abdominal, urologic, and gynaecologic fields.

3.5 Disaster Area

In disaster areas the bio-inspired robot is widely usedand these are also used for the Urban Search and Rescue (USAR) missions[18]. To focus or to get the better situation awareness into the dangerous or inaccessible areas it is necessary to place sensors or cameras[19]. For performing these dangerous tasks bio-inspired design robots are perfectly fit because for this the robot should be quick and agile and at the same instant it will able to deal with rough terrain and even to climb stairs[20]. The bio-inspired design robot should be rugged waterproof and dust proof corpus and it will have capability to swim. The bio-inspired robot ASGUARD[21] was developed with the consideration of above requirements which is hybrid legged-wheeled robot. It has capability to cope with stairs, very rough terrain and is able to move fast on flat ground. In disaster areas the swarms of flying robots can be used which are automaticallycreating communication networks for rescues and victims according to condition. In disaster the main advantage of flying bio-inspired design robot is that they overcoming difficult terrain and providing undisturbed wireless communication. Swarm is composed of cheap, transportable and robust robots in which we avoid using positioning sensors which base or depend on the environment and are expensive and heavy[22]. The behaviour of robot depends upon the local communication within the transmission range. In current there is no methodology to design robot controllers by which desired swarm behaviour can be obtained so to overcome this, two bio-inspired techniques are possible.

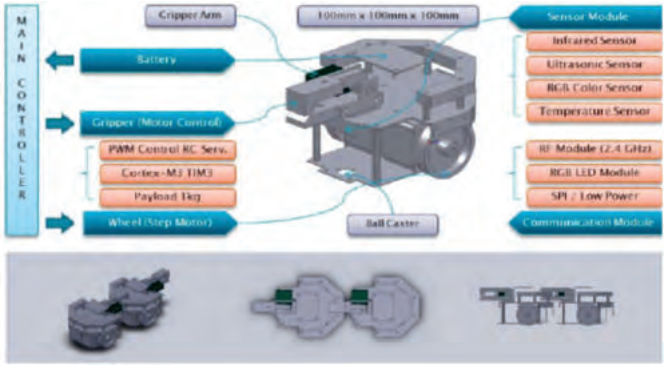

Figure 11. System configuration and mechanical design of ARTHROBOT.

Firstly the use of artificial evolution is to automatically design simple efficient and thoughts of controllers for robots. Secondly by creation, maintenance and evaporation of army-ant pheromone trails during foraging and by apply the same principle to design of robot controllers for the deployment, maintenance and retraction of communication networks.

Figure 12. System configuration and mechanical design of ARTHROBOT.

In disaster condition to provide relief and rescue operations for victims a bio-inspired modular robot named as ARTHROBOT[23] which can be assemble or dissemble process based on the proposed mobile algorithms. It can gather data and information in dangerous areas

which are inaccessible to human operators and protect the human. It consists of advanced sensors and tools which are used in emergency situation. ARTHROBOT is widely used in snake-link robot or multijoint robot. This type of robot passes through the narrow space in line and can overcome the obstacles in its way.

It consists of main controllers, sensors module, a communication module, a motor module, a battery as shown in Fig. 11 to supporting assemble, disassemble, collective behaviours.

Surveillance robots fitted with advanced sensing and imaging equipment can operate in hazardous environments such as urban setting damaged by earthquakes by scanning walls, floors and ceilings for structural integrity.

3.6 Civilian and Military Applications

MAV application is meant to address a large number of civilian and military applications including intelligence, surveillance and reconnaissance[24,25].

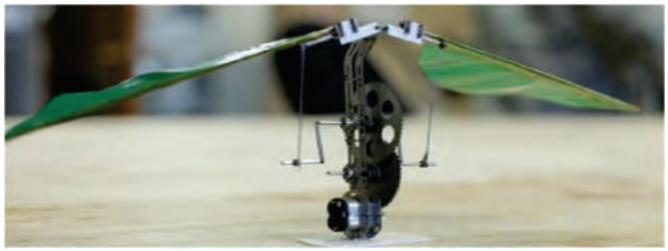

Figure 13. System configuration and mechanical design of ARTHROBOT.

A first person view (FPV) approach is utilised to wirelessly pilot the vehicle and for surveillance, etc. To save our nation bio-inspired design robots are prepared which are autonomous robots mobile machines that can make decisions, such as to fire upon a target. These robots are used from tunnelling through dark caves in search of terrorists, to securing urban streets rife with sniper fire to patrolling the skies and waterways where there is a little cover from attacks to protect or clearing roads and seas of improvised explosive devices (IEDs)[26], to secure or guarding borders and multi-storey buildings. These bio-inspired design robots take quick decision and smartly enough to make decision that only human now can.

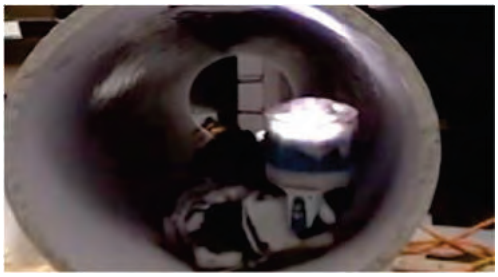

Figure 14. System configuration and mechanical design of ARTHROBOT.

These represents a significant force-multiplier each effectively doing the work of many human soldiers, while immune to sleep deprivation, fatigue, low morable, perceptual, and These bio-inspired design robot are capable of climbing on vertical and rough surfaces such as stucco walls (LIBO) (claw inspired robot); the robot can remain in position for a long period of time.

These robots have a capability in civilian and military advantages such as surveillance, observation, search and rescue and for also entertainment and games. These robots can able to move in any direction with four degree of freedom. The robot's kinematics and motion is a combination between mimicking a technique commonly used in rock climbing using four climbs and a method used by cats to climbs on trees with their claws[27]. In military and terrestrial settings these bio inspired design robots have capability of autonomous and semi-autonomous platforms to function in the shallow water surf zone.

To manufacture or design this type of robot implementation of the Wheegs trade concept and make it more suited for amphibious operation.These designs innovations allow Whegstrade navigate on rough terrain and underwater, and accomplish with little or no low-level control[28,29]. Figure DAGSI whestrade can climb rectangular obstacles as tall sa 2.19 times the length of leg. Blue morpho butterfly wing reflects light through this bio mimicked RFID tags are created capable of reading through water and on metals. Certain nanosensors are created through inspiration by it wings to detect explosivies.

3.7 Aircrafts

Scientist in 2004 developed design of morphing aircraft wings which can change its shape resemblance with the speed and also with duration of flight. These morphing wings bio-mimics the behaviour bird species that vary wings shapes according to the speed through which they are flying.

4. IMPACT AND IMPORTANCE

Robotics can play the important role in importance. If there is one technological advancement that would certainly make living easy and convenient, robot would be the answer. Robots are human like machines capable of doing tasks they are programmed to do. They have shown significance in decreasing human work load especially in industries.

The brain of robots where they receive set of instructions that make them perform tasks automatically is called artificial intelligence or AI[30]. There have been stories showing that these machines have become intelligent enough to think and act independently and overthrow humanity. At present, this is nowhere near to

happen since robots nowadays are not capable enough to do tasks without being controlled. Going too far away planets spying on people in ways people can't move and from views humans can't reach. Going far down into the unknown waters where humans would be crushed. Giving us information that humans can't getworking at places 24/7 without any salary and food. Plus they don't get bored. They can perform tasks faster than humans and much more consistently and accurately. They can capture moments just too fast for the human eye to get, for example the Atlas detector in the LHC project can capture ~ 600000 frames per second while we can see at about 60.

Most of them are automatic so they can go around by themselves without any human interference.

5. STATE-OF-ART OF BIO-ROBOTIC TECHNOLOGY

There are many different kinds of robots: factory automation systems that weld and assemble car engines; machines that place chocolates into boxes; medical devices that support surgeons in operations requiring high-precision manipulation; cars that drive automatically over long distances; vehicles for planetary exploration; mechanisms for power line or oil platform inspection; toys and educational toolkits for schools and universities; service robots that deliver meals, clean floors, or mow lawns; and 'companion robots' that are real partners for humans and share our daily lives. In a sense, all these robots are inspired by biological systems, it's just a matter of degree. A driverless vehicle imitates animals moving autonomously in the world, a factory automation system is intendedto replace humans in tasks that are dull, dirty, or dangerous. The term 'robot' itself is anthropomorphic as it is derived from the Czech word 'robota' which is generally translated as 'drudgery' or 'hard work',' suggesting the analogy to people. However, if we look inside these robots, we find that for the better part, they function very differently from biological creatures: they are built frommetal and plastic, their 'brains' are microprocessors, their 'eyes' cameras, their 'ears' microphones, and their 'muscles' electrical motors that sit in the joints. Humans and other animals, by contrast, are built from biological cells; they have muscles made of fiber-like material that pull tendons anchored to the bones of the head, arms, fingers, and legs; they have a soft skin covering the entire body; their sense of sight relies on a retina that spatially encodes visual information and performs a lot of processing right at the periphery. Recent developments in the field of bio inspired robotics have been centeredon the idea that behaviour is not only controlled by the brain, but are the result of the reciprocal dynamical coupling of brain (control), body, and environment.

Future generations of robots will be bio-inspired, have soft bodies composed of soft materials, soft actuators and sensors, and will be capable of soft movements and soft and safe interaction with humans. Progress in bio-inspired robotics can only occur when various technologies computation, sensors, actuators, materials: are integrated and can be made to smoothly cooperate to achieve desired behaviours. Because part of the control in bioinspired soft robotic systems is outsourced to morphological and material properties, novel design principles for 'orchestrating' behaviour must be developed.

Bio-inspired soft robotics technologies might entail a quantum leap in the engineering of robots with complex skillsets capable of dexterous.

6. CONCULUSIONS

Nature offers many hints and insights whichcan be used in robotic desigrs. Much of inspriration has been taken from bilogical organisms, the way they move and underlying mechenics are successfully employed in designity and manufacturing of robots. Still, future work is required to install many more features that initate nature.

निष्कर्ष

रोबोटों के अभिकल्पन में प्रकृति में विद्यमान ज्ञान को अधिकृत कर उपयोग कर सकते हैं। इसमें सर्वाधिक उपयोग जैविकी प्राणियों के चलने के तौर तरिकों के अध्ययन किया गया है। रोबोटो को अधिक शक्तिशाली बनाने के लिए इस दिशा में और अधिक प्रयास करने की आवश्यकता है।

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निफ्टी–50 का तकनीकी विश्लेषण : बीपीएफएफएन और एनएआरएक्स के बीच तुलना
Technical Analysis of NIFTY-50 : A Comparision between BPFFN and NARX

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सारांश

समय श्रृंखला समय पर दी गयी टिप्पणियों का एक आदेश सेट है। समय श्रृंखला विश्लेषण का भौतिक विज्ञान, सामाजिक विज्ञान और अर्थशास्त्र आदि जैसे कई क्षेत्रों में महत्त्वपूर्ण स्थान है। समय श्रृंखला से हमें ऐसे कई क्षेत्रों में मदद मिलती है जहां पिछले डाटा का विश्लेषण किया जा सके और भावी परिणामों के बारे में भविष्यवाणी की जा सकती है। इन दिनों प्रबंधकों को बाजार के आकार की भावी परियोजनाओं के लिए एक रास्ता और विकास की आशावादी दरों को खोजने के लिए कठोर परिश्रम करना पड़ रहा है। ठीक इसी प्रकार लोग शेयरबाजार में कम्पनियों के शेयरों की भविष्यावाणी जानने के लिए एक रास्ता खोजने के लिए कोशिश कर रहे है ताकि उनका लाभ पोर्टपोलिया पर पहुंच जाए। आंकड़ों में कुछ ऐसे तरीके हैं जो पिछले डाटा को विश्लेषण कर देते हैं और उस पर आधारित आउटपुट दे देते हैं। ये कम्पनी के ऋण का वित्तीय विश्लेषण और स्टॉक का तकनीकी विश्लेषण है। डाटा और पूर्वानुमान के विश्लेषण करने का एक नया तरीका कृत्रिम तंत्रिका नेटवर्क के रूप में जाना जाता है। इससे कम्पनी के पिछले डाटा का विश्लेषण किया जाता है और उसी के आधार पर भविष्य के मूल्यों का पूर्वानुमान किया जा सकता है। उनमें डाटा को स्पष्ट किये बिना ही अंतर्निहित जटिलताओं को समझने की क्षमता है। तंत्रिका नेटवर्क का यह गुण पिछले मूल्यों से सीखते हुए समय श्रृंखला के व्यवहार की भविष्यवाणी में मदद करता है।

ABSTRACT

Time series is an ordered set of observations in time. Time series analysis is important in many fields of physical science, social science, economics, etc.. The time series help us to in many fields where past data can be analyzed and prediction about future outcome be found. These days managers are striving hard to find a way to project the future of market size, expected growth rates, etc. Similarly in stock market people are trying to find a way to make predictions about shares of company so that their profit portfolio will go up. There are some methods in statistics which analyze the past data and give output based on it. These are financial analysis of a company's health and technical analysis of a stock. A new way of analyzing the data and forecasting is known as artificial neural networks. They analyze the past data and can forecast the future value according to it. They have the capacity that they can understand the underlying complexity without be explicitly given to them. This property of neural network helps in forecasting the behavior of time series by learning from the past values.

Keywords: Artificial neural networks, financial markets, forecasting, technical analysis, NIFTY, data mining

1. INTRODUCTION

Financial Markets are places where trading of financial securities, commodities, etc. take place. This trading of securities in these market reflect various concepts of economy like demand and supply, investor sentiment in the economy, etc. Securities include things like shares, stocks, etc., and commodity market comprises of bullions, agricultural products, etc. The financial markets for these transactions are either general in nature, i.e., where securities and commodities both are traded or specialized in nature where only either securities (shares or bonds, etc.) or for commodity (like a bullion market). Markets help the players in the following :

- Raising capital
- Risk transfer
- Discovery of price
- Liquidity transaction
- International trade, etc.

In financial markets, the data is available in the form of time series. Time series data is a special for of data in the values are spaced over a regular interval

of time. In our work, we are analyzing a special form of data which is happens to be a time series but is highly volatile one and is related to share market. The data on stock markets contain may forms of noise into it which may be because of local or global factor[1]. This noise can be dealt with a number of different techniques like FIR filters, etc.[1]. This type of time series has following features :

- Highly intense data
- Unstructured data
- Degree of uncertainty is very high
- Relationships are implicit.

This data is highly complex in nature and needs to analyzed to find meaningful statistical interferences. The standard statistical methods of forecasting the share markets have reached their limits in applications with the nonlinearities in the data set of the markets[2,3]. Time series forecasting is the use of any model to forecast the value of a commodity based upon past trend of the value of commodity. Time series data is different from other type of data as it consists of natural temporal ordering.

2. THE STOCKS MARKETS

The forecasting of future for a financial market in economics has been done since many decades. There are a two main hypothesis about the profitability from the share market. These are:

1. Random Walk Hypothesis, and
2. Efficient market Hypothesis.

The Random Walk Hypothesis states that "Stocks follow a random walk and hence, cannot be predicted". While there are opponents of Random Walk of Hypothesis state that this can be done which in return can return in making huge profits.

The Efficient Market Hypothesis States that Markets fully reflect the freely available information and prices are adjusted fully and immediately once the new information comes in the public domain. In other words, it states that the markets informationally efficient. There are 3 variations in this hypothesis being.

2.1 Hard Efficient Market Hypothesis

It states that information of any form, i.e., public or private is reflected in the share prices and this reflection of information in the price is instantaneous.

2.2 Semi Hard Hypothesis

It states that the public information which was in the public domain is historically is reflected in the price and if any new information comes into the domain it is reflected into the share price as soon as the people become aware of it.

3.3 Weak Efficient Hypothesis

It assets that the informational which is publically available is reflected in the share prices.

Apart from the theoretical considerations, we also have a number of Statistical techniques which are used in economics to forecast the share prices. There are two main approaches towards forecasting in standard economics literature:

1. Financial analysis
2. Technical analysis

Financial analysis is used in long term forecasting of the market. In financial analysis, we analyze the security into consideration for long stability, growth, return on investment, etc. over a horizon of years. This helps one to find the potential growth of a commodity over time and growth of his/her investment. It is even used for analyzing business, projects, etc. as well. If the analysis for investment has to be company specific, then the points taken into consideration are the things like income statement, cash flow statement, balance statement, etc.

Technical analysis which is for short term forecasting is highly dependent upon the moment oscillators of the commodity/security into consideration. In Technical analysis the previous trends of a graph is analyzed to find the potential movement of the thing into consideration. This trend analysis is based upon few parameters like the movement, Relative strength index, stochastic, etc.

A new tool inspired from human intelligence, has come up which is known as artificial neural network. This tools learns the underlying complexity in the data being supplied to it. This gives an added advantage to the analysis of time series which formulated because of actions of many people which are governed by different aspects like sentiments, beliefs, monetary policy, federal policy, interactions among parties into consideration, etc. Because of this capacity to learn the underlying complexity of data the artificial neural networks are coming up as very powerful statistical tool for modeling such type of series. Artificial neural network have many properties which make it highly suited for analyzing a financial time series which are:

Artificial neural networks are capable of analyzing non-linear data and the price is in itself a highly complex non-linear data[4,5].

Artificial neural networks have the capacity to act as a universal approximators for different functions. Now, the functional behavior of financial markets itself comprises of many different factors which range from sentiments to demand-and-supply. Thus in a scenario like this artificial neural networks are highly suited[6].

Artificial neural networks have the capacity to generalize the pattern which is supplied to it. Technical analysis is based upon the assumption that share price movement must form some pattern which can be exploited to make money[6].

Artificial neural networks are used in isolation or with combination to other artificial intelligence techniques like the genetic algorithms to produce more efficient results[7,8].

2.1 NIFTY

Nifty is the National Stock Exchange of India's benchmark index for the Indian equity market. It is also known as NIFTY-50 or CNX NIFTY. India Index Services and Products limited owns and managed NIFTY. NIFTY is an index value reflecting shares of 50 different companies dealing in 22 different sectors of Indian Economy. It is a free float market capitalization weighted index and was initially calculated on full market capitalization methodology. From 26 June 2009, the computation was changed to free float methodology. The base period for the CNX Nifty index is November 3, 1995, which marked the completion of one year of operations of National Stock Exchital Market Segment. The base value of the index has been set at 1000, and a base capital of Rs 2.06 trillion. The developers of CNX Nifty Index are Ajay Shah and Susan Thomas.

3. TECHNICAL ANALYSIS

Technical analysis of a share for short term forecasting is completely dependent upon the analysis of the curve of the stock under consideration. Technical analysis has a number of parameters which depict the curve movement. The one selected for our study are as follow:

3.1 Momentum of share,M

It is the difference between current closing price and the closing price n days ago.

Mathematically:

$M = C_t - C_{t-n}$

Where C_t is the closing price for the day under consideration

and C_{t-n} is the closing price n days ago.

3.2 Simple Moving Averages (MA)

It is calculation of different data points to make series of averages over different subsets of same series. It shows the un-weight average over different time intervals. Our data set in total was from 1995 to 2013 comprising of roughly 4500 daily values. Thus, owing this huge data set we selected the moving average for 50 days, 100 days and 200 days. It indicates the support in raising markets and resistance in falling markets.

Mathematically:

Step 1: we 1st need to calculate the simple moving average for the specified period:

$MA = (p_1 + p_2 + \ldots.. + p_n)/n$

Step 2: now to calculate the moving average for the day into consideration we use the following formulas:

$MA_t = MA_{t-1} - P_{m-n}/n + P_m/n$

Thus, our moving averages which are for 50, 100 and 200 days are represented as :-

Case 1: MA50

$MA50 = (p_1 + p_2 + \ldots.. + p_{50})/50$ and subsequently

$MA50 = MA_{previous} - P_{m-n}/50 + P_m/50$

Case 2: MA_{100}

$MA_{100} = (p_1 + p_2 + \ldots.. + p_{100})/100$

$MA_{100} = MA_{previous} - P_{m-n}/100 + P_m/100$

Case 3: MA_{200}

$MA_{200} = (p_1 + p_2 + \ldots.. + p_{200})/200$

$MA_{200} = MA_{previous} - P_{m-n}/200 + P_m/200$

Where MA = moving averages

P_t= closing price for that day

n = no of days the average is sought

m = is the day at which the average is sought

3.3 Relative Strength Index

It was designed to show the current and historical strength or weakness of a share based on the closing prices of a recent trading period. It also shows the buying and selling conditions of the stock. Mostly, it is calculated for a period of 14 days.

Calculation:

Step 1: Start by calculating the simple moving average for a period offirst14 days, only once as this is used in exponentially moving average.

Step 2: Calculate the exponentially moving average (EMA) form now. For the 1st step in this EM_{t-1} is replaceable by MA_{14}.

$EMA = \alpha P_t + (1-\alpha)\ EMA_{t-1}$

Where $\alpha = 2/(v+1)$

Step 3: Calculate the relative strength

$RS = EMA(U,14)/EMA(D,14)$

Where U is positive momentum changes,

D is negative momentum changes.

Step 4: Calculate the relative strength index, RSI

$RSI = 100\text{-}100/(1+RS)$.

Importance of RSI: Relative strength index always lie between 0 to 100. Its value indicates the criterion of cases like overbought and oversold. If its value falls below 30 it shows that the stock is oversold and its value indicates the degree of selling in this case. If its value is above 70, it indicates that the stock is overbought. These indicators are important in decision making in the share markets as one of the most important points in share market is the time in and time out.

3.4 Stochastic

The term stochastic depicts to the placement of a present price in relation to its price range over a time period. This indicator tries to forecast price turning points by comparing the closing price of a security to its price range.

Mathematically:

$\%K = 100*(C-L_5)/(H_5-L_5)$

$\%D = 100*H_3/L_3$

Where %k is the stochastic

C is the current closing price

L_5 is the lowest low of past 5 days

H_5 is the highest high of past 5 days

H_3 is the highest high of past 3 days.

L_3 is the lowest low of past 3 days.

Importance: Stochastic oscillator is an highly sensitive oscillator. It shows a reversal of trend before it actually happens.

3.5 Rate of Change

It shows the relative change of the stock over time.

Mathematically:

Rate of Change, $RoC = (C_t - C_{t-n})/C_{t-n}$

Where C_t is present closing price

C_{t-n} is the closing price n (n= 100) days age.

4. EXPERIMENTAL SETUP

4.1 Data

The data was taken from the NSE website directly which comprised of the opening price, closing price, High, low, number of shares traded and total turnover for each day. The data consisted of roughly 4000 value with start date being 29-Oct-1997 and last date being 30-Aug-2013. The daily data was taken and used as the input and target values in the neural networks. The input parameters were current closing price, closing price on yesterday, momentum of change, Moving averages for 50 days, 100 days and 200 days, Relative strength index, stochastics and rate of change. The target value supplied to the system was the closing price of next day for the period of which the data was available. The data available to us had quite huge political noise in it as the country saw a number of changes in its political and economical environment after liberalization of the market economy in 1991. Table 1 shows the data usage of date wise usage of data and its supply to the system.

4.1.1 NARX

It stands for non-linear auto-regression exogenous model. In time series modeling, it refers to a nonlinear autoregressive system which has some parameters coming in it from outside the system and effecting it. This means that the model relates the present value of interest in a time series with the following:

previous values of the same series; and present and previous values of the external series — that is, of the externally determined series that influences the series of interest.

Mathematically

$$y_t = F(y_{t-1}, y_{t-2}, y_{t-3} \ldots \ldots \ldots, u_t, u_{t-1}, u_{t-2}, u_{t-3}, \ldots \ldots,) + \varepsilon_t$$

where y is the variable of interest, u is the external variable and ε is the error term.

4.1.2 BPFFN

It stands for back-propagation feed forward neural network. It is a type of artificial neural network where there is no cycle formation between the connections and information only flows in one direction.

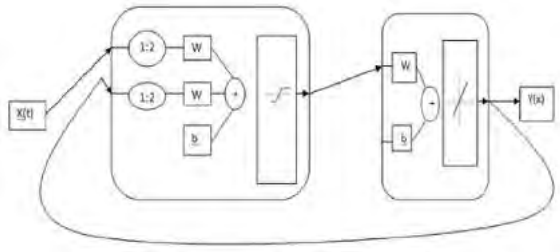

Figure 1. NARX system.

Table 1. Data usage of system

Purpose	Days	Start Date	End Date	Start value	End Value
Training	2769 (70% of total data)	30-oct-1997	17-Nov-2008	1085.25	2799.55
Validation	593(15% of total data)	18-Nov-2008	11-Apr-2011	2798.5	5785.7
Testing	593 (15% of total data)	13-Apr-2008	26-Aug-2013	5911.5	5476.5
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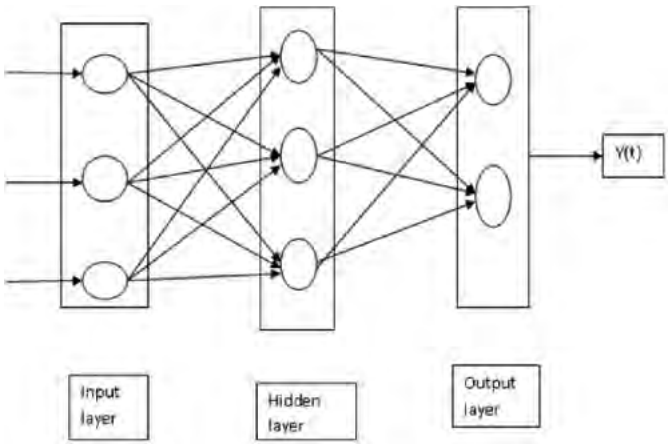

Figure 2. BPFFN system.

4.1.3 Results

Freisleben[3] achieved the best results with the following formula

No_of_hidden_nodes=(k*n)-1 (1)

Where k is some integer

And n is the number of inputs.

Although this is not a hard and fast rule but comes handy to find a local optima. Even while using the hit and try method one is going to find a local optima but a cost of great time.

The Table 2 shows the best results obtained by the use of the system and their corresponding neural network architectures. Table 1 clearly shows that NARX performs better then BPFFN in forecasting a time series.

Figure 3 depicts the overall error in forecasting accuracy of the system for whole of the time frame the system was trained. The maximum of the error is 243 on the positive side and 100 on the negative side. Then positive and negative sides if the graph indicates that when forecasted value was above the actual value and when it was below the actual value.

This graph shows that the maximum error that occurred in the system was in range of -5 to 5 % and overshoot up to 6% only for a single point and in its whereabouts the fluctuation is very high because this data corresponds to the scenario in which global economy was troubled.

Table 2. Comparision of results

Artificial neural network	Architecture (input neurons-hidden layer neurons-output layer neurons)	Error (for t+1 day)	% age Error (for t+1)
NARX	9-8-1	39.63186	0.749546%
BPFFN	9-16-1	62.78161	1.146382%

5. CONCLUSION

In this study, it had been found that the behavior of Stock Markets can be forecasted with a greater

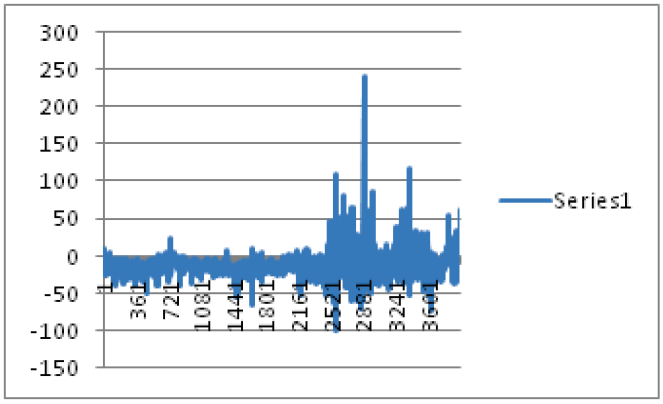

Figure 3. Error graph in absolute terms.

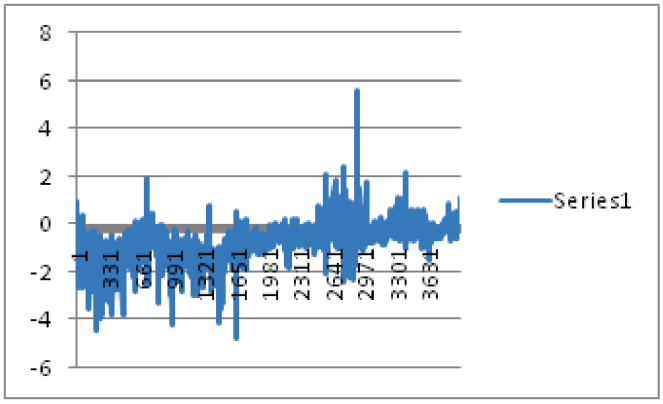

Figure 4. Error graph in percentage terms.

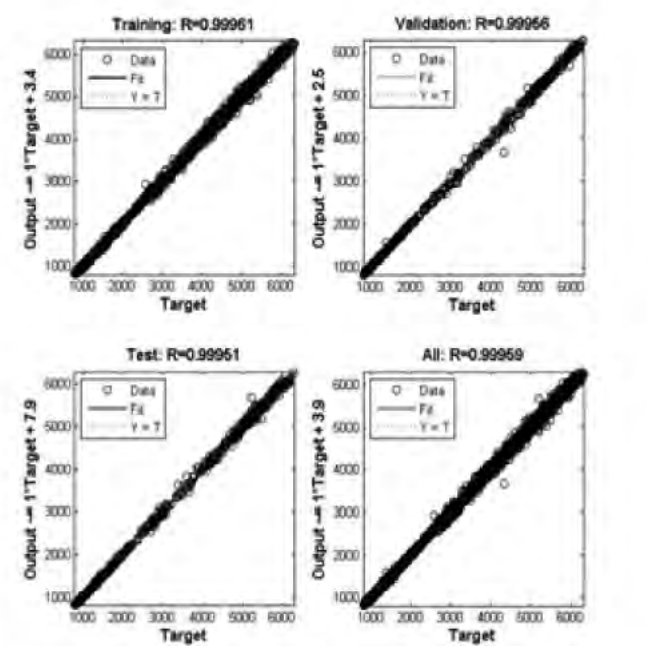

Figure 5. Regression plot for NARX.

accuracy using NARX as compared to BPFFN. It was also noticed that Efficient Market Hypothesis plays a key role in determining the trend. Efficient market hypothesis has a dominate effect on the markets causing it to shift in an previously unexpected behavior. The closing trend of the share markets can be forecasted

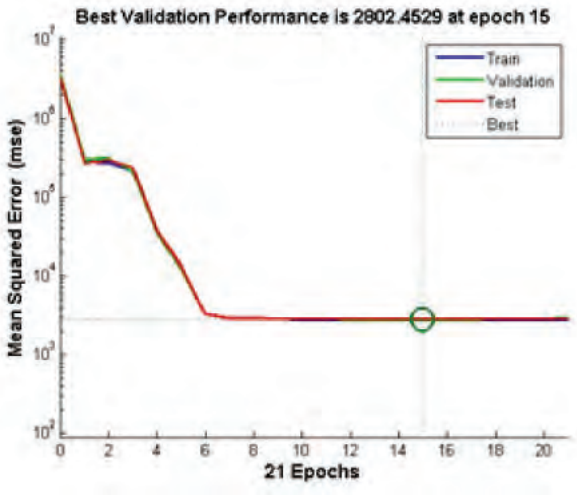

Figure 6. Performance graph for NARX.

with using the neural networks and the results can be further enhanced by incorporating the news feed in it.

निष्कर्ष

इस अध्ययन में यह शेयर बाजारों की व्यवहार BPFFN की तुलना में NARX का उपयोग कर अधिक से अधिक सटीकता के साथ पूर्वानुमानित किया जा सकता है कि पाया गया था। यह भी कुशल बाजार परिकल्पना प्रवृत्ति का निर्धारण करने में एक महत्वपूर्ण भूमिका निभाता है कि देखा गया था। कुशल बाजार परिकल्पना यह एक पहले से अप्रत्याशित व्यवहार में बदलाव करने के कारण बाजारों पर हावी प्रभाव पड़ता है। शेयर बाजारों के बंद होने की प्रवृत्ति तंत्रिका नेटवर्क का उपयोग कर के साथ पूर्वानुमानित किया जा सकता है और परिणामों के आगे उस में समाचार फीड को शामिल करके बढ़ाया जा सकता है।

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संदेश प्रमापीकरण के लिए द्रुतान्वेषण कार्य
Hash Functions for Message Authentication

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सारांश

यह लेख द्रुतान्वेषण संदेश प्रमाणीकरण कोड के बारे में बताता है जो द्रुतान्वेषण कार्यों का उपयोग करके संदेश प्रमाणीकरण के लिए प्रयोग किया जाता है। इसमें बंद द्रुतान्वेषण कार्यों और डिजिटल हस्ताक्षर के बारे में भी परिचर्चा की जाती है।

ABSTRACT

This paper talks about hash message authentication code which is used for message authentication using Hash functions. It also discusses about keyed-hash functions and digital signatures

Keywords: Hash functions, HMAC, digital signatures

1. INTRODUCTION

Message authentication deals with processes which are used to ensure integrity of a message and identity of the sender. When a message is sent over some network, authenticator details, signature and message authentication code (MAC) are also sent along. MAC is an authentication process in which secret key is used to generate cryptographic checksum which is sent along with the message. This cryptographic check sum is known as MAC. In this process a common secret key is shared by both sender and receiver. If a message M is to be sent from Sender Cathy to receiver George using Key K, then MAC will be calculated as MAC=E(K,M).

2. E IS THE MAC FUNCTION

Message and MAC will be sent to the receiver. MAC can be of any size, sometimes hash function is used in place of authentication scheme to fix the size. In order to identify the problem with MAC, timestamp and message sequence number are required. Various methods are used to authenticate the message

Session-Key – Session key is used to authenticate the message. Cathy and George create their session key. The session key is known to both sender and receiver. Session keys are transmitted in encrypted format to prevent the compromise of these keys.

Block Cipher- This is another method which is used for message authentication. Block ciphers treats the complete block of message as individual unit and creates an encrypted message of length equal to that of the block. This method uses the combination of substitution and transposition techniques. Encryption of the data is repeated multiple times in case of the block ciphers. CFB and CBC modes can be used to send the final block of data and this final block will depend on the previous blocks which are given as input to each advancing stage.

3. E-MAIL MESSAGE ENCRYPTION

Every e-mail message that a sender sends travels a large distance before reaching the receiver. It travels through many networks which may be monitored, insecure or making other kinds of passive or interception attacks onto the message. In such a scenario if a message is being sent in plaintext – anyone could read that message, provide he has access to any of these servers.

Pretty Good Privacy (PGP)- a phenomenon developed by Phill Zimmermann. PGP is used for email and file storage apps to provide confidentiality and authentication services.

PGP is comprised of five different services – authentication, confidentiality, compression, email compatibility and segmentation. PGP makes email encryption easy offers strong protection against spying eyes.

4. CONFIGURE PGP IN THUNDER BIRD

Mozilla's email program, Thunderbird with the Enigmail extension is the easiest tool to use.

1. Install the add-on which will integrate into Thunderbird the ability to use PGP encryption in your mails.

2. Search for enigmail: In the Add-ons window.

3. Out of many add ons available-install Enigma.

4. Click Install button, then restart Thunderbird to apply Add-on configuration.
5. PGP Libraries for Windows must be installed.

5. INSTALLING GNUPGP

1. Run the GPGP Installer, GNUPGP will appear under Program Files directory.
2. Once you've downloaded Enigmail, in Thunderbird open Tools -> Options -> Extensions -> Install New Extension, and then choose the Enigmail extension file.
3. When you've restarted Thunderbird with Enigmail installed, you will see an OpenPGP menu item. Open it and go to Preferences. There you'll find a dialog to point to your Gnu PGP binary. Click Browse. It will be installed under Program Files\ GNU\GnuPG\gpg.exe.
4. Now you'll need to generate your public/private key pair. From the OpenPGP menu item, choose Key Management. From the Generate menu choose New Key Pair.
5. Choose the email address you want to create a key for, and set a passphrase. Hit the "Generate Key" button, and relax - it can take a few minutes.

6. MESSAGE AUTHENTICATION CODES HMAC AND CBC-MAC

Hash-based message authentication code is created to calculate a message involving a cryptographic hash function with private key. HMAC-MD% or HMAC-SHA1 have been used for calculating HMAC. Cryptographic strength of the hash function used determines the strength of HMAC.

CBC-MAC: Technique to build message authentication code from block cipher. Cipher block chaining mode creates a chain of blocks in which each block is dependent on the previous block's encryption.

6.1 Cryptographic Hash Functions

A user transmitting a message would never want the message to be tampered or analysed in any way. In such scenarios message authentication is a great tool to validate the messages. Hash function can be used for message authentication. MD-5 and SHA-1 are such hash functions. Generally hash functions are sent along with digital signatures. The Major point of consideration here is that hash functions don't use any key.

Cryptographic hash function is a deterministic procedure – that takes arbitrary blocks of data and returns fixed size data. The data encoded using Hash functions is called the message digest.

6.2 Keyed Hash Functions

A secret key is used along with cryptographic hash function in case of keyed hash function. The cryptographic key is known only to sender and receiver, which introduces more security features.

6.3 Digital Signature

Digital signatures are used to ensure authentication. It is an authentication mechanism that enables the creator of a message to attach a code that acts as a signature. The signature is formed by taking the hash of a message and encrypting the message with the creator's private key. The signature guarantees the source and integrity of the message[7]. They are used to ensure that the original content of the message remains unchanged. User is given two different keys-private key and public key. Public key can be known to anyone who needs it but private key lies only with the desired users. Anyone with the public key can

encrypt the message but it cannot be decrypted without the private key. Thus data is pretty useless without the private key, as it cannot be decrypted without the private key. With private key an authentic user can put digital signatures over a document. Digital signature is a tamp which is very difficult to forge. During the process of signing, the data is crunched down into few lines via a process called hashing. The crunched down data is called message digest, which cannot be changed v\back to original data.

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असममित युग्मनों (असमेट्रिक पेयरिंग) पर आधारित क्रिप्टोसिस्टम
Cryptosystems based on Asymmetric Pairings

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सारांश

युग्मन आधारित क्रिप्टोग्राफी, और सूचना सुरक्षा में नवीन अनुसंधान दिशाओं में से एक है। युग्मन आधारित क्रिप्टोग्राफी में कई अनुसंधानकर्ता युग्मन को एक "ब्लैक बॉक्स" के रूप में मानते हैं। वे युग्मन की विभिन्न विशेषताओं का उपयोग करके क्रिप्टोग्राफिक स्कीमों को बनाते हैं। एक युग्मन असममित युग्मन कहलाता है यदि हो, जहां और समूह संरचनाएं है। ऐसा असममित युग्मन जिसके लिए एक दक्षता से संगणनीय आइसोमॉर्फिस्म ज्ञात होता है, टाइप 2 युग्मन कहलाते हैं और यदि ऐसा आइसोमॉर्फिस्म नहीं ज्ञात होता है, तो म को टाइप 3 युग्मन कहा जाता है। असममित युग्मन में कई क्रिप्टोग्राफिक प्रोटोकॉल होते हैं जो अपने सुरक्षा ह्रास के लिए आइसोमार्फिस्म की मौजूदगी पर निर्भर करते हैं और कई ऐसे होते हैं जो खुद प्रोटोकॉल में ही का उपयोग करते हैं। इस पत्र में हम क्रिप्टोग्राफिक संदर्भ में युग्मनों के प्रकारों को प्रस्तुत कर रहे हैं। हम असममित युग्मनों पर आधारित क्रिप्टोसिस्टम की समीक्षा करेंगे। हम उन क्रिप्टोग्राफिक प्रोटोकॉलों के कार्यान्वयन और सुरक्षा पहलुओं पर ध्यान केन्द्रित करेंगे जो दीर्घवृत्तीय वक्रों पर टाइप 2 और टाइप 3 युग्मनों का उपयोग करते हैं। हम इन प्रोटोकॉलों में आइसोमॉर्फिस्म भूमिका को रेखांकित करेंगे। हम दर्शाते हैं कि किस प्रकार टाइप 2 युग्मन केवल टाइप 3 युग्मनों का अदक्ष कार्यान्वयन मात्र है और यह कार्यशैली, सुरक्षा और निष्पादन की दृष्टि से असममित युग्मनों पर आधारित प्रोटोकॉलों के लिए कोई लाभ प्रदान करता प्रतीत नहीं होता है।

ABSTRACT

Pairing based cryptography is one of the recent research directions in cryptography and information security. Many researchers in pairing based cryptography treat pairings as a 'black box'. They build cryptographic schemes making use of various properties of pairings. A pairing e: $G_1 \times G_2 \rightarrow G_T$ is called asymmetric pairing if $G_1 \neq G_2$, where G_1, G_2 and G_T are group structures. Asymmetric pairings for which an efficiently-computable is omorphism ψ: $G_2 \rightarrow G_1$ is known are called type 2 pairings and if such an isomorphism is not known then e is called type 3 pairing. There are many cryptographic protocols in the asymmetric pairing which rely on the existence of isomorphism ψ for their security reduction and there are many which use ψ in the protocol itself. In this paper, we present types of the pairings in cryptographic context. We review cryptosystems based on asymmetric pairings. We focus on the implementation and security aspects of cryptographic protocols that use type 2 and type 3 pairings on elliptic curves. We highlight the role of isomorphism ψ in these protocols. We show how type 2 pairings are merely inefficient implementation of type 3 pairings and appear to offer no benefit for protocols based on asymmetric pairings from view of functionality, security and performance.

Keywords: Elliptic curves, pairing based cryptography, asymmetric pairing, weil pairing, tate pairing

1. INTRODUCTION

Public-key cryptography[1] is perhaps the most celebrated contribution of modern cryptography. It is hard to imagine what the world would belike without their revolutionary approach to key distribution. Public key cryptography was publicly introduced by Whitefield Diffie and Martin Hellman in 1976. In a public key cryptosystems there are two keys. The public key which is published in a directory allows encryption and the private key which is kept secret allows decryption. Ronald Rivest, Adi Shamir and Leonard Adleman proposed a scheme in 1977, which became the most widely used public key cryptographic scheme, RSA. ElGamal cryptosystem is a non-RSA public key cryptosystem based on discrete logarithms.

Elliptic curves over finite fields had played an important role in public key cryptography. The first use of elliptic curves for cryptography[2] was suggested

independently by Koblitz and Miller in 1985. Elliptic Curve Cryptography (ECC) is becoming accepted as an alternative to cryptosystems such as RSA and ElGamal over finite field, because it requires less bandwidth as well as less computational complexity when performing key exchange and/or constructing a digital signature. ECC is based on the generalized discrete logarithm problem, and thus DL-protocols such as the Diffie-Hellman key exchange can also be realized using elliptic curves. Elliptic curve cryptosystems are currently among the most efficient public key cryptosystems. Their security relies on the difficulty of computing discrete logarithms in suitable instances of elliptic curves over finite fields.

Pairing based cryptography has become one of the most active areas in elliptic curve cryptography since 2000. The first notable application of pairings to cryptography was the work of Menezes, Okamato and Vanstone[3]. They showed that the discrete logarithm problem can be shift from an elliptic curve to a finite field through the Weil pairing as the discrete logarithm problem is more easily solved over a finite field than over an elliptic curve. There are four types of pairing in cryptography literature. Many successful cryptographic protocols have been designed by using these pairing.

2. MATHEMATICAL BACKGROUND

In this section, we give some required mathematical background for pairing based cryptosystems.

2.1 Bilinear Pairing

There are two forms of bilinear pairings or simply pairings[4] used in the cryptography literature. The first are of the form

e: $G_1 \times G_1 \rightarrow G_T$

where G_1 and G_T are groups of prime order l. This form of pairing is called symmetric pairing. This e satisfies the following properties:

1. Bilinearity: $e(aP,bQ) = e(P,Q)^{ab}$, for all $P,Q \in G_1$ and for all $a,b \in F_q^*$.
2. Non-Degeneracy: There exists $P \in G_1$, such that $e(P,P) \neq 1$.
3. Computability: There is an efficient algorithm to compute e(P,Q) for all $P,Q \in G_1$.

The second are of the form e: $G_1 \times G_2 \rightarrow G_T$

where $G_1, G_{(2)}$ ($G_1 \neq G_2$) and G_T are groups of prime order l. This form of pairing is called asymmetric pairing. These pairings are also bilinear, non-degenerate and computable. In this paper our concentration is on the cryptosystems based on these pairings. There are many choices for the groups G_1, G_2 and G_T but in this paper we only consider pairings for which G_1 and G_2 be two subgroups of elliptic curve group and G_T be multiplicative subgroup of a finite field. Figure 1 & 2 shows asymmetric pairings with the notations $G_1 = G_1 = E[r] \cap Ker(\pi-[1])$, $G_2 = E[r] \cap Ker(\pi-[q])$ and P_1, P_2 be generator of G_1, G_2.

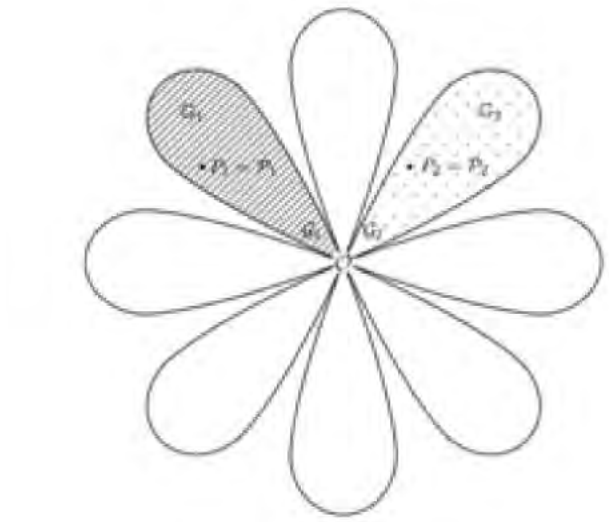

Figure 1. Asymmetric pairing (type-2).

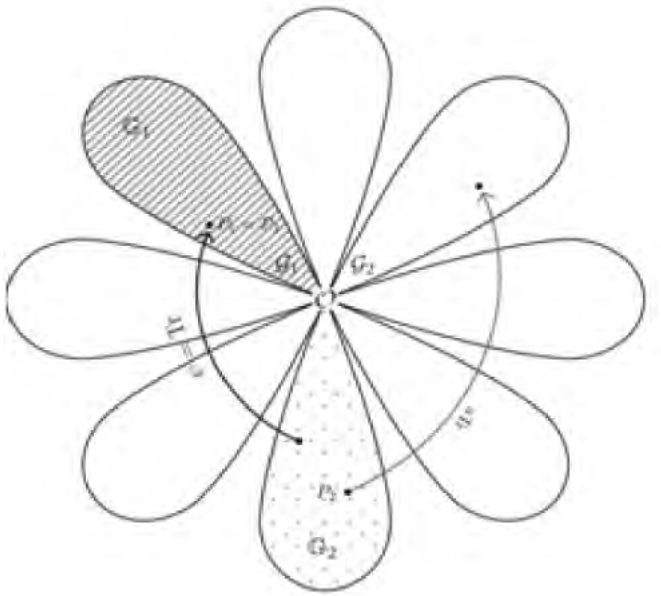

Figure 2. Asymmetric pairing (type-3).

2.2 Elliptic Curve

An elliptic curve[5] over a field Kis set of all points on the curve (given by the Weirstrass equation

$$y^2+a_1\,xy+a_3\,y = x^3+a_2\,x^2+a_4\,x+a_6$$

together with O, the "point at infinity". If the characteristic of the field K is not equal to two or three, then the Weirstrass equation convert to.

$$y^2 = x^3+ax+b$$

An elliptic curve forms an abelian group under the group law. To define this group law consider two points, say P and Q, on our elliptic curve and draw line from P to Q until it hit the curve again. From this

we get another point on the curve. Now draw a line from the point at infinity, O, through this new point. The point where this line intersects the elliptic curve again is P+Q. If P= Q, we take the line between P and Q to be the tangent at P and proceed in the same as above. If the line from P to Q does not intersect the curve anywhere on the finite plane then we say it intersect at O. We denote this group by E(K). The most popular choice of the field K is prime field $\mathbb{F}_p$. If $P(x_1,y_1)$ and $Q(x_2, y_2)$ be two on points on the elliptic curve $y^2 = x^3+ax+b$ over the $\mathbb{F}_p$, then $Q(x_3,y_3)$ =P+Q and 2P=P+P are defined as:

$x_3=s^2-x_1-x_2 \bmod p$

$y_3=s(x_1-x_3)-y_1 \bmod p$, where

$s=(y_2-y_1)/(x_2-x_1) \bmod p$; if P≠Q (point addition) and $s=(3x_1^2+a)/(2y_1) \bmod p$; if P=Q (point doubling).

The group $E[r]=\{P\in\bar{E} \mid [r]P=\mathcal{O}\}$ i.e. the group of points of order r on E ($\bar{\mathbb{F}}_p$), called r- torsion subgroup of E.

2.3 Weil Pairing

Let m be a fixed integer coprime top and let P, Q∈E[m]. Let A and B be divisors such that $A\sim(P)-(\mathcal{O})$ and $B\sim(Q)-(\mathcal{O})$, and A and B have disjoint support. Since P and Q are m-torsion points, it follows that mA and mB are principle divisors. So there are rational functions f_p, $f_Q\in(\bar{K}(E)$ such that div (f_p)= mA and div(f_Q)= mB, with these notions, the Weil pairing[4].

e_m: E[m]×E[m]→μm

is given by:

e_m $(P,Q)= f_p(B)/f_Q(A)$.

The Weil pairing e_m as defined above is well defined i.e. maps to a m^{th} root of unity and is independent of the choice of A and B and functions f_P and f_Q. This e_m is bilinear, non-degenerate and computable.

2.4 Tate Pairing

Let m be a positive integer coprime toq, such that $E(F_qk))$ contains a point of order m. Let k be the smallest integer satisfying $m|q^k-1$. Suppose $K=F_qk$. For every P∈E(K) and integers, let $f_{s,p}$ be a K-rational function with divisor

$div(f_{s,P}))=s(P)-([s]P)-(s-1)(\mathcal{O})$. The Tate pairing [6]

$e: E(K)[m] \times E(K)/mE(K)\rightarrow K^*/K^{*m}$

is given bye $(P,Q)=f_{m,P}(Q)(q^k-1)/m$. This pairing is also bilinear, non-degenerate and computable. Miller's algorithm[4] is used to compute the Weil and Tate pairings.

The Ate pairing[6] and all its variants are simply optimized versions of the Tate pairing when restricted to the eigenspaces of Frobenius.

3. TYPES OF PAIRINGS

Galbraith, Paterson,Smart[7] were the first to identify that all of the potentially desirable properties in a protocol cannot be achieved simultaneously i.e. what can be achieved or what cannot when a particular pairing type is employed. So they classified pairings into certain types. There are now four pairing types in cryptography literature.Galbraith, *et al.* originally presented three but a fourth type was added soon after by Shacham. Pairing type basically arises from the practical implications of placing $G_1$and G_2 in different subgroups of E[r].Very soon it was seen that is always best to set $G_1=\mathcal{G}_1=E[r]\cap Ker(\pi-[1])$, where π is Frobenius map. So the classification of four types of pairings are based on choice of G_2. The factors like the ability to hash and/or randomly sample elements of G_2, the existence of an isomorphism $\psi: G_2\rightarrow G_1$ which is often required to make security proofs work and issues concerning storageand efficiency. It should be in our mind that e(P,Q) will only compute non-trivially if P and Q are in different subgroups.

Type 1 pairing: This is the scenario where the elliptic curveE is supersingular curve. Because of this we can map out of G_1 with the distortion map ϕ.The pairing $e:G_1\times G_2\rightarrow G_T$ is called type 1 if $G_1=G_2$. We set $G_1=G_2=\mathcal{G}_1$ and we definee(P,Q)= ê(P,ϕ(Q)), where e^ is Weil or Tate pairing. In this pairing there are no hashing problems and we have a trivial isomorphism ψ from G_2 to G_1. The condition that E is supersingular is highly restricted and hence it is slow at higher security level. This is the drawback of this pairing.

Type 2 pairing: In this type E be ordinary elliptic curve. The pairing e: $G_1\times G_2\rightarrow G_T$ is called type 2 pairing if $G_1\neq G_2$ and we have an efficiently computable isomorphism $\psi: G_2\rightarrow G_1$. For best choice we set $G_1=\mathcal{G}_1$ and we take G_2 to be any of the (r-1) subgroups in E[r] that is not $\mathcal{G}_1$or $\mathcal{G}_2=E[r]\cap Ker(\pi-[q])$. We can take $\psi: G_2\rightarrow G_1$ as the trace map Tr. The drawback of this pairing is that there is no known way of hashing into G_2 specifically or to generate random elements of G_2. See Fig. 2.1.

Type 3 pairing: In this type the elliptic curve E is also ordinary. The pairing e: $G_1\times G_2\rightarrow G_T$ is called type 3 pairing if $G_1\neq G_2$ and we have no efficiently computable isomorphism $\psi: G_2\rightarrow G_1$ or $\psi: G_1\rightarrow G_2$. For this pairing we set $G_2=\mathcal{G}_2$. Now we hash into G_2. One drawback of this pairing is that security proofs that rely on the existence of isomorphism ψ are no longer applicable. See Fig. 2.2.

Type 4 pairing: In this scenario we take G_2 to be the whole r-torsion subgroup E[r], which is of order r^2. In the type 4 pairings the security proofs becomes more cumbersome as the image of the hash function into G_2 is not going to be into the group generated by P_2.

4. CRYPTOSYSTEMS BASED ON PAIRINGS

Security of a pairing- based protocol is based on some hard problems in the respective pairing groups. There are many hard assumptions in the asymmetric setting. For example, as shown in[8], security of Boneh-Lynn-Shacham (BLS) scheme in type-2 setting is based on computational Diffie Hellman problem (co-DHP) problem (i.e. compute h^z given $h \in G_1$and $g_2'^z \in G_2'$), whereas security of BLS scheme in the type 3 setting is based on the co-DHP* problem (i.e. compute h^z given h, $g_1^z \in G_1$ and $g_2^z \in G_2$). The Bilinear Diffie-Hellman assumption in type 2 pairing (BDH-2),Bilinear Diffie-Hellman assumption in type 3 pairing (BDH-3) with all versions are some more examples of hard assumptions in asymmetric setting. In this section we presentsome existing cryptographic protocols based on type 2 and type 3 pairings. We will see some of these protocols employ the isomorphism ψ in the protocol itself and some use it in security only. In this presentation we investigate two thing, first investigation is to determine the exact role played by isomorphism ψ in functionality and security of these protocols, secondly we investigate whether it is possible to avoid the use of ψ altogether[9].

4.1 Boneh-Franklin Identity based encryption (BF-IBE)

This scheme was originally described in the symmetric setting but latter also implemented in asymmetric setting[10,11]. We elaborate both BF-IBE based on type2 (BF-IBE-2) pairings and BF-IBE based on type 3 pairings (BF-IBE-3).

BF-IBE-2: In this scheme the master secret key is $x \in_R Z_n$ and the corresponding public key is $g_{pub}=g'^x_2 \in G'_2$. Given a user identity id $\in \{0,1\}^*$, the public key of the user is $h_{id}=H_1(id) \in G_1$ where $H_1: \{0,1\}^* \rightarrow G_1$ is publicly computable hash function. The corresponding private key is $d_{id}=h_{id}^x$. Now to encrypt a message $M \in \{0,1\}^n$,a sender chooses $r \in_R Z_n$ and sends$<g_2'^r$, M $H_2(e_2(h_{id}, g_{pub})^r) >$, where $H_2: G_T \rightarrow \{0,1\}^n$ another publicly computable hash function. The receiver computes $H_2(e_2(d_{id}, g_2'^r))$ and then xors it with the second component of the ciphertext to obtain M. We can decrypt the massage because of the property of pairing $e_2(d_{id}, g_2'^r)= e_2(h^x_{id}, g'_2)^r = e_2(h_{id}, g_{pub})^r$.

BF-IBE-3: The above BF-IBE-2 scheme can be directly implemented in type 3. In this KGC's public key is $g_{pub}= g^x_2 \in G_2$ and the ephemeral key in the ciphertext will be $g^r_2 \in G_2$. This study[9] show that type 3 is a better choice than type 2 for BF-IBE, i.e. BF-IBE-3 is a better choice than BF-IBE-2.

4.2 The Boneh-Lynn-Shacham (BLS) signature Scheme

This BLS short signature scheme[12] is also an example of asymmetric pairing. Let $\Gamma=(q, G_1, G_2, G_T, P_1, P_2, \hat{p})$ be a problem instance on which our pairing based protocol be defined. The BLS scheme requires the following three elements of the groups G_1, and G_2 to be defined.

1. The public key of the user is defined to be $R=xP_i$, for $i \in \{1, 2\}$, and some secret key $x \in F_q$.
2. The hash of a massage M is defined to be $Q_M=H(M) \in G_j$, for $j \in \{1,2\}$,and $H: \{0,1\}^* \rightarrow G_j$ is a cryptographic hash function.
3. The signature is given by $S \in G_k$, where either $S=xQ_M$ or $S=\psi(xQ_M)$.

From theabove step three steps we can instantly notice a number of points. Due to point 2 the group G_1 and G_2 must be randomly samplable; otherwise one would never be able to implement such a hash function.Due to point 3 we must have either j=k, or if there is an oracle to compute ψ we may also have (j,k)= (2,1).

4. To verify a signature we need to compute the pairing of either Q_M and R, or Q_M and $\psi(R)$, or $\psi(Q_M)$ and R. This implies that either $i \neq j$, or if there is an oracle to compute ψ we may also have i=j=2.We also need to compute the pairing of either S and P_i,or S and $\psi(P_i)$, or $\psi(S)$ andP_i. This implies that either $k \neq i$,or if there is an oracle to compute ψ we may also have i=k=2.

There are also some other well known cryptosystems from type-2 and type-3 pairings. For example Boneh-Boyen short signature scheme[13], Boneh-Boyen-Shachamshort group signature scheme [14], SCK identity-based encryption scheme[15] and ring signature scheme of Boneh, Gentry, Lynn and Shacham (BGLS-2 & BGLS-3)[16] etc. The ring signature scheme originally was in type-2 setting but it can be modify to allow in type-3 pairing.

In this section we have seen that some known protocols are in both, type-2 and type-3 setting. Chatterjee and Menezes[9] argued that an arbitrary type-2 setting protocol can be transformed to the type-3 setting protocol without affecting the functionality or security of the protocol. For this transformation they propose some guidelines.

5. SECURITY ANALYSIS

Following the paper proposed by Boneh and Franklin in 2001, many cryptographic schemes, based on bilinear pairings were proposed. Because of at higher security levels, type-1 pairings are expected to be slower on many platforms. So type-2 and type-3 pairings are considered better choices. Security of a pairing-based protocol is based on some hard problem in the respective pairing groups. The standard practice is to argue the security of the protocol in terms of a reduction from the hard problem to breaking the protocol in an appropriate security model. For example security of BLS scheme in the type-2 setting is based on co-

DHP problem, whereas the security of BLS scheme in type-3 setting is based on the co-DHP* problem. In [17] the authors observed that the efficiently-computable isomorphism ψ: $G_2 \rightarrow G_1$ is essential for the security of the protocol and can be avoided only at the cost of making a stronger complexity assumption.

From the analysis of BLS signature scheme[11], we can say that if ψ is not efficiently computable then one needs to select (i, j, k)=(2,1,1) and the security proof of the scheme in this relative to the hardness of the $CDH^{\psi}_{2,1,1}$ problem. In other words, although the scheme in this instance may not require an efficiently computable $\psi$the security proof is relative to an adversary which has oracle access to ψ. And if ψ is efficiently computable then one needs to select (i,j,k) from one of the(2,1,1), (2,2,1), (2,2,2). Now security proof is relative to the hardness of $CDH^{\psi}_{i,j,k}$ except that ψ is not only given as oracle access to the adversary it is actually computable, hence the hardness is relative to the standard $CDH^{\psi}_{i,j,k}$ problem. So from this discussion, we can say that if there is no efficiently computable isomorphism ψ: $G_2 \rightarrow G_1$, we have to make complex assumption on CDH problem. A similar analysis can be done for Boneh-Franklin encryption scheme.

6. CONCLUSION

Many pairing-based cryptosystems in the asymmetric setting rely on the existence of efficiently-computable isomorphism $\psi$from G_2 to G_1, i.e., the type-2 setting. Some initial works in pairing-based cryptography gave the impression that such an isomorphism is necessary for the functionality or the security of the cryptosystems or for both. But later it was argued that relying on such an isomorphism is more of an artifact of initial research in this area rather than an actual necessity as far as the functionality and security of the cryptosystems are concerned. In this paper we presented various types of pairing in cryptographic context. We reviewed cryptosystems based on asymmetric pairings and discussed implementation and security aspects of these cryptographic protocols. We have elaborated on the role of isomorphism ψ in these protocols. We have also elaborated on practical application of pairing based schemes for encryption and digital signatures. With the recent developments in cryptanalysis of discrete logarithm based schemes we would focus on security of practical pairing based cryptosystems.

निष्कर्ष

असममित व्यवस्था में कई युग्मन आधारित क्रिप्टोसिस्टम दक्षता से संगणनीय आइसोमॉर्फिस्म अर्थात, टाइप 2 व्यवस्था पर निर्भर करते हैं। युग्मन आधारित क्रिप्टोग्राफी में कुछ प्रारंभिक कार्यों से ऐसा लगा कि ऐसा आइसोमॉर्फिस्म क्रिप्टोसिस्टम की कार्यशैली या सुरक्षा या दोनों के लिए आवश्यक है। लेकिन बाद में यह दलील दी गई कि ऐसा आइसोमार्फिस्म पर निर्भरता इस क्षेत्र में, जहां तक क्रिप्टोसिस्टम की कार्यशैली और सुरक्षा का संबंध है, एक वास्तविक आवश्यकता होने के बजाए प्रारंभिक अनुसंधान की एक शिल्पकृति अधिक है। इस पत्र में हमने क्रिप्टोग्राफिक संदर्भ में विभिन्न प्रकार के युग्मनों को प्रस्तुत किया है। हमने असममित युग्मनों पर आधारित क्रिप्टोसिस्टम की समीक्षा की और इन क्रिप्टोग्राफिक प्रोटोकॉलों के कार्यान्वयन और सुरक्षा पहलुओं पर चर्चा की। हमने इन प्रोटोकॉलों में आइसोमार्फिस्म की भूमिका की विस्तृत व्याख्या की है। हमने इनक्रिप्शन और डिजिटल हस्ताक्षरों के लिए युग्मन आधारित स्कीमों के व्यावहारिक अनुप्रयोग की भी व्याख्या की है। असतत लॉगरिथ्म आधारित स्कीमों के क्रिप्टाएनालिसिस में हुए हाल के विकासों के साथ हम व्यावहारिक युग्मन आधारित क्रिप्टोसिस्टम की सुरक्षा पर ध्यान केन्द्रित करेंगे।

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देवनागरी में विरासती कूटलेखन से यूनीकोड में प्रव्रजन संबंधी मुद्दे
Issues in Migration from Legacy encodings to Unicode in Devanagari

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सारांश

यूनीकोड अभिकलनात्मक भाषाविज्ञान के लिए सर्वाधिक पंसदीदा कूटलेखन पद्धति के रूप में उभरा है, बहुत सारे इंडिक भाषा आंकड़े ८ बिट गैर–मानक ग्लिफ आधारित कूटलेखन में हैं। बहुत बड़ी मात्रा में विरासती आंकड़ें मौजूद हैं जिन्हें यूनीकोड मानक में परिवर्तित करने की जरूरत है। अतः, उन विरासती आंकड़ों को कॉरपस बनाने, खोजने, छांटने/परितुलन क्रम इत्यादि के लिए उपयोग करना व्यावहारिक रूप से असंभव है। इस पत्र में देवनागरी के लिए विरासती कूटलेखन योजनाओं में मौजूद पाठ को यूनीकोड में परिवर्तित करने की समस्याओं पर चर्चा की गई है। विरासती फॉन्ट विशिष्ट रूप से इंडिक लिपियों की विशेषताओं को इन तरीकों से कूटबद्ध करते हैं जो तार्किक कूटलेखन से अत्यधिक असंगत होते हैं। बन्ध (लिगेचर) का ग्लिफ निरूपण विरासती कूटलेखन योजनओं में एक सामान्य परिपाटी है। यह पत्र विभिन्न फॉन्ट वेंडरों से विरासती आंकड़ों का यूनिकोड में प्रव्रजन करने के लिए सॉफ्टवेयर डिजाइन करने हेतु किए गए अध्ययन पर आधारित है और ऐसे मामलों पर प्रकाश डालता है जिन्हें विरासती कूटलेखन से यूनिकोड में प्रव्रजन करते समय ध्यान में रखना चाहिए। इसे इसके लिए एक दिशानिर्देश के रूप में उपयोग किया जा सकता है और इस पत्र में चर्चा किए गए मुद्दों को अन्य इंडिक लिपियों के लिए भी सामान्यीकृत किया जा सकता है।

ABSTRACT

UNICODE has emerged as most favoured encoding system for computational linguistics, lots of Indic language data is in 8-bit non-standard glyph-based encoding. There is huge legacy data which needs conversion to Unicode standard. It is therefore practically impossible to use that legacy data for corpus generation, searching, sorting / collation order etc. This Paper discusses problems of converting text in legacy encoding schemes for Devanagari to Unicode. Legacy fonts typically encode features of Indic scripts in ways that are highly incompatible with logical encodings. Glyph representation of ligatures is a common practice in legacy encoding schemes. This Paper is based on study that was carried out for designing software for migrating legacy data from various font vendors to Unicodeand throw some light on cases that one must take into account when migrating from legacy encodings to UNICODE.It can be used as a guideline for same and the issues discussed in this paper can be generalised for other Indic scripts.

Keywords: Unicode, font, devanagari, legacytext, encoding, conjunct, vowel diacritic, logical encodings

1. INTRODUCTION

Major challange faced when processing of Indian language data for corpus generation and other similar fields is the existence of Indic data in non standard encodings. This paper mainly focuses on Devanagari script issues ,it may be anticipated that issues in other indic script are comparable.

Since there was no text editor who could fully support Unicode, lack of awareness about Unicode and lack of support at OS level, people opted to work with font based 8 bit encodings or legacy encodings. Font vendors started to use the ASCII codes 128-255 for their own purposes while some vendors also used lower 128 also.

Because of very delayed support from operating systems and web browsers web publishers were quite hesitant to use any standard such as UNICODE.

Atext oriented solution to delivery of Indic text has been given in the form of legacy encodings or in house fonts encoding.These encodings introduced inconsistencies and anomalies in Indic text of same script where these two data could not be used for same purpose and carrying font everywhere was not a good solution.and they are indeed big problem when one wants to have multi-script data in a single database or when question comes of resource sharing. (Rajesh Chandrakar, (2002)).

2. LEGACY ENCODINGS FOR DEVANAGARI

First standard of encoding of all Indian language scripts was ISCII (Indian Standard Codefor Information Interchange; see Bureau of Indian Standards, 1991) and PASCII(Perso Arabic standard Code for Information Interchange)which are storage standards and not suitable for display.

However these encodings were rarely used by font vendors who used their own approach to encode the script. These font vendors chose to construct a8-bit font. These are also known as "graphical encodings" as these encodings are based upon representing graphical form of a particular letter of a script with out emphasizing on abstract value of letterIn this context non Standard effectively means "not Unicode."

ISCII provide a quite transparent relationship between characters and their Unicodeequivalents which contains only basic alphabets required by Indic scripts and provide one to one character mapping between ISCII code and its Unicode equivalent.

Logical encodings such as Unicode marks a difference between glyph and character.Visualrepresentaion of same character on paper or any screen will be called glyph. Encoding which emphasizes on encoding character such as UNICODE and ISCII does not define glyphs or images.

Where as graphical encodings emphasizes on representing glyphs of various characters of a script.

"Devanagari letter KA" may be visually different in two different 8-bit encodings.In Shivaji font this letter has been assigned code point 0x6B while in DV-TTYogesh font it has been assigned code point B4.

It seems clear that both vendors assigned two different code points for same character "Devanagari letter KA".

If we observe same case in two different open type fonts used for Unicode, In Mangalfont

character code: 0915

while in DV-OT Yogesh it wil look like

Character Code : 0915

It is clear that Visual Representaion of one character may differ in Unicode but encoded value for that character will remain fixed. As Logical Encoding does not define glyphs or images ,but abstract value or code point will remain same in both cases which is 091[5].

When "U+20B9 Indian Rupee Sign" was introduced in Unicode 6.0 ,Various font vendors started to add this symbol in their respective fonts.As most of 128 positions were already occupied in their fonts, this lead to either removing the existing glyph from font and supporting rupee symbol at that vacant position. Complexity of this case can be understood taking example of Shivaji Font.

To support rupee symbol in Shivaji font vendors chose to removeexisting glyph, half consonant form of "ज"

Which is "Devanagari letter nya" and was at code point 0x48 and glyph for rupee symbol added at same position. This solution has many ill consequences.It will produce problems for users who are accustomed to typing in previous version of font and also exists possibilities of data loss . Data generated with previous version of Shivaji Font will have compatibility issues with data of new font .

Some vendors could not delete any glyph from existing font,So designed a new font only for rupee symbol. Foradian Technologiesdesigned a new font rupee.ttf which will display rupee symbol at code point 60. However, code point 60 can be assigned to a different character inanother font. For instance in Shree-dev-0708 font rupee symbol will be visible as य.

While for Unicode this process consisted of supporting Rupee sumbol glyph at code point 20B9 in open type font and OS vendors releasing updates which can be downloaded and installed freely.

3. DIFFICULTIES IN MAPPING 8 BIT ENCODINGS TO UNICODE

3.1 Vowel Symbols

Devanagari and other ancient Indian scripts that have originated from Brahmi Script represent vowels in two forms, as–

Independent Vowels and Dependent Vowels

In Unicode, code points(0904-0914)represent Independent Vowels.

While Dependent vowel letters can not stand alone . In Devanagari Unicode Code chart dependent vowels cover range from 093E to 094C. There are equivalent matras for all vowels except aa vowel. (0904).

Dependent vowels and Independent vowels has been assigned separate code points in both ISCII and Unicode. But that is not certainly case with legacy encodings. To look briefly at an example in Devanagari, in word "Deye" in Aps-DV Priyanka Font,"0905 Devanagari letter A" is formed with two Character codes 0x44 and0x65 while this letter is represented in Unicode with a single code point.

Unicode-equivalent: 0905

Rendered as: अ

Similarly independent vowels letters AA, O, AU are

formed in font APS DV-Priyanka as–

"0906 Devanagari letter AA" is formed in this font as

Character codes0x44 0x65 0x65

Rendered as: आ

Similarly " 0913 Devanagari letter O" is formed

with character codes

"0914 Devanagari letter AU" is also formed with four character codes

It seems clear that there is one glyph representing half form of independent vowel letter "U+0905 Devanagari letter A" which will form other independent vowels "AA", "O" and "AU" when juxtaposed with one or more glyphs of vertical stem which is at code point 0x65 and glyphs representing independent vowels forms of O and AU.

Thing to be noted is that neither vertical stem has been assigned a code point in Unicode nor half form of "U+0905 Devanagari letter A".

When data contains such vowel sequences, we can not have one to one mapping from such sequences as they are considered invalid because virarma sign can be applied only to consonants.We can not have virama sign applied to vowel itself as language orthography does not permit this.

3.2 One Code Point for Multiple Characters

In some legacy fonts, same code point is used to represent two or more consonants. In APS-DV Priyanka Font, Code points are assigned to glyphs representing tail of various consonants ka, pha andva. In this font consonantka is formed with 3 character codes.

Character Codes: 0x6B 0x650xE2

Unicode-equivalent: 0915

Rendered as: क

Formation of dead consonant ("U+0915 Devanagari letter KA") in this font is with three character codes.

Character Codes :0x6B0x650xE4

Unicode-equivalent 0915+094D

Rendered as क्

Formation of consonant ("U+092B Devanagari letter PHA") is also with two character codes in this legacy font.

Character Codes:0x480x65 0xE2

Unicode-equivalent:092B

Rendered as : फ

It may be depicted with above visual representations that various glyphs when joined in sequence form a single consonant in legacy encoding while consonants have been assigned separate code points in Unicode. Legacy encodings do not follow any standard for representation of consonants also and may encode glyphs for half or quarter of a consonant and same code point is used to form two or more different consonants.

3.3 No Separate Code Point for Visarga

No separate code point for Visarga:Some vendors do not assign separate glyph for Devanagari sign visarga. Devanagari Sign Visarga (0903 in Unicode) has visual similarity to ASCII colon sign(0x3A) . Some font vendors take advantage of this fact and does not provide separate code point for visarga sign and use ASCII colon sign wherever visarga sign is required in text. In APS-DV Priyanka font there has been incorrect use of ASCII character colon to represent Visarga Sign in Devanagari.

Value 3A which is Ascii value of colon has been used to represent Visarga. When migrating to Unicode in such type of data colon value can not be kept intact, it must be mapped to Visarga. Though how actual character colon will be represented in migrating from such encoding is an another issue.One solution in this scenario could be to insert Devnagri Sign Visarga (0903) wherever colon character was used to represent Visraga in legacy data during migration process. There are scenarios when people do this in another different way i.e using visarga in place of colon.

3.4 Juxtaposing Dependent Vowels Signs to Dead Consonant

In logical encodings such as Unicode and iscii, Dependent Vowel Signs can not be applied to dead consonant.

In Indic text generated with Shivajifont,there are several instances where a matra has been juxtaposed on a dead consonant .

Half forms of consonnats, Ligatures have not been assigned code points in Unicode. However they can be formed using zero width joiner, if such glyph has been provided in font itself.

However in above scenario when dependent vowel signs are juxtaposed on dead consonant. In migration process to Unicode virama Sign can be omitted to make sequence logically correct as per script orthography and considering this as typo error in data generation with legacy encodings.In another way dead consonant can be displayed as half consonant with use of zero width joiner and omit mapping of dependent vowel sign aye, but this method will result in data loss.

3.5 Formation of Ligatures

There are no separate code points assigned to ligatures in logical encodings however same is not true with glyph based encodings. In Unicode, ligatures are glyphs not characters. One may provide glyphs for ligatures in open type font, but they do not have separate code points. In contrary to this legacy encodings encode most ligatures with a single code point.

In APS-DV-Priyanka font Glyphs are assigned for various ligatures. One instance is ligature DNKHA which is encoded at code point 0x93. While unicode equivalent is

Unicode equivalent:095C + 094D + 0916

Rendered as: ड्ख in mangal font on windows xp.

Mapping seems to be simple for ligatures during migration process. Half ligatures are also assigned unique code points in some legacy encodings and as they do not have unique code point in unicode and for representation of them one need to use zero width joiner in Unicode.

In AkrutiDev Yogini font half ligature form kSha(Devanagari consonant ka+Virama+Devanagari letter SSA) is represented with a single Character code 0x23 whose unicode sequence is:

Unicode sequence:0915+094D +0937+ 094D + ZWJ

rendered as: क्ष n mangal font on windows XP.

One may have to use zero width joiners when migrating to unicode from such encodings in half ligatures scenario and need to have same glyph in open type font.

4. CONCLUSION

Legacy encodings that may be found in Indic text vary greatly.While most of legacy encodings are based upon graphical representation of characters thus diacritics,ligatures, contextual variations and other language primitives have great variation in terms of encoding used. Most of 8-bit encodings are based upon graphical representaion of characters. Mapping from an logical encoding like ISCII can be easy while same can not be true for mapping from glyph based encoding for a number of reasons as mentioned in Section 3 and in short as following -

a. A single code point being used for different characters in different encoding schemes
b. The purpose of a code point is determined by the value of one or more other nearby code points
c. Incorrect code point values
d. Missing code points
e. Multiple code points for a single character
f. Various representations of the character
g. Insufficient documentation of the encoding mechanism

But before start with migration of such legacy data to UNICODE, first step should be to understand the scope of the challenge, compare and contrast common problems that are likely to be encountered.

Although this is a fairly time-consuming process , but the benefits can be worth the cost for bringing out the valuable legacy data in the most favorable Encoding scheme UNICODE.

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निष्कर्ष

विरासती कूटलेखन, जो इंडिक पाठ में पाया जा सकता है, बहुत भिन्न–भिन्न होता है। जहां अधिकतर विरासती कूटलेखन संकेताक्षरों के ग्राफीय निरूपण पर आधारित होते है, अतः डायक्रिटिक्स, लिगेचर्स, संदर्भगत भिन्नताएं और अन्य रूढ़ि शब्द प्रयुक्त कूटलेखन की दृष्टि से अत्यधिक भिन्नताएं रखते हैं। अधिकतर 8 बिट कूटलेखन संकेताक्षरों के ग्राफीय निरूपण पर आधारित होते हैं। आईएससीआईआई जैसे एक तार्किक कूटलेखन से मैपिंग आसान हो सकती है जबकि कई कारणों से, जैसाकि खंड 3 में उल्लेख किया गया है और संक्षेप में नीचे दिया गया है, ग्लिफ आधारित कूटलेखन से मैपिंग के संबंध में यह बात सत्य नहीं हो सकती है।

1. भिन्न–भिन्न कूटलेखन स्कीम में विभिन्न संकेताक्षरों के लिए एक एकल कूट बिंदु का उपयोग किया जा रहा है
2. किसी कूट बिंदु का प्रयोजन एक या अधिक अन्य नजदीकी कूट बिंदुओं के मान द्वारा निर्धारित किया जाता है
3. गलत कूट बिंदु मान
4. लुप्त कूट बिंदु
5. एक एकल संकेताक्षर के लिए अनेक कूट बिंदु
6. संकेताक्षर के विभिन्न निरूपण
7. कूटलेखन तंत्र का अपर्याप्त प्रलेखन

किंतु ऐसे विरासती आंकड़ों के यूनिकोड में प्रव्रजन को शुरू करने से पहले, पहला कदम चुनौती के दायरे को समझने और उन सामान्य समस्याओं की तुलना और विभेद करने का होना चाहिए जिनके पेश आने की संभावना है। यद्दिप यह काफी समय–खपाऊ प्रक्रिया है, किंतु इसके लाभ सर्वाधिक अनुकूलनीय कूटलेखन स्कीम यूनिकोड में बहुमूल्य विरासती आंकड़ों को लाने की लागत से कहीं अधिक हो सकता है।

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हल्के वजन वाले ब्लॉक साइफर्स के डिजाइन मानदंडों से संबंधित कुछ परिणाम
Some Results on Design Parameters of Lightweight Block Ciphers

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सारांश

इस पत्र में, हम हल्के वजन वाले ब्लॉक साइफर्स एफईडब्ल्यू में प्रयुक्त मानदंडों पर विशेष ध्यान देते हुए ब्लॉक साइफर्स के डिजाइन मानदंडों से संबंधित कुछ परिणामों को प्रस्तुत कर रहे हैं। पत्रों में आज तक प्रकाशित ब्लॉक साइफर्स ज्यादातर दो संरचनाओं पर आधारित होते हैः फाइस्टेल और सबस्टिट्यूशन पर्म्यूटेशन नेटवर्क। हम एफईडब्ल्यू के राउंड फंक्शन में प्रयुक्त शाखा संख्या के महत्व पर चर्चा करेंगे। इसके कारण, एफईडब्ल्यू क्रिप्टाएनैलिटिक हमलों के विरुद्ध अन्य साइफर्स से अधिक सुरक्षित होने का दावा किया जाता है। हम प्रत्येक 4 बिट के छोटे आकार को लेने वाले फंक्शनों हेतु 16 बिट इनपुट पर शिफ्ट और एक्सओआर के सभी संभावित संयोजनों के संबंध में अपने प्रयोग के परिणाम भी प्रस्तुत कर रहे हैं। हम शाखा संख्या का अधिकतम मान उत्पन्न करने के लिए रैखिक परतों में प्रयुक्त शिफ्टों और एक्सओआर के 4 अलग–अलग संयोजन पाते हैं। हम 4–शाखा सामान्यीकृत फाइस्टल संरचनाओं को भी वर्गीकृत करते हैं और कुछ डिजाइन मानदंडों में मौजूद दोहनीय दुर्बलता को दर्शाते हैं।

ABSTRACT

In this paper, we present some results on design parameters of block ciphers with specific attention to the parameters used in lightweight block cipher FeW. Block ciphers published in literature till date are mostly based on two structures: Feistel and Substitution Permutation Network. We discuss the importance of branch number used in the round function of FeW. Due to which, FeW is claimed to be more secure than other ciphers against cryptanalytic attacks. We also give the results of our experiment on all possible combinations of shift and XORs on 16-bit input to the functions which are taking the nibble size of 4 bit each. We find out 4 distinct combinations of shifts and XORs used in linear layers to produce the maximum value of the branch number. We also classify 4-branch generalized Feistel structures and show the exploitable weakness present in some design parameters.

Keyword: Block cipher, branch number, feistel structure, lightweight cryptography, SPN structure

1. INTRODUCTION

Block ciphers are among the oldest and widely used cryptographic primitives known in the history of cryptography. Starting from the era of classical cryptography, there are various examples of old ciphers which perform encryption on the blocks of data e.g. Vigenere, Hill cipher etc. Block ciphers of today`s era are evolved to encounter the problem of key management occurred in codebook based ciphers. The first widely used block cipher is Data Encryption Standard (DES)[4] which was adopted as an encryption standard in 1975 after an announcement of NBS (today`s NIST) for designing a Data Encryption Standard for commercial applications. This cipher was being used for two and a half decade and variety of cryptanalytic attacks were also published on DES including the very famous differential[4] and linear attacks[10] in 1990`s. After some real time cryptanalytic attacks on full round DES, there was an initiative by NIST for establishing a new Advance Encryption Standard in 1998. As an outcome of the competition held over 3 years, Rijndael[5] was selected as AES in 2001. After the acceptance of AES, some cryptographers started saying that cryptography is almost dead and it is not possible to design a cipher better than AES. This was the time when most of the new designs in symmetric key cryptography were using design parameters already used in AES. Some of them were using the MDS layers and some of them were relying on the S-box of AES to design a secure and efficient cryptography primitive. At the same time the IT industry was also growing at the very fast pace and security applications were being made available to the common public[2][9]. Due to the urgent requirement of security requirements

in the new technologies, industry came up with some new proprietary cryptography primitives like KeeLoq used in the key of cars to cater the demand[2] [9]. Some of these algorithms were badly broken and thereafter academia started research in the direction of Lightweight Cryptography[8] somewhere in the beginning of 21st century. The first remarkable lightweight block cipher design is the ultra-lightweight block cipher PRESENT [3], which is also chosen as a lightweight encryption standard by ISO and Electro-technical Commission (ISO/IEC 29192-2). After the popularity of PRESENT, new lightweight block cipher designs started raining in crypto conferences and journals. There were almost 10-20 new designs being published yearly and all of them used a tailored cryptography in some or the other way to design a new lightweight block cipher. Majority of them are based on Feistel and SPN structure and designed using modifications or combinations of the previously published designs.

2. DESIGN PARAMETERS

There are mainly two types of reliable design structures to design a secure and efficient block cipher. The first one is Feistel Structure named after the Horst Feistel, the designer of Lucifer and the second is Substitution Permutation Network (SPN) structure whose origin lies in the famous paper written by Shannon in 1949 and it is used in the design of the current encryption standard AES. In this paper, we focus on the Feistel based design parameters that are used to design a new lightweight block cipher. DES was the first widely known and used Feistel based block cipher. There are two main categories in Feistel structure: balance Feistel and unbalance Feistel [2] [11]. In balance Feistel, the whole block size is divided into equal parts (Fig 1) and unbalance Feistel divide the block into unequal parts. Feistel structure based designs rely on the first structure i.e. balanced Feistel. The classical Feistel structure proceeds by dividing the whole block length into two equal parts. If the branches (equal size) in the structure are more than two then this is called a generalized Feistel structure. There are several lightweight block cipher designs[2] [9] based on Feistel and generalised Feistel structure. These are LBlock [15], CLEFIA [14], TWINE [13] etc. Recently we have proposed one new category in Feistel structure which we have called Feistel-M (Mix) structure[7]. In this structure, we perform mixing operation on the data between generalised Feistel branches. We have designed a lightweight block cipher called FeW based on Feistel-M structure.

2.1 Generalized Feistel Structures (4-branch)

In generalised Feistel structure, some branches are used to modify other branches and some remain

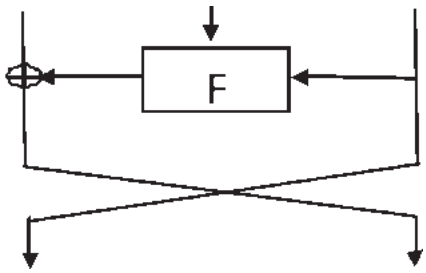

Figure 1. Feistel structure.

unchanged for the next round. In this section, we analyze the 4-branch generalized Feistel structures in detail. We define the branches used to modify other branches as the source branches and the branches to be modified as the target branches. We categorize 4-branch generalized Feistel based designs in the following three categories on the basis of number of round functions used:

There is only one round function used to design a block cipher and it modifies only one branch out of the 4 branches. We are using one round function to modify one branch using either 1st or 2nd or 3rd branch out of the remaining three branches.

I. Only one source branch is used to modify one target branch (Fig 2).

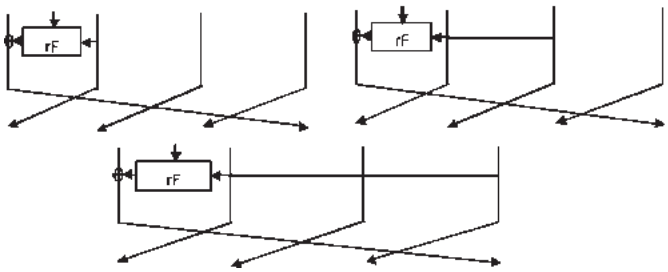

Figure 2. One source and one target branch.

II. Two source branches are used to modify one target branch (Fig 3).

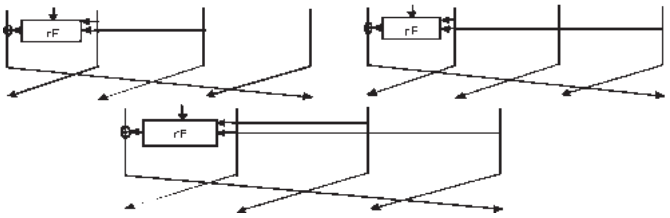

Figure 3. Two source and one target branch.

III. All three source branches are used to modify one target branch (Fig. 4).

Two round functions are used in the design and these two round functions may be the same or different functions. These modify one target branch separately by using one source branch resp. There is only one possibility for this type (Fig. 5).

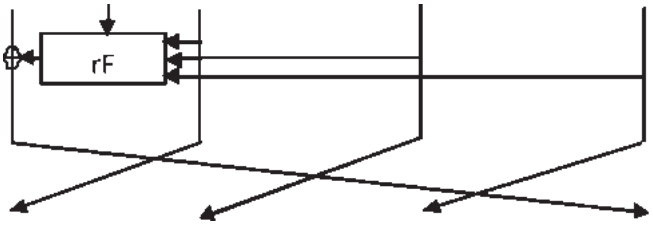

Figure 4. Three-source and one target branch.

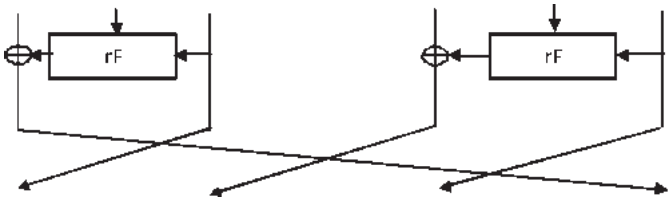

Figure 5. Two-source and two target branches (resp.).

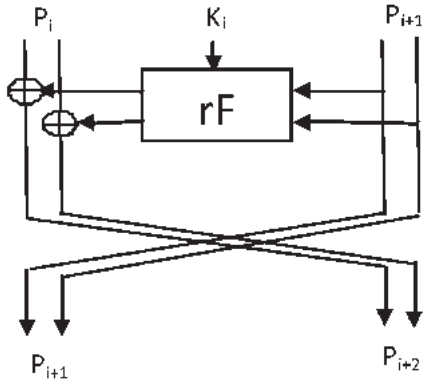

Figure 6. Two-source and two target branches (Feistel-M).

Two round functions are used within F and these two round functions communicate between each other and swap some data between them before processing. This is called Feistel-M structure, a mix between Feistel and generalized Feistel structures (Fig. 6).

3. WEAK DESIGN PARAMETERS

We are describing now two design parameters (Figs. 7 & 8) which are very weak and can be broken easily. If we use two round functions with 2 source braches as input and it uses these branches to modify other two target branches. We also assume that we XOR both the inputs and key materials to produce same size of output.

These type of design structures (Figs. 7 & 8) are prone to full round differential attack. We present differential distinguisher for the above two types of design structures.

Differential distinguisher for type-I structures is:

(ffff ffff ffff ffff)$\xrightarrow{\text{Pr.1}}$ (ffff ffff ffff ffff)

Differential distinguishers for type-II structures are:

(ffff ffff ffff ffff)$\xrightarrow{\text{Pr.1}}$(ffff ffff ffff ffff)

(0000 0000 ffff ffff)$\xrightarrow{\text{Pr.1}}$(0000 0000 ffff ffff)

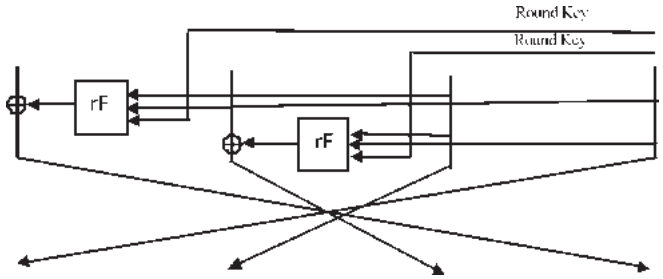

Figure 7. Weak design parameter type-I.

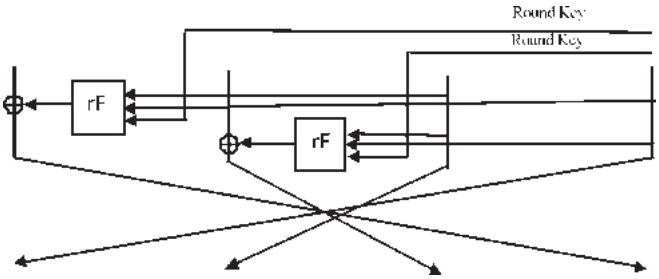

Figure 8. Weak design parameter type-II.

(ffff ffff 0000 0000)$\xrightarrow{\text{Pr.1}}$ (ffff ffff 0000 0000)

We use r-1 round differential trail of probability 1 to recover the last round subkey of r-round block cipher. We can use these distinguihers to distinguish between the ciphertext obtained from the ciphers using these types of structures and the random data.

4. BRANCH NUMBER

Kanda [6] has discussed about branch number of differnet type of functions used in linear layers of round functions. We describe the branch number of the functions used in 4-branch generalised Fesitel and Feistel-M structures. If a functions F takes n bits as input (Ip) and produces n bits as output (Op) as follows:

F: $\{0,1\}^n \rightarrow \{0,1\}^n$

then its branch number $\beta_{(N)}$for some non zero input (Ip) is defined as:

$$\beta_N(F) = \min_{Ip \neq 0, Ip \in \{0,1\}^n} (Hw(Ip) + Hw(Ip))$$

where Hw(Ip) is the number of non zero bits in Input (Ip) and Hw(F(Ip)) is the number of non zero bits in the output (Op) of the function F.

We apply shifts with xores on branches of Feistel by dividing these in some group of bits called nibbles to achieve a better diffusion. Therefore we modify the definition of branch number according to our input and output requirement. We divide n-bit input X and n-bit output Y in m number of nibbles, where each nibble is of fix size b-bit. We redefine the branch number of a function with some non zero input X to the function F, where X consists m nibbles with b bits in each nibble.

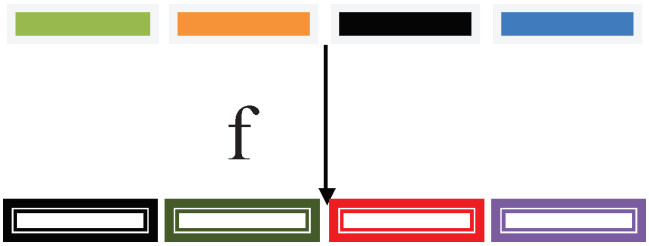

Figure 9. Function F with 4 nibble input and 4 nibble output.

$$\beta_N(F) = \frac{\min}{X \neq 0, X \in \{0,1\}^n}(Hw(X) + Hw(Y))$$

Here Hw(X) impies the number of non zero nibbles in the input X to the function F and Hw(Y) implies the number of non zero nibbles in the output Y= F (X).

In case of FeW[7] lightweight block ciphers, whose block size is 64 bits and each of the Feistel branch is of size 16-bit. Shifts and xors are applied on these 16-bit in the round function. Therefore, we need to find shifting and xoring combinations which gives the maximum branch number to result a best diffusion. We divide 16 bits into 4 nibbles of 4-bit each, so our function take 4 nibbles as input and produces 4 nibbles as output. A pictorial view of this type of function is as follows in Fig 9.

For a non zero input X with 4 nibbles, all possible number of non zero nibbles in the input and output is listed in Table 1.

We conclude from the table that the maximum value of the branch number for a 4 nibble input is 5. We have to search for those shifts and xor combination in input and output such that the branch number is not less than 5 for all possible values of inputs.

Shifts and XORs used in function F is as described by the equation below. It applies XOR between X and different circular shifts on X. One of these values is X itself and the other four have used different combination of left circular shifts.

$Y = X \oplus X{<<<}p \oplus X{<<<}q \oplus X{<<<}r \oplus X{<<<}s$

We searched for all possible values of shifts and XORs with the help of a computer programme and found that there are only four distinct valuse of shifts which gives the maximum value of branch number (i.e. 5). These values are listed in the Table 2.

Table 2. Distinct values of circular shifts

Valuses for left circular shifts giving the Max value of branch Branch Number (i.e. 5)			
p	q	r	s
1	5	9	12
3	7	11	12
4	5	9	13
4	7	11	15

5. CONCLUSION

In this paper, we focused on the 4-branch generalised Feistel based design parameters used to design a new block ciphers. We categorized these parameters in three categories and presented some useful and important observations to be avoided while designing a new block cipher. We also presented the possible value of circular shift used to obtain the maximum branch number for the functions with 4-nibble input and 4-nibble output. We have found only 4 distinct values of these circular shifts, which provide us the maximum value of the branch number.

निष्कर्ष

इस पत्र में, हमने एक नया ब्लॉक साइफर्स डिजाइन करने के लिए प्रयुक्त 4–शाखा वाले सामान्यीकृत फाइस्टल आधारित डिजाइन मानदंडों पर ध्यान केन्द्रित किया। हमने इन मानदंडों को तीन श्रेणियों में श्रेणीबद्ध किया और उन उपयोगी और महत्वपूर्ण समुक्तियों को प्रस्तुत किया जिनसे एक नया ब्लॉक साइफर्स डिजाइन करते समय बचना चाहिए। हमने 4 छोटे इनपुट और 4 छोटे आउटपुट वाले फंक्शनों हेतु शाखा संख्या का अधिकतम मान प्राप्त करने के लिए वृत्ताकार शिफ्ट का संभावित मान भी प्रस्तुत किया। हमने इन वृत्ताकार शिफ्टों के 4 अलग–अलग मान भी पाए हैं, जो हमे शाखा संख्या का अधिकतम मान प्रदान करते हैं।

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Table 1. Branch number of functions with 4 nibbles input and output

Possible number of non zero nibbles in inputs and outputs																
Input: X	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4
Output:Y	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Branch Number	2	3	4	5	3	4	5	6	4	5	6	7	5	6	7	8

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फज्जी लॉजिक क्वान्टम की डिस्ट्रिब्यूशन
Fuzzy Logic Quantum Key Distribution

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सारांश

क्वान्टम क्रिप्टोग्राफी बहुत आकर्षक बन गई है क्योंकि यह कुंजी वितरण के लिए बिना शर्त सुरक्षा प्रदान करती है। क्वान्टम क्रिप्टोग्राफी अभिकलनों और संचार के लिए, जो क्रिप्टोग्राफी से संबंधित होते हैं, नए अवसरों की तलाश करने के लिए क्वान्टम मैकेन्किस में अवधारणाओं का उपयोग करती हैः प्राइम फैक्टराइजेशन के लिए शॉर का एलॉगरिद्म और क्वान्टम की डिस्ट्रिब्यूशेन के लिए बीबी 84 प्रोटोकॉल कुछ प्रमुख उदाहरण हैं। इस पत्र में, क्वान्टम क्रिप्टोग्राफी की आधारभूत बातों पर चर्चा करने के बाद, हमने नवीनतम विकासों की समीक्षा की है और फज्जी लॉजिक क्वान्टम की डिस्ट्रिब्यूशन (एफएलक्यूकेडी) को प्रस्तुत किया है। फज्जी लॉजिक क्वान्टम की डिस्ट्रिब्यूशन (एफएलक्यूकेडी) बिट त्रुटि दर को कम कर देता है और इस प्रकार मापित ध्रुवीकरण पर आधारित प्राप्त बिट्स को निर्धारित करने में अनिश्चितता का निराकरण कर देता है। फज्जी लॉजिक क्वान्टम की डिस्ट्रिब्यूशन (एफएलक्यूकेडी) बिना शर्त सुरक्षा और पूर्ण गोपनीयता प्रदान करने के लिए एककालिक पैड (ओटीपी) के साथ संयोजित किया जाता है।

ABSTRACT

Quantum cryptography has become very attractive as it offers unconditional security for key distribution. Quantum cryptography utilizes the concepts in quantum mechanics for exploring new avenues for computations and communication related to cryptography. Shor's algorithm for prime factorization and BB84 protocol for quantum key distribution are some prime examples. In this paper, after discussing the basics of quantum cryptography, we review the latest developments and present the Fuzzy Logic Quantum Key Distrbution (FLQKD). FLQKD reduces bit error rate and hence resolves the uncertainity in determining the received bits based on the measured polarization. The FLQKD is combined with One Time Pad (OTP) to provide unconditional security and perfect secrecy.

Keywords: Fuzzy logic, quantum mechanics, quantum cryptography, key distribution, encryption, decryption, unconditional security, perfect secrecy, otp

1. INTRODUCTION

Cryptography has benefitted from various fields such as Number Theory, Information Theory, Probability Theory, Complexity Theory, Fractal Theory etc. While pushing the frontiers of research in cryptography, researchers have left no stones unturned. In this direction, modern physics with quantum mechanics has been explored to find possibilities for crypto tasks[1]. Quantum cryptography originated from the use of quantum mechanical effects (i.e., quantum communication and quantum computation). Classical Physics has found extensive applications and resulted in the present day high performance computers and cryptographic algorithms. Quantum cryptography has found applications in crypto tasks such as key distribution and prime factoring. However, current applications of Quantum computing is limited to these[2,4].

The major advantage of quantum cryptography is in providing unconditional security in case of (QKD) and speedup in computation of prime factors of large numbers. The further advances in quantum cryptography can usher in whole new array of cryptographic protocols. While conventional cryptography fails to detect the eavesdropping on the communication channels, Quantum cryptography is able to detect eavesdropping in quantum channel[5,6]. While speech encryption based approaches have been developed for anti-tapping mobile phones[9], quantum cryptography would facilitate secure communication with Unconditional security.

Current Quantum cryptography techniques such as BB84 Quantum Key Distribution have several limitations[6,7]. Fuzzy Logic based techniques have been successfully applied for solving several problems with uncertainity[10]. In this paper we introduce fuzzy

logic block to facilitate resolution of uncertainity in decision making in QKD. The innovation of combining QKD and fuzzy logic has several benefits such as reduced bit error rates while transmitting the keys over quantum channel.

This paper is structured as follows: we discuss the basic concepts of quantum cryptography in the next section. The key quantum crypto algorithms i.e., Shor's algorithm and QKD protocols are discussed in section 3. In section 4, further discussion on implementation of QKD protocols is presented. In Section 5, we discuss the fuzzy logic applications in QKD. Summary and conclusions are presented in section 6.

2. QUANTUM CRYPTOGRAPHY

Quantum cryptography is based on the principles of quantum mechanics[1]. Quantum mechanics (QM) is a part of modern physics and deals with physical phenomena at sub-atomic particle levels.Quantum mechanics provides a theoretical explanation of the dual wave-particle behavior and interactions of energy and matter.

Quantum mechanics has been instrumental in explaining various sub-atomic phenomenon and also helpful in development of many new technologies. Some of the important concepts of quantum mechanics which are further useful in discussing quantum cryptography are as follows[8]:

- *Uncertainty Principle:* This principle states that the two complementary properties such as positon and momentum of a sub-atomic particle cannot be accurately determined. While one of the properties is measured accurately, there will be uncertainity about the other and vice-versa.
- *Wave-Particle Duality:* Light was earlier thought either to consist of waves or of photons. The current view based on the quantum mechanics is that sub-atomic particles such as photons, electrons, protons etc. also have a wave nature. This phenomenon has been verified not only for elementary particles, but also for compound particles like atoms and even molecules.
- *Quantum Super-position:* This is a basic principle that holds an elementary sub-atomic particle such as an electron to exist partly in all its particular theoretically possible states (i,e., Spin directions) simultaneously. However, when measured, the result corresponding to only one of the possible states is observed.
- Quantum Entanglement: This is a physical phenomenon that occurs when groups of particles are generated or interact in ways such that the quantum state of each particle cannot be described independently. A quantum state may be given for the system as a whole rather than individual particles. Measurements of group physical properties such as position, momentum, spin, polarization, etc. performed on entangled sub-atomic particles are found to be correlated. For example, if a pair of electrons is generated in such a way that their total spin is known to be zero and if one electron is found to have upward spin, then the spin of the other electron, will be found to be downward.

Quantum computers are based on the principles of quantum mechanics. They are designed to exploit the quantum mechanics for computing problems which any conventional computer would find it impossible. Quantum computers would solve set of computing problems, such as factoring integers, faster than conventional computers. However, for most of the computing problems, quantum computers may not add value. Quantum computer uses qubits instead of bits, unlike in a conventional computer. A qubit may be a particle such as an photon or electron whose polarization or spin direction encodes the information. For example, for a photon, the vertical polarization can be used for representing 1, horizontal polarization for representing 0. The quantum states called super-positions that consist of both the states simultaneously. Elementary particles such as photons or electrons in superposition states can carry an enormous amount of information. For example: 100 particles can be in a superposition that represents every number from 1 to 2100 . A quantum computer is designed to manipulate all those numbers concurrently by mechanisms such as Lases bombardments. Such designs can operate on the particles, and can solve certain problems such as prime factoring of large number instantaneously.

One of the most striking quantum computing algorithm is the Shor's Algorithm[1]. This is a quantum computing algorithm for prime factoring large numbers developed by Peter Shor of MIT. The computational difficulty of prime factoring large numbers is the basis of RSA algorithm. The successful implementation of Shor's algorithm using quantum computer will threaten the RSA algorithm by making it easy to compute private keys The efficiency of Shor's algorithm is due to the efficiency of the quantum Fourier transform, and modular exponentiation by repeated squarings. However, the factorization requires huge numbers of quantum gates. In 2001, a group at IBM implemented Shor's algorithm on quantum computer and factored 15 into 3×5, using an NMR implementation of a quantum computer with 7 qubits.

3. QUANTUM KEY DISTRIBUTION

Quantum cryptography has been successful with the development of QKD. QKD uses quantum communication to establish a shared key. The QKD key distribution is highly secure and makes it impossible for the

eavesdropper to determine the key. QKD protocol has even been commercialized by several companies such as BBN[4].

The details of QKD are illustrated with the following example. Alice wants to setup a secret key with Bob for communication using QKD. Alice first encods the bits of the key as quantum data i.e., using polarization of photons. The photons are transmitted to Bob on a quantum channel (such as optical fibres). If Eve tries to intercept the key information on quantum channel, the polarization of photons will be modified in the process which can be observed by Alice and Bob.The key exchanges will be used for encrypted communication using ciphers such as One Time Pad.

- The security of QKD has been proven mathematically which is not possible with classical key distribution.
- The QKD provides unconditional security i.e., no matter what techniques the eavesdropper adopt to break the key, it will not be possible to regenerate the key. This is unlike in public key cryptographic systems such as RSA where it is computationally made infeasible to determine the private key by knowing the public key. While the eavesdropper can easily intercept the public key in RSA, the chances of finding the private key are very little given the difficulty of prime factoring large numbers such 1024 bit number. However, QKD imposes no restriction on computation or communication.
- Quantum key distribution that occur at the subatomic level i.e., polarization of photons.
- Eavesdropper cannot intercept the communication and obtain the bits of the key as such attempts can be detected. Since measuring photons can result modification of polarization.
- The polarization of a photon is used to represent each bit. Horizontal polarization may represent bit '0' while vertical polarization may be used for bit '1'.
- While the sender encodes the key bits into stream of photons by modifying their polarization as required, the optical fibre serves as a quantum channel to carry those photons to the recipient.
- The receiver does measurements on the photon stream received and determines their correct polarization thus decoding the key.

Some of the preliminary information regarding the photon polarization and their measurement are as follows:

- The wave-particle dual nature of light leads to the concept of photon which is an elementary particle of light carrying a fixed amount of energy.
- The polarization is a physical property of light. Light is as an electromagnetic wave and the direction of the electric wave is the direction of the polarization of light.
- The direction of a light's polarization is oriented to any desired angle (using a polarizing filter) and also can be measured using a calcite crystal.
- Rectilinearly polarization: The polarization directions at 0° or 90° with respect to the horizontal are collectively referred to as rectilinear polarization represented by symbol +. The vertical and horizontal polarizations are at 0° or 90° with respect to the horizontal and are represented by symbols: ↕ and ↔.
- Diagonally polarization: The polarization directions at 45° or 135° to the horizontal are referred collectively as diagonally polarization represented by symbol X. The right and left polarizations are at 45° or 135° to the horizontal. and are represented by symbols / and \.
- Table 1. shows the binary bits and their corresponding light polarization representations.
- While transmitting a key stream consisting of

Table 1. Binary bits and polarization representations

Bits	Rectilinear Polarization +	Diagonal Polarization X
0	↔	\
1	↕	/

"0100111001", the rectilinear and diagonal polarization schemes may be used randomly by the sender. A sequence of photons may encoded with these polarizations as shown in the following table 2.

- While receiving these bits, to determine whether

Table 2. Encoding with polarization

Bits	0	1	0	0	1	1	1	0	0	1
Polarization	↔	/	\	↔	↕	↕	/	↔	\	/
Basis	+	X	X	+	+	+	X	+	X	X

it is 0 or 1, the polarization of the photons need to be measured for each bit duration. The rectilinear or diagonal filters (basis) have to be appropriately used. If the receiver uses a wrong basis, the measurement of the polarization may not be accurate.

4. PROTOCOLS FOR QKD

Two persons Alice and Bob want to communicate the secret key using QKD. Alice orients photons with one of the four possible polarizations. She chooses the polarizations at at random. For the photons received, Bob selects random the type of measurement: either the rectilinear (+) or the diagonal (X). Bob collects the result of his findings and stores it securely. Bob communicates to Alice the measurement bases he used. Alice confirms the correct bases used by Bob. Alice

and Bob retain the bases in which Bob adopted the correct base for measurements and delete the incorrect ones. Now the correct bits recorded with these bases define the key.

The conversion of key bits into a sequence of rectilinearly and diagonally polarized photons is termed as conjugate coding. The rectilinear and diagonal polarization are referred to as conjugate variables. Quantum mechanics principle of uncertainity implies that it is impossible to measure the values of any pair of conjugate variables simultaneously. Another set of conjugate variables used for illustration are position and momentum of sub-atomic particles such as electrons. In quantum mechanics, position and momentum are also referred to as incompatible observables. This is because of the impossibility of measuring both at the same time accurately. This principle also applies to rectilinear and diagonal polarization for photons. If an observer tries to measure a rectilinearly polarized photon with respect to the diagonal, all information about the photon's rectilinear polarization is lost in the process.

4.1 BB84 Protocol

BB84 is the earliest quantum key distribution scheme, proposed by Bennett and Brassard 1984[3]. BB84 makes it possible for two users to establish a secret common key sequence using polarized photons. The protocol consists of following steps:

- Alice and Bob want to communicate with each other. Alice first generates a random bit sequence s. Alice uses two types of photons i.e, rectilinearly polarized, "+", or diagonally polarized, "X" while representing each bit in s. A rectilinearly polarized photon encodes a bit in the +-basis, while a diagonally polarized photon encodes a bit in the X-basis. Let b denote the sequence of choices of basis for each photon.
- Alice creates a sequence p of polarized photons whose polarization directions represent the bits in s. The sophisticated equipments may be used in this step.
- Alice communicates p to Bob over a quantum channel (can be optical fibre).
- Bob while receiving the photons, randomly uses rectilinearly or diagonally polarized basis for measuring each bit. Let b' denote his choices of basis.
- Bob generates a new sequence of bits s' after making the measurements.
- Bob over a telephone like tells Alice his choice of basis for each bit, and Alcie confirms whether he made a right choice or not. The bits for which Alice and Bob have used same bases are retained and rest are discarded.

Error Reconciliation: This is a process for error correction procedure while transmitting the key bits over quantum channel. The reconciliation contributes to detection of :

- errors due to incorrect choices of measurement basis
- errors induced by eavesdropping, and
- errors due to channel noise.

Reconciliation consists of recursive search for errors in the blocks of data.

- Parity is added to each block of data.
- Whenever their respective parities for specific blocks do not match, the sizes of the blocks are reduced and further the error bits are detected recursively.
- For the error bit, discard the corresponding bit, or agree on the correct value.
- The reconciliation may be performed over non-quantum communication channel.

QKD has several limitations and drawbacks.

- In QKD, apart from using Quantum Channel, there is also communication of information over insecure non-quantum channel between the two users. This channel may be a telephone line or computer network which is susceptible for eavesdropping without detection.
- Curiously, any information obtained by an eavesdropper through this channel is useless.
- When an eavesdropper is detected on Quantum channel, the QKD must be aborted and postponed. This can cause indefinite delays in establishing the secret keys.
- Also, single photons have been suggested to be used for carrying the bits. This makes it very expensive and difficult to realize the QKD in hardware.

5. FUZZY LOGIC QUANTUM KEY DISTRIBUTION

The uncertainity about the measurement of polarization of photons by receiver can be resolved with the use of fuzzy logic QKD (FLQKD). The fuzzy logic based decision making ensures that the error rates of received key bits is reduced. The following block diagram shows the use of fuzzy logic block in the FLQKD. The photons received are passed through Rectilinear or diagonal basis filters. Then, the fuzzy logic block is used for determining the bit to be 1 or 0.

The steps involved in the FLQKD are as follows:

1. Alice transmits the following key bit stream s consisting of 1s and 0s.
2. Alice selects a sequence of encoding bases at random, say b = +X+XX.
3. Alice polarizes the photons corresponding to bit stream s using the bases b.
4. Bob receives the photons transmitted on quantum channel, and measures them with a set of randomly chosen measurement bases b' = +X+XX..

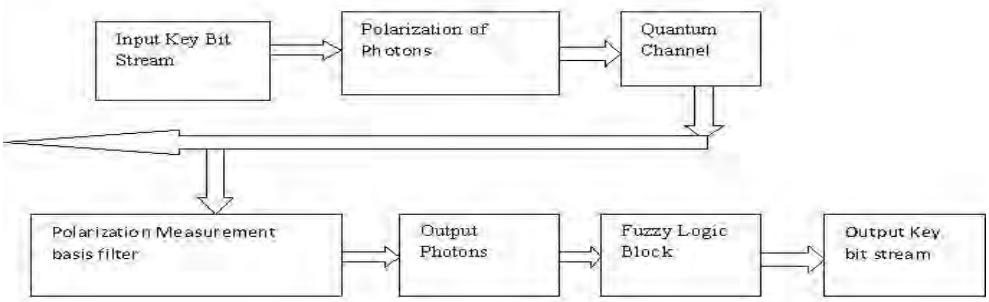

Figure 1. Block diagram of FLQKD.

5. Bob uses the fuzzy logic block to make a decision on whether bit '1' or bit '0' was received based on the measurement.
6. For rectilinearly polarized photons, there is a probability that they may pass through the diagonal basis vice-versa. This leads to uncertainity which is resolved by the fuzzy logic block.

Fuzzy logic block takes as input the number of photons received for each of the bases used. It outputs the decision on whether the bit received is 1 or 0. The Fuzzy logic block has membership functions which are tuned for the quantum channel being used using machine learning techniques. The typical membership function for bits '1' and '0' for a given basis are as shown in the following figure. The 'i' corresponds to use of wrong basis for measurements. Currently, the FLQKD is being modelled using Simulink and Matlab (Fig.2)

Benefits of FLQKD:

- Better decisions in finding the bits resulting in improved bit rates and reduced error rates.
- Membership functions of fuzzy logic block can be tuned to suit the quantum channel.
- Multiple photons instead of single photons can be utilized for conveying the single bit information.
- Detection of use of wrong basis while doing the polarization measurements.

6. SUMMARY AND CONCLUSION

In this paper, we have discussed in detail the basic and advance concepts in quantum cryptography which is a promising field. Quantum cryptography provides unconditional security as the basis for security is in the quantum mechanics theory from the modern physics. The protocols such as quantim key distributionhave been discussed in detail in this paper. The technology required for realizing QKD are currently available. Laboratory demonstration systems for QKD have been successfully made and currently focus is on developing commercial products. Fuzzy Logic based QKD further solves the uncertainity in bit level decision thus improving the data rate of key transmission and reducing the bit error rate. The FLQKD for key distribution and One-time-pad for Encryption/Decryption will provide Perfect Secrecy and Unconditional Security for data communication.

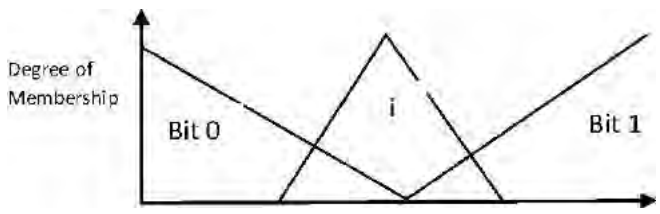

Figure 2. Fuzzy logic membership functions.

निष्कर्ष

इस पत्र में, हमने क्वान्टम क्रिप्टोग्राफी में निहित मूलभूत और उन्नत अवधारणाओ पर, जो कि एक उत्तम संभावनाओं वाला क्षेत्र है, विस्तार से चर्चा की है। क्वान्टम क्रिप्टोग्राफी बिना शर्त सुरक्षा प्रदान करती है क्योंकि सुरक्षा का आधार आधुनिक भौतिकी के क्वान्टम मैकेनिक्स सिद्धांत में निहित है। इस पत्र में, क्वान्टम की डिस्ट्रिब्यूशेन जैसे प्रोटोकॉल पर विस्तार से चर्चा की गई है। क्वान्टम की डिस्ट्रिब्यूशेन को साकार करने के लिए अपेक्षित प्रौद्योगिकी वर्तमान में उपलब्ध है। क्वान्टम की डिस्ट्रिब्यूशेन के लिए प्रयोगशाला प्रदर्शन प्रणालियों को सफलतापूर्वक बनाया गया है और वर्तमान में ध्यान वाणिज्यिक उत्पादों को विकसित करने पर केन्द्रित है। फज्जी लॉजिक आधारित क्वान्टम की डिस्ट्रिब्यूशेन बिट स्तरीय निर्णय में अनिश्चितता का निराकरण भी करता है और इस प्रकार 'की' ट्रांसमिशन के आंकड़ों के दर को बढ़ाता है और बिट त्रुटि दर को कम करता है। की डिस्ट्रिब्यूशन के लिए फज्जी लॉजिक क्वान्टम की डिस्ट्रिब्यूशेन और एनक्रिप्शन/डिक्रिप्शन के लिए एककालिक पैड आंकड़ा संचार के लिए अचूक गोपनीयता और बिना शर्त सुरक्षा प्रदान करते हैं।

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होमोमोरफिक एन्क्रिप्शन के वास्तविक अनुप्रयोग
Practical Applications of Homomorphic Encryption

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सारांश

डेटा आउटसोर्स करने की जरूरत दिन पर दिन बढ़ती जा रही है। आउटसोर्स डिजिटल डाटा की गोपनीयता बनाए रखने और उस पर किया जाने वाला अभिकलन प्रमुख चिंता का विषय है। हम आउटसोर्सिंग से पहले डेटा एन्क्रिप्ट करके और फिर इस एन्क्रिप्टेड डेटा पर अभिकलन करके इन चिंताओं से मुकाबला कर सकते हैं। यह होमोमोरफिक एन्क्रिप्शन की मूल अवधारणा है। होमोमोरफिक एन्क्रिप्शन का उद्देश्य एन्क्रिप्टेड डेटा की गोपनीयता बनाए रखना, एन्क्रिप्टेड डेटा पर अभिकलन करने का क्षमताओं की वृद्धि, एन्क्रिप्टेड डेटा को ढूढना आदि हैं। एन्क्रिप्टेड डेटा पर अभिकलन करने का क्षमताओं की वृद्धि कई वास्तविक अनुप्रयोगों में काम आ सकती हैं। क्लाउड कंप्यूटिंग के प्रति बढ़ती रुचि और झुकाव ने होमोमोरफिक एन्क्रिप्शन के लिए विभिन्न डोमेन को खोल दिया है। दुनिया की कई वास्तविक समस्याओं का इसी से मुकाबला किया जा सकता हैं। इस आलेख को माध्यम से (कार्यान्वयन के परिणामों की मदद से) हम ई–वोटिंग, ई–नीलामी, गुप्त सूचना साझा करना और दुनिया की वास्तविक समस्याओं में होमोमोफिज्म प्राप्त करने के बारे में व्याख्यान देते है।

ABSTRACT

The need to outsource the data is increasing day by day. Preserving the privacy of outsourced digital data and carrying out computation on it is a major concern. These concerns can be addressed if we encrypt the data before outsourcing it and then performing computation over the encrypted data, this is the basic concept of Homomorphic encryption. The aim of Homomorphic Encryption is to ensure privacy with added capabilities of performing computation over encrypted data, searching an encrypted data etc. Certainly this additional capability (performing computation over encrypted data) leads to many practical applications. The growing interest and inclination towards cloud computing has opened various domains for Homomorphic Encryption. Many real world problems can be addressed by the same. In this paper we have explained (with the help of implementation results) how homomorphism can be achieved in E-Voting, E-Auction, Secret sharing and other real world problems.

Keywords: Homomorphic encryption, fully homomorphism, cryptosystem

1. INTRODUCTION

The development of cloud computing has highlighted the need of computation over encrypted data because data is held by third party (cloud provider) which may or may not be trustworthy, therefore it is kept in encrypted state one of the traditional cryptosystem satisfies the needs of cloud computing environment. Thus Homomorphic Encryption (HE) came into existence. An encryption is said to be homomorphic if and only if the result obtained by applying some operations on plain text is the same as if applied on cipher text and decrypting it. Data is processed without knowing the private key, i.e, without performing the decryption. From and *Enc (b)* it is possible to compute *Enc (f(a,b))* where f can be + or x or can be combination of both.The encryption is said to be additive homomorphic encryption if operator used is + (additions on plain text) and it is Multiplicative Homomorphic Encryption if operator used is x (products on plain text). Since it ensures the confidentiality of processed data it has wide range of applications and acceptability. Homomorphic cryptosystems can be used to ensure secure systems such as E-voting, E-auctions, Multi Party Computation, Private information retrieval(PIR), etc.

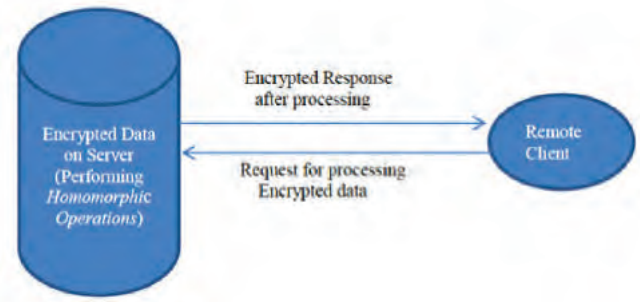

Figure 1. Homomorphic encryption.

2. HOMOMORPHIC ENCRYPTION

The term Homomorphic Encryption is actually derived from the group homomorphism HE has a long history since 1978, but advancement in HE has increased after Craig Gentry's work[6] In 2009, Gentry proposed a Somewhat Homomorphic Encryption (SHE) scheme which supports multiplication as well as addition but the shortcoming of this scheme was that it supports limited number of additions and multiplications. Indeed the limit in the number of operations is due to error part(noise) that was introduced deliberately while generating key pairs Then in 2010,he converted SHE into Fully Homomorphic Encryption(FHE) with the use of bootstrapping. In bootstrapping operation he reduced the noise part which increases after every homomorphic operation. When this noise reaches its threshold, then decryption of operated cipher text will not yield correct output. This is how, he developed FHE from SHE which overcame the shortcoming of SHE. Fully homomorphic cryptosystems can be defined as the cryptosystems that preserves the ring structure of the plain text. Before 2009 homomorphic cryptosystems defined were partially homomorphic that preserves the structure of addition or multiplication but not both. The concept of somewhat homomorphism and fully homomorphism removed this drawback. In fully homomorphic encryption , When the error goes above threshold, a new cipher text (also called refreshed cipher text) is created in which error is comparatively less than the error in original cipher text.

3. PRACTICAL APPLICATIONS OF HOMOMORPHIC ENCRYPTION

A homomorphic encryption function allows for the manipulation of encrypted data without inherent loss of the encryption. Homomorphic cryptosystems are used instead of traditional cryptosystems because of its inherent property and wide application scope. Some of the applications are listed below

3.1 E-Voting

Electronic voting also termed as E-voting uses electronic systems for casting and counting votes In E-voting votes are digitized Confidentiality of the voter is threatened if his vote is decrypted, by the election authorities who are counting the votes. To overcome this issue, the concept of homomorphic E-voting came into existence. In this scheme the votes of the voters are counted before decryption. There can be ' ' number of candidates, voter must vote for one and only one candidate. A vote can be represented by a vector where 1 indicates vote for the candidate and 0 indicates no vote for the candidate. Thus there will be n entries in the vector equal to the number of candidates in the election. Each voter encrypts his vote and submits it to the election authorities and they continue to count the vote in its encrypted state with any additive homomorphic encryption algorithm. This is explained with the help of implementation results in next section.

3.2 Multiparty Computation

Multiparty computation (MPC) is a sub domain of cryptography which helps multiple parties to unitedly compute a function over their inputs but these parties can be mutually untrusted, therefore their inputs must be kept private. MPC protocol is required for communication and for preserving the privacy of data, so that the party who wants to compute a function will have no information of the inputs provided by all other parties and have access only to the final value computed. Assume there are m number of parties P_1, P_2, P_3.....P_m providing their inputs X_1, X_2, X_3..... X_m to the server for computation such that inputs must be kept private from each other and from the server too. Server should not have access to these value. Figure 2 shows the topology of the network.

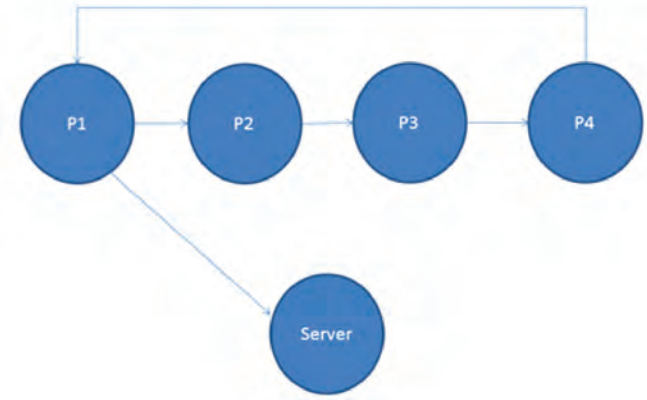

Figure 2. Topology of the Network.

Server generates a public private homomorphic key pair for computation. P_1 encrypts its input X_1 using the public key of server and then multiplies it with a random value 'a' known only to P_1, then encrypts this value with the public key of P_2 and forwards it to P_2 . P_2 then encrypts its input X_2 with public key of server and decrypts the value sent by P_1 with its own private key and then multiplies that value with encrypted X_2 and gets $Enc(a \times X_1) \times Enc(X_2)$, encrypts this with public key of P_3 and forwards it to P_3 and this way it continues till P_m gets the encrypted value of $a \times X_1 \times X_2 \times X_3 ... X_{m-1}$. P_m then multiplies this value with its input X_m which is also encrypted with server's public key and then encrypts $Enc(a \times X_1 \times X_2 \times \ldots X_{m-1}) \times Enc(X_m)$ with P_1's public key and transmit it to P_1, P_1 divides the whole value by 'a' and forwards it to the server where he decrypts the value of the function with its private key. Thus individual inputs are kept private

from server and all remaining parties and the value of the function is computed. Figure 3 illustrates the whole process considering only 3 parties and function to be computed by the server is taken as

$$F(X_1, X_2, X_3) = X_1 \times X_2 \times X_3$$

Implementation details of the whole process is described in Section 4.

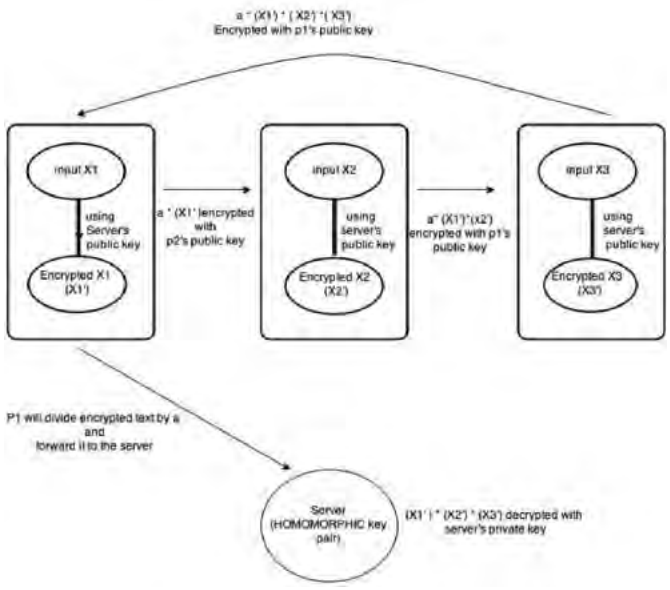

Figure 3. Multiparty computation.

3.3 Secret Sharing

In secret sharing, a secret is distributed among different parties and each party shares some part of the secret. The secret is reconstructed only when sufficient number of shares (say k) are combined, this is termed as thresholding scheme where k shares are mandatory for secret reconstruction. Anyhow, less than k shares will not reveal the secret and also the individual shares are of no use. Each secret can be formulated into a polynomial where constant term represents the secret. Degree of polynomial is equal to one less than number of parties involved. The constant term of polynomial is the secret. Assume there are '*m*' parties involved in this protocol. α_0 the constant term is the secret which is to be shared among *m* parties. Therefore a polynomial formulated for this secret can be written as

$$f(x) = a_0 + a_1 * x + a_2 x^2 + \ldots\ldots a_{m-1} x^{m-1}$$

here the coefficients $a_1, a_2, \ldots a_{m-1}$ are randomly chosen by the one who is sharing this secret with m parties. Each share is a tuple $(x, f(x))$. The secret cannot be reconstructed till *m* parties are involved. Just as minimum 2 points are necessary for finding the equation of a line, 3 points are required for formulating a quadratic equation, 4 points for finding the equation of a curve similarly *m* shares are required to reconstruct equation of degree m^{-1}.

3.4 E-Auction

E-Auction is a mechanism in which participants bid for the items and item allocation is done based on their bidding prices E-Auction protocol consists of an auction server, auctioneer, bidders and a bulletin board that is used to broadcast the encrypted bid value in order to ensure that no bidder repudiate his bid. First of all, bidders register themselves to the auction server so that they can participate in the bidding process. Each bidder generates a bidding vector and publishes his encrypted bid vector on the bulletin board.

Consider the case when there are n bidders bidding for an item and a set of biddable prices (say from 1 to *X*).Operations are based on Group Z_{13}. Every bidder selects a bid price Y_i from the predefined range 1 to *X* and generates a random vector of length *X*. Based on his bidding value the bidder constructs his bid vector B_i which is also of length *X*. Y_i values of bid vector of a bidder are same as his random vector values and remaining values are 0. Then each bidder N_i splits his bidding vector into *N* (equal to number of bidders involved in the process) random vector and sends the N^{th} random vector to N^{th} bidder. Now the bidder B_i gets his final bidding vector B_i' by adding all these random components and publishes it to the bulletin board. This way all the bidders publish their final bid vectors. Using these vectors, a deciding vector is formed by adding all these vectors that were published by the bidders. Find out the maximum value in this deciding vector. If this value matches with any of the bidder's random vector's value then that bidder will win the auction. This whole process can be explained by a toy example:

Let's say there are *2(N=2)* bidders and bidding range be 1 to 5(here $X = 5$). N_1 choose 2 and N_2 chooses 4 as their bidding prices. Operations are based on group Z_{13} . Random vectors chosen by them be (2,4,8,10,12) and (1,3,7,5,11). Their bidding vectors will be

B_i=(2,4,0,0,0) { 2 values are same as its random vector's values and remaining values are 0}

B_2=(1,3,7,5,0) {4 values are same as its random vector's values remaining values are 0}

Now each of the bidder will divide his vector into n sub components under the mod 13 operation. The 2 sub components of N_1 can be B_{11} =(11,9,7,5,12) and B_{12} =(4,8,6,8,1) and for N_2 sub components can be B_{21} =(2,10,4,10,4) and B_{22} =(12,6,3,8,9) now there vectors are exchanged with other bidders. B_1 will forward its B_{12} to B_2 and B_2 will forward its B_{21} sub vector to B_1 Final bid vectors that will be published on the board will be:

B_1'=(11+2 mod 13, 9+10 mod 13, 7+4 mod 13, 5+10 mod 13, 12+4 mod 13)= (0,5,11,2,3)

Similarly

B_2'=(4+12 mod 13, 8+6 mod 13, 6+3 mod 13, 8+8 mod 13, 1+9 mod 13)=(3,1,9,3,10)

Final deciding vector BV=(3,6,7,5,0)

Maximum value of final vector is 7

This value matches with 3rd value of random vector of bidder N_2. Therefore B_2 wins the auction.

3.5 Homomorphic Lottery Protocol

In homomorphic lottery schemes, there is an auditor whose homomorphic key pairs are used in the entire process. A winning lottery ticket is selected by all the participating parties randomly such that winning probability of each participant is the same. Suppose there are N number of sparticipants and each participant selects a random number in the predefined range {0 to N -1} and encrypts it with the auditor's public key before publishing. These encrypted numbers are added homomorphically using any additive homomorphic cryptosystem. The sum is obtained by adding all the numbers chosen by the participants. S mod N is computed efficiently to get the winning ticket of the lottery. Thus the process ensures the fairness because decryption process is not kept private. Even the auditor will not be able to deceive.

3.6 Private Information retrieval

If client wants to obtain index of outsourced data without giving information about to the server (may be remote).one of the solution which suffice the needs of client is sending the entire database to the client machine but this will increase the communication cost which is not desirable because database can be of large size. Homomorphic PIR scheme can do this with significantly less overhead and more security. Let say server contains vector (database) of integer values which are in range $(0, m)$. Client formulates a vector whose i^{th} (index to be retrieved) value is 1 and remaining values are zero. Encrypt all the values of a vector and send it to the server where homomorphic multiplication of client's encrypted vector and vector present at server is performed. After this additive HE algorithm is applied to add all the values obtained after multiplication. This will output the data present at i^{th} index of the vector but is encrypted. Server sends this encrypted data to client for decryption

4. IMPLEMENTATION AND RESULTS

The applications discussed in previous section are implemented in C/C++ using GMP library and results are verified. We have used Paillier cryptosystem for the implementation of E-Voting and RSA cryptosystem for multi party computation. The results of the same are shown below.

Let V be the set of voters and X be the set of candidates. Suppose there are 4 voters and 3 candidates.

$V = \{V_1, V_2, V_3, V_4\}$ and $X=\{X_1, X_2, X_3\}$

Using the paillier Cryptosystem [5]

we took P=5 and q=7 as two primes, then n =35 and n^2 = 1225 and λ=12. is chosen to be 141. Assume that V_1 voted for X_1 and random value (r) chosen by him for encryption is 11. First voter's vector is [01 00 00] which shows he voted for X_1 therefore its corresponding value is 01 and value corresponding to X_2 and X_3 is 00. Now convert this binary value into its decimal equivalent (say X) which is equal to 16. Then value of encrypted vote is calculated as:

$$Enc(X, r) = g^X \times r^n mod\ n^2$$

$$Enc(16,11) = 141^{16} \times 11^{35} mod\ 1225 = 541$$

Similarly encrypted values of other votes are computed which are shown in theTable 1:

In order to sum the votes, we multiply the encrypted vote values modulo and calculate the cipher text as

$$C = 541 \times 298 \times 202 \times 741 mod 1225 = 1101$$

Now the decryption is done as :

$$Dec(C) = \left(L\left(C^{\lambda} mod\ n^2\right) \times \left(L\left(g^{\lambda} mod\ n^2\right)\right)^{-1}\right) mod\ n$$

$$L\left(1101^{12} mod\ 1225\right) = (351 - 1)/35 = 10$$

$$L\left(141^{12} mod\ 1225\right) = (456 - 1)/35 = 13$$

$$Dec(C) = 10 \times (13)^{-1} mod\ 35 = 25$$

binary equivalent of 25 is 01 10 01 (01 02 01) that shows 2 votes are casted for . Therefore is the winner.

Table 1. Implementation results of E-voting

Voters	Random No.	X_1	X_2	X_3	Binary equivalent of vote	Decimal equivalent of vote	Encrypted vote
V1	11	01	00	00	010000	16	541
V2	2	00	01	00	000100	4	298
V3	3	00	01	00	000100	4	202
V4	6	00	00	01	000001	1	741

4.2 Multiparty Computation

We present here a toy example using RSA cryptosystem (multiplicative homomorphism) to illustrate the whole process. Considering there are 3 parties which are providing their data to the server for computation. Let *P* be a vector containing data of all the parties that includes randomly selected 2 prime numbers, public key and the private key.

P = { 1st prime number, 2nd prime number, public key, private key}

The public key and private key selected by all the 3 parties and the server using RSA cryptosystem[7] are:

P_1 = {7, 19, 37, 73}
P_2 = {23, 29, 47, 367}
P_3 = {11, 31, 71, 131}
S = {11, 17, 23, 7}

Function to be computed by the server is

$$F(X_1, X_2, X_3) = X_1 \times X_2 \times X_3$$

And input of the 3 parties are X_2 =2 , X_2 =3 and X_3 =4. The parties will encrypt their input using public key of the server. Their values after encryption are:

X_1'=162 X_2'=181 and X_3'=64

1st party P_1 will multiply encrypted input by a random variable say 'a' (let value of 'a' be 1) and encrypt the whole value by P_2's public key and forward it to P_2.

$$Enc(a \times (X_1')) = 70$$

P_2 will decrypt 70 using its private key and will get 162 back. Now P_2 will find the product of Enc(a (X_1')) and Enc (X_2') whose value will be 29322. P_2 will encrypt this value by P_3's public key and transmit it to P_3 . Then P_3 decrypt it with its private key and follow the same procedure as followed by P_2 and transmit the same to P_1. Now P_1 will decrypt it and divide it by 'a' and forward it to the server. Server will get the solution of the function by decrypting the output by its private key.

5. CONCLUSION

The field of homomorphic encryption is attracting many of the researchers these days and they are taking keen interest in developing homomorphic cryptosystem that can be deployed practically. The focus is on its practical applicability and on how real world problems can be solved easily preserving the privacy of the client. In our paper, we have implemented and shown how homomorphic encryption can be helpful in some of the practical problems and also shown how these problems can be dealt with. Applying homomorphic encryption to the traditional approaches makes them more secure and reliable. In future, we will like to focus on designing or modifying existing homomorphic cryptosystems we will also attempt to extend the usability and practicality of Homomorphic Encryption Scheme. Homomorphism is a growing field and there is much more to explore in it.

निष्कर्ष

होमोमोरफिक एन्क्रिप्शन का क्षेत्र इन दिनों शोधकर्ताओं को आकर्षित कर रहा है और वे वास्तविक रूप में लगने वाले होमोमोरफिक क्रिपटोसिस्टम को विकसित करने में रूचि ले रहे हैं। हमारा ध्यान इसकी वास्तविक अनुप्रयोगता और उपभोक्ता की गोपनीयता बरकरार रखते हुए दुनिया के समस्याएँ कैसे समाप्त हो पर रहेगा। हमारे आलेख में हमने होमामोरफिक एन्क्रिप्शन को कार्यान्वित किया और दिखाया हैं कि यह कुछ वास्तविक समस्याओं में मददगार हो सकता है और इनसे कैसे निपटा जा सकता है। पारंपरिक पद्धतियों के स्थान पर होमोमोरफिक एन्क्रिप्शन लागू करके इसे अधिक सुरक्षित और विश्वसनीय बनाया जा सकता हैं। भविष्य में, हमे नए मोरफिक एन्क्रिप्शन की डिजाइन पर या इन मौजूदा होमोमोरफिक एन्क्रिप्शन क्रिप्टोसिस्टम को संशोधित करने पर ध्यान केंद्रित करना होगा। हम होमोमोरफिक एन्क्रिप्शन योजना की उपयोगिता और वास्तविकता के विस्तार का प्रयास करेगें। होमोमोरफिज्म एक बढ़ता हुआ क्षेत्र है और उस में पता लगाने के लिए बहुत कुछ है।

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निगरानी अनुप्रयोग के सक्रिय आंतरिक और बाहरी दृश्य हेतु सर्फ और हैरिस गुण विश्लेषण

Surf and Harris feature Analysis for Dynamic Indoor and Outdoor Scene for Surveillance Application

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सारांश

निगरानी अनुप्रयोगों में दृश्यित वस्तु पर नजर रखना कंप्यूटर दृष्टि में एक महत्वपूर्ण कार्य है। सक्रिय और जटिल दृश्यों की स्वचालित वीडियो निगरानी कंप्यूटर दृष्टि में सबसे अधिक सक्रिय अनुसंधान विषयों में से एक है। कंप्यूटर दृष्टि और वीडियो आधारित निगरानी प्रणाली सार्वजनिक सलामती और सुरक्षा बनाए रखने में सहायता प्रदान करती हैं। किसी वस्तु को पहचानने में एक मुख्य कठिनाई लक्ष्य को पहचानने और ट्रैकिंग के लिए उपयुक्त गुणों और मॉडल को चुनना है। सर्फ (सपीडीड अप रोबस्ट फीचर) एल्गोरिथ्म का प्रयोग वीडियो में निरंतर छवि पहचान के लिए किया जाता है। सर्फ गुण वर्णनकर्ता छवि पिरामिड के अंदर खोजनीय जगह में लोकप्रिय बिन्दु को कम कर देता हैं। सर्फ हर कदम में काफी गुणों को जोडकर गति में तेजी प्रदान करता हैं। परिणामी लोकप्रिय बिन्दु अधिक दोहराने योग्य और शोर से मुक्त हैं। सर्फ धुंधली और घुमावदार आकृतियों पर संचलन करनें में अच्छा है। यह कोनों को पहचानकर आकृतियों के गुणों को प्राप्त कर वस्तुओं को पहचानने और नजर रखने में अच्छा है। किसी आकृति में लोकप्रिय बिन्दु की पहचान कोने डिटेक्टर से पता की जाती हैं। हैरिस कोर्नर पहचान एल्गोरिथ्म और सर्फ गुण वर्णनकर्ता के उपयोग से नजर रखने की दक्षता में बेहतरी की जा सकती हैं। यह आलेख मानकीय मूल्याकंन आंतरिक और बाह्य दृश्य पर प्रयोगात्मक परिणाम प्रस्तुत करता है। सर्फ और हैरिस आंतरिक गतिशील दृश्यों पर मजबूत कार्यन्वन करते हैं।

ABSTRACT

Visual object tracking for surveillance applications is an important task in computer vision. Automatic video surveillance of dynamic and complex scenes is one of the most active research topics in computer vision. Computer vision and video-based surveillance have the potential to assist in maintaining public safety and security. One main difficulty in object tracking is to choose suitable features and models for recognising and tracking the target. Speeded Up Robust Features (SURF) algorithm is used for continuous image recognition in video. The SURF feature descriptor operates by reducing the search space of possible interest points inside of the scale space image pyramid. SURF adds a lot of features to improve the speed in every step. The resulting tracked interest points are more repeatable and noise free. SURF is good at handling images with blurring and rotation. Corner detection is good for obtaining image features for object tracking and recognition. Interest points in an image are located using corner detector. By using Harris corner detection algorithm along SURF feature descriptor, tracking efficiency is improved. This paper presents experimental results on a standard evaluation set of Indoor and outdoor scene. SURF & Harris shows strong performance on indoor dynamic scene.

Keywords: SURF, Harris, video surveillance, object tracking, object recognition, feature extraction

1. INTRODUCTION

Video tracking is the process of locating a moving object (or multiple objects) over time using a camera. In video tracking an algorithm analyzes sequential video frames. Two major components of visual tracking are target representation and localization. Video tracking is a time consuming process depending the amount of data that is contained in given video. The main objective of video tracking is to associate target objects in consecutive video frames. Locating and tracking the target object depends on the algorithm. Robust feature descriptors such as Scale Invariant Feature Transform (SIFT), Speeded Up Robust Features (SURF), and Gradient Localization Oriented Histogram (GLOH) have become a core component in applications such as image recognition. As name suggests, SURF is a speeded-up version of SIFT. SURF descriptor is three times as fast as SIFT feature descriptor. SURF descriptor

is preferred for its fast feature extraction. Quality of object recognition is important to the real-time tracking requirement, and the tracking algorithm should not interfere with the recognition performance.

SURF[1] algorithm is used for feature extraction and continuous image recognition and in video. It reduces the search space of possible interest points inside of the scale space image pyramid. The interest points tracked by SURF are resilient to noise. SURF is based on sums of 2D Haar wavelet responses and makes an efficient use of integral images. SURF feature tracks the objects by interest point matching and updating. It then continuously extracts feature for recognition.[7] The association can be especially difficult when the objects are moving fast relative to the frame rate. When the tracked object changes orientation over time, complexity increases. For these situations video tracking systems usually employ a motion model. The motion model describes how the image of the target might change for different possible motions of the object. Motion estimation is done through Harris corners and object recognition is done through robust features such as SURF feature descriptor. Harris corner detection is used for its computation speed. Harris corner detector is rotation and scale invariant. Using SURF descriptor along with Harris corner detection improves tracking efficiency and is invariant to illumination changes in images.

2. SURF ALGORITHM OVERVIEW

A correspondence matching is one of the important tasks in computer vision, and it is not easy to find corresponding points in variable environment where a scale, rotation view point and illumination are changed. A SURF algorithm have been widely used to solve the problem of the correspondence matching because it is faster than SIFT(Scale Invariant Feature Transform) with closely maintaining the matching performance[6].

SIFT uses visual pyramids to find candidate points and filters each layer according to the Gauss law with increased Sigma values and finds differences. SURF on other hand uses Hessian Matrix to select the candidate points in different sizes. SURF uses Haar wavelet filters and the integral of the image to speed up the filtering operation. SURF is good at handling images with blurring and rotation. The method is very fast because of the use of an integral image where the value of a pixel (x,y) is the sum of all values in the rectangle defined by the origin and (x,y). SURF uses integer approximation. To detect features the Hessian matrix (H) is assembled, where Lxx is the convolution of the second derivative of a Gaussian with the image at the point. Hessian matrix is represented as,

$$H = \begin{bmatrix} L\,xx & Lxy \\ Lxy & Lyy \end{bmatrix} \quad (1)$$

SURF uses different scales of Gaussian masks, while the scale of image is always unaltered.

3. HARRIS CORNER DETECTION ALGORITHM

Corner detection is an approach used to extract certain kinds of features and image contents. Corner detection is used in motion detection, image registration, video tracking, panorama stitching, and object recognition etc. The corner detection block finds corners in an image using the Harris corner detection. Harris detector considers the differential of the corner score with respect to direction directly, instead of using shifted patches.

Harris corner detector[2] is based on the local autocorrelation function of a signal. The local auto-correlation function measures the local changes of the signal by patches shifted in different directions. Algorithm of Harris corner detector is to:

- Find partial derivatives from intensity of an image
- Compute corner response(R)
- Find local maxima in the corner response

In harris corner detection x and y derivatives is computed for an image. Product of derivative is determined for each pixel. Next sum of product is computed. Harris matrix in defined at each pixel (x,y). Corner response is computed and local maxima in corner response is found out. Auto correlation function is also called as summed square difference (SSD). For a point (x.y), its auto correlation function is represented as,

$$S(x,y)=\sum_u\sum_v w(u,v)\ (I(u+x,v+y)\ I(u,v))^2 \quad (2)$$

where I(u+x,v+y) is approximated by taylor expansion. IX and IY are known are partial derivatives such that

$$I(u+x,v+y)=I(u,v) + Ix(u,v)x + Iy\ (u,v)y \quad (3)$$

The partial derivate can be calculated from image with a filter as [-1,0,1] and [-1,0,1]. Let Ω1 and Ω2 be two eigen values of autocorrelation function S(x, y). Auto-correlation matrix (H) captures intensity structure of the local neighborhood and it measure intensity based on the eigenvalues.

Three cases arrives:

- If both eigen values are high=>Interest point (corner) is detected
- If one eigenvalue is high=>Then it is contour
- If both eigen values are small=>It is uniform region

Corner response is characterized based on eigen values. Corner reponse is represented as,

$$R = Det(H) - K(Trace(H))^2 \quad (4)$$

where, H is the autocorrelation matrix and K is a constant such that K= 0.04- 0.06. Det(H) is the product of eigen values and trace(H) is the sum of eigen values. R depends only on the eigen values of H. R value is larger for corner, small for flat region and negative for edge.

4. A VISUAL SURVEILLANCE SYSTEMS CLASSIFICATION

There is extensive literature on video surveillance systems, thus it is useful to classify them. The classification is performed according to the following key features:

- Background nature, concerning the properties of the environment to be monitored. The background nature can be static (or nearly static) or dynamic depending on the environment we are observing. A static background can be a lab or an office, where the environment is mostly static, the light is artificial[8,9] and the 3D structure of the environment is known. Typical outdoor static background scenario is a parking lot. An example of dynamic Background environment can be a water scenario because of the sun rays on the water surface and waves caused by wind or by moving vessels that form highly correlated moving patterns that confuse traditional background analysis models[10]. Similar problems arise in background such as trees and lawns with wind and a great amount of shadow.
- Number of objects to track, in order to manage crowded or non-crowded situations. The number of objects to track is a key aspect for classifying a system. Failures arise when the tracking system has to deal with occlusions and multiple objects close to each other. Usually up to 3 or 4 objects (e.g., people) are considered in the scene at the same time. Dealing with more objects is challenging because of partial and complete occlusions causing tracking failures. Taking into account more than 10 objects in the scene is considered an hard task[3,5].
- Size of the monitored area, concerning number, position and type of installed cameras
- Evaluation method, in order to properly evaluate how well an automated system performs a task. For our study we consider dynamic outdoor and dynamic indoor scene.

background nature	static	no. of objects to track	1 - 4
	dynamic		5 - more
size of the monitored area	single camera	evaluation method	self evaluation
	stereo camera		benchmark data
	multiple cameras		third party eval.

Figure 1. A visual surveillance classification system.

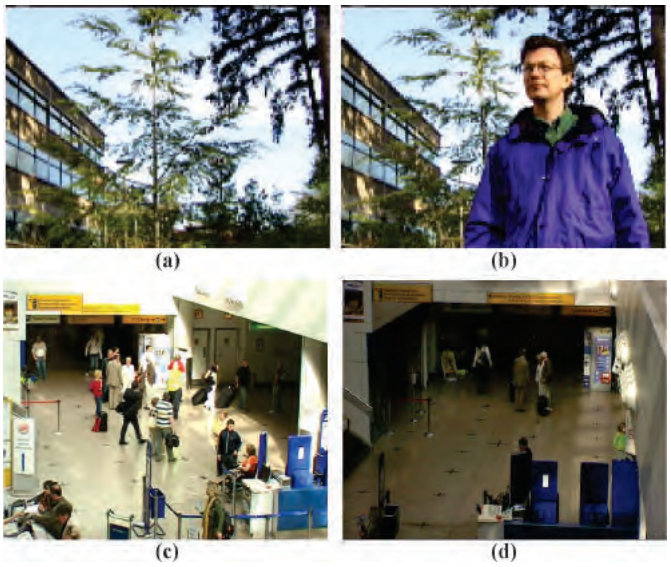

Figure 2. Different background examples: a) dynamic outdoor[4], b) dynamic outdoor with object[4] c) dynamic indoor more crowd[5] d) Dynamic indoor less crowd[5].

5. RESULT AND DISCUSSION

We tested SURF & Harris corner detector on standard image sequences. These are images of real textured and structured scenes. Due to space limitations, we cannot show the results on all sequences. For the detector comparison, we selected the two scenes dynamic indoor and dynamic outdoor.

Figure 3. Harris & Surf features detected for dynamic indoor scene.

SURF and Harris corner detection algorithm is applied for dynamic indoor scene PETS 2007 data set as shown in Fig. 3 shows detected corner points and SURF features in the sample image marked as green.

Figure 4. Harris & Surf features detected for Dynamic outdoor scene.

SURF and Harris corner detection algorithm is applied for dynamic outdoor scene dataset as shown in Fig. 4 shows detected corner points & SURF features in the Dynamic Indoor scene marked as green.

Table 1. No. of detected pointed points for Harris & SURF detector

Scene	Harris corner points detected	SURF points detected
Dynamic Indoor scene[5]	794	925
Dynamic outdoor scene[4]	255	123

6. CONCLUSIONS

SURF is responsible for fast feature extraction since it is designed to be rotation invariant and is uses Haar wavelet filters which performs a fast filtering operation. More number of features are extracted with SURF and Harris corner detector for Indoor scene. Thus SURF features and Harris corner detection algorithm which easily detects corner points can results in excellent tracking for dynamic indoor scenes.

निष्कर्ष

सरफ (एसयूआरएफ) तेजी से गुण प्राप्ति के लिए जिम्मेदार हैं क्योंकि इसे घुमाव अपरिवर्तन के लिए डिजाइन किया गया हैं और यह आर (एचएएआर) वेवलैड फिल्टर जो तेजी से फिल्टर का कार्य करता है का उपयोग करता हैं। सरफ और हैरिस कोरनर संसूचक आंतरिक दृश्य में अधिक गुणों की प्राप्ति करते हैं। इस प्रकार सरफ गुणों और हैरिस कोरनर संसूचक एल्गोरिथम जो आसानी से कोने के बिन्दुओं को पता लगा लेता हैं का उपयोग सक्रिय आंतरिक दृश्य के उत्कृष्ट खोज करनें में परिणाम दे सकता हैं।

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होमोमोरफिक एन्क्रिप्शन में हाल ही में किए गए विकास
Recent Developments in Homomorphic Encryption

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सारांश

होमोमोरफिक एन्क्रिप्शन के कई अनुप्रयोगों के कारण होमोमोरफिक एन्क्रिप्शन वर्तमान क्रिप्टोग्राफी समुदाय में लोकप्रिय शब्द बन गया है। कुछ अनुप्रयोगों के नाम हैं–इलैक्ट्रॉनिक वोटिंग, बहुदलीय अभिकलन, स्पैम फिल्टर, प्रतिबद्धता योजना आदि। होमोमोरफिक एन्क्रिप्शन डेटा पर स्वछन्द अभिकलन करने की अनुमति देता है जबकि यह डेटा एन्क्रिप्टेड रूप में होता है। यदि अभिकलन केवल जोड और गुणा तक सीमित है तो यह योजना कुछ होमोमोरफिक होगी अन्यथा यह पूर्ण होमोमोरफिक कही जाएगी। होमोमोरफिक योजनाएं 2009 में क्रेग जेन्ट्री की कार्य सफलता के बाद काफी बढ गया। इस आलेख में हमारा लक्ष्य होमोमोरफिक योजना में हाल में हुए विकास को दर्शाना हैं। हम होमोमोरफिक योजना के सफलतापूर्वक स्थापन के कारण हुई कुछ वास्तविक अनुप्रयोगों को दर्शाते हैं।

ABSTRACT

Homomorphic encryption has become a buzzword in present cryptography community, as there are numerous applications of homomorphic encryption. To name a few – Electronic voting, multiparty computation, spam filters, commitment scheme etc. Homomorphic encryption allows performing arbitrary computation on data while it remains in encrypted form. If the computations are limited to addition or multiplication, the scheme is said to be somewhat homomorphic, otherwise it is said to be fully homomorphic. Construction of homomorphic schemes boosted up after the breakthrough work of Craig Gentry in 2009. Since then, community is working hard to design a scheme for practical applications. Our aim in this paper is to showcase recent developments in homomorphic schemes. We have also shown some practical applications which can be catered upon a successful development of homomorphic scheme.

Keywords: Homomorphic encryption

1. INTRODUCTION

Cryptography refers to the branch of computer science that deals with the study and practice of secure communication schemes amidst third parties. The field of cryptography originated much before the advent of computers. Earlier versions included transposition ciphers and substitution ciphers. As the computers began to store and process on large scale basis, the need of secure communication arose. This led to the formation of more robust and reliable cryptographic methods to make information sharing safer.

Further to make data processing in the presence of third parties secure, we needed methods that could process on encrypted data. This led to the development of homomorphic encryption that allowed two or more parties to communicate with each other without exposing the unencrypted data to any of them. During the past decades, homomorphic encryption schemes have been applied in different cryptographic protocols over untrusted channels. These channels compute on encrypted data without decrypting it.

Ron Rivest[1] *et al*. presented the first homomorphic encryption scheme. Their privacy homomorphism had security flaws as discussed by Brickell and Yacobi[2]. In 1991, Feigenbaum and Merritt[3] raised an important question: Whether an encrypting function is additive or multiplicative homomorphic, if it's values at two input parameters and are known? There was a little progress in investigating and designing an algebraically homomorphic encryption schemes. Breakthrough was achieved when Craig Gentry[4] (2009) in his PhD. thesis demonstrated how to construct homomorphic encryption scheme. Gentry[5] used a bootstrappable somewhat homomorphic scheme and made a fully homomorphic scheme over integers.

2. FUNDAMENTAL TERMS

2.1 Encryption

Encryption refers to decoding a plain text in such a way that it is not easily understood by the interceptors. Encryption doesn't guarantee to not reveals information, but provides a way so that even if

information is somehow revealed to irrelevant authorities, they can't easily understand the contents. The strength of the encryption depends upon the secrecy of key used for encrypting the piece of information. On the basis of key management, encryption schemes can be classified into two types: Symmetric Encryption and Asymmetric Encryption.

2.1.1 Symmetric Encryption

In symmetric encryption, both the sender and receiver upon mutual consent use the same key to encrypt the plain text as well as to decrypt the cipher text. These schemes are generally faster but their efficiency reduces as number of parties in a communication increases because they will require different keys for secure communication. Furthermore, the shared key also needs to be exchanged in a secure way. Due to its secret nature, symmetric-key cryptography is sometimes referred as secret-key cryptography.

2.1.2 Asymmetric Encryption

In asymmetric encryption, two keys are required. One key is used to encrypt the data while another is used to decrypt it. The main feature of asymmetric is that only public key can be used to encrypt the data while corresponding private key is used in decryption. It is impossible to determine the private key even if public key is revealed. These schemes are generally slower than symmetric ones due to much larger mathematical computations. Asymmetric key cryptography is sometimes referred to as public key cryptography.

2.2 Decryption

Decryption refers to the process of decoding cipher text correctly to obtain back the original plain text. Decryption techniques depend on the mathematical hard problem upon which a cryptographic scheme has been established.

3. HOMOMORPHIC ENCRYPTION

In recent decades, cryptographic schemes particularly homomorphic schemes, have been studied extensively because of their important property of performing mathematical operations on encrypted data and get the same operation done on actual plaintext. If we have two plaintexts P1 and P2 and their corresponding ciphertext are C1 and C2, then homomorphic encryption allows computation of P1 Θ P2 from C1 Θ C2 without revealing P1 or P2.

Homomorphic encryption schemes consist of following four algorithms:

Keygen (λ)

- Input – security parameter λ.
- Output – pair (sk,pk) ∈ , where sk ,pk,K denotes secret key, public key and Key Space respectively.

Encrypt (pk,π)

- Input – a public key pk and a plaintext π.
- Output – a ciphertext ψ.

Decrypt (sk,ψ)

- Input – secret key sk and ciphertext ψ.
- Output – the corresponding plaintext π.

Evaluate (pk,C,ψ)

- Input – a public key pk, a circuit C with t inputs and a set ψ of t ciphertext ψ1,ψ2,…,ψt.
- Output – a ciphertext ψ.

If ψ_i is a ciphertext corresponding to the plaintext for i = 1 … t and ψ= (ψ_1 ,.....,ψ_t), then Evaluate (pk,C,ψ) shall return a ciphertext ψ corresponding to the plaintext C (π_1 ,.....,π_t) for a circuit C with t inputs.

A homomorphic encryption scheme is said to correctly evaluate (a set of circuits), if the correctness-condition on the algorithm Evaluate from above holds for all circuits C ∈ C.

4. PRESENT HOMOMORPHIC ENCRYPTION SCHEMES

4.1 Goldwasser-Micali Scheme

Goldwasser-Micali Scheme[7,8] (1982) is considered as the first probabilistic public-key encryption scheme that is proved to be secure under standard cryptographic assumptions. In the Goldwasser–Micali cryptosystem, if the public key is the modulus *m* and quadratic non-residue *x*, then the encryption of a bit *b* is $\varepsilon(b)= x^b r^2 \bmod m$ for some random $r \{0,\ldots,m-1\}$. The homomorphic property is then

$\varepsilon(b_1).\varepsilon(b_2)= x^{b}1\ r_1^{\,2}\ x^{b2}\ r_2^{\,2}= x^{(b1+b2)}\ (r_1\ r_2)^{(2)}= \varepsilon(b_1 \oplus b_2)$

where ⊕ denotes addition modulo 2, (i.e. exclusive-or).

4.2 Benaloh Cryptosystem

Benaloh cryptosystem[9] (1988) is an extension of Goldwasser-Micali cryptosystem with nearly same encryption cost but with an increased decryption cost.

In the Benaloh cryptosystem, if the base is *g* and public key is modulus *m* with a block size of *c*, then the encryption of a message *x is*, $\varepsilon(x)= g^x r^c \bmod m$ for some random $r\{0,\ldots,m-1\}$. The homomorphic property is then

$\varepsilon(x_1).\varepsilon(x_2)=(g^{x1}\ r_1^{\,c})(g^{x2}\ r_2^{\,c})=g^{x1+x2}(r_1\ r_2)^2=\varepsilon(x_1+x_2 \bmod c)$

4.3 Naccahe-Stern Scheme

Nacche & Stern[10] (1998) presented an improvement to Benaloh's[9] scheme. This scheme gave much more efficiency when the parameter *k* used in Benaloh's scheme was chosen to be of greater value. The proposed

encryption method was nearly the same as in Benaloh's scheme but decryption method was different. The improvement reduced the cost of decryption.

4.4 Okamato-Uchiyama Scheme

Okamato & Uchiyama[11] (1998) proposed to change the base group G to improve the performance of earlier homomorphic encryption schemes. Taking $n = p^2q$, where p and q being two large prime numbers and group $G = Z^{*}_{p^2}$, they achieved $k = p$. The security of this scheme rests on the hardness of determining whether a number in , also belongs to sub-group of order. However, a ciphertext attack has been proposed that can break the factorization scheme. Hence, it is not extensively used.

4.5 Paillier Scheme

Paillier[12] (1999) proposed an efficient, additive, scalar and probabilistic scheme based on an arithmetic ring of N^2 where N is product of two large primes numbers. The author extended his proposal to elliptic curve Paillier scheme. The elliptic curve Paillier scheme is much slower than the original Paillier scheme as it computes on elliptic curve modulo large numbers. However, cost of decryption is too high in this scheme as it requires exponentiation modulo N^2 to the power $\lambda(N)$ and multiplication to the modulo N. This scheme had smaller expansion in comparison to other encryption schemes and thus had great acceptability.

4.6 Damgard-Jurik Scheme

Damgard- Jurik[13] proposed a generalised form of Paillier's probabilistic scheme to groups of the form Z_n^{s+1} *for* $s>0$. They achieved lower values of expansion by choosing larger values of s. This scheme was computationally more expensive than Paillier's scheme. It was also proved that the semantic security of this scheme depends upon whether the two given elements are in the same coset or not.

5. RECENT DEVELOPMENTS

In 2009, Gentry presented his fully homomorphic encryption scheme which was not practically feasible as it took more than 900 seconds to add two 32 bit numbers, and more than 67000 seconds to multiply them. In 2012, Liangliang Xiao[18] *et al*. devised a homomorphic encryption scheme with non-circuit based symmetric key. Their scheme could withstand an attack upto m *lnpoly*(λ) for any m and security parameter λ. Linear algorithms were constructed for multiplication, encryption and decryption. The algorithm formulated could perform multiplication in 108 milliseconds and addition in one-tenth of a millisecond for $m = 1024$ and $\lambda = 16$. They also proposed a multi-user protocol for secure data communication between server and different users using different user keys. Jean-Sébastien Coron[19] *et al*. devised a scale-invariant homomorphic encryption. Their scheme used a linear size single secret modulus in the homomorphic evaluation. The security of the scheme was based on the Approximate GCD problem and it could be transformed into FHE scheme using bootstrapping.

Gu Chunsheng[15] (2012) presented his fully homomorphic scheme by modifying Smart-Vercauteren's fully homomorphic encryption scheme[16] by applying self-loop bootstrappable technique. He used re-randomized secret key in squashing the decrypting polynomial. The security of scheme depends on the hard assumption of factoring integer problem, approximate GCD problem and solving Diophantine equation problem. Marten van Dijket[17] *et.al* devised a cryptosystem which was based on the unique shortest vector problem.

Rohloff and Cousins[14] (2014) designed a fully homomorphic encryption based on the NTRU cryptosystem. Their implementation supports key switching and modulus reduction operation to reduce the frequency of bootstrapping operations. The cipher text is converted into a matrix of 64 bit integers. The key switching algorithm converts a d degree cipher text into a d-1 degree cipher text. The encryption keys for ciphertext and may or may not be the same. The ring reduction algorithm shifts the ring (N) of ciphertext to $N/2^x$ (where x is generally 1). The modulus reduction algorithm converts a ciphertext in modulo q to a ciphertext in modulo q, where q is a factor of q and is co-prime with p (p is prime number used in key generation algorithm). This also reduces the noise by a factor of q. Wei Wang[20] *et al*. presented an efficient and optimised implementation of Gentry-Halevi FHE scheme [22] using an NVIDIA GPU. They used Strassen's FFT multiplication[23] (to improve the efficiency of modular multiplication) with Barrett reduction[21] to implement modular reduction.

6. APPLICATIONS OF HOMOMORPHIC ENCRYPTION

Homomorphic encryption schemes can be applied in many areas. Few are presented below:

6.1 Electronic Voting

Electronic Voting is a digital, private, and secured way of casting vote. In this system, it is not necessary for the user to physically visit a ballot centre to cast his/her vote. Since the voter is not under the surveillance of any concerned government authority, so this process needs to be carried out securely. It should guarantee anonymity, correctness, fairness, receipt-free and verifiability. This is where homomorphic encryption comes to practical application. Andrea

Huszti[24] presented a homomorphic scheme that can be used in electronic voting.

6.2 Spam Filter

Spam filter is an automatic program designed to check an incoming e-mail for unwanted, unsolicited and fraudulent content and prevent it from getting in user's inbox. The basic idea is to scan the encrypted incoming message for certain keywords. More efficient implementation requires Bayesian and other heuristic filters. Khedr, Gulak and Vaikuntanathan[25] constructed a spam filter based on HElib[26] which efficiently implemented a multiple keyword search.

6.3 Multiparty Computation

In multiparty computation, the need is to compute a framework which can evaluate function while keeping the inputs private. Ivan Damgård[27] *et al*. constructed a multiparty computation using some what homomorphic encryption.

7. CONCLUSION AND FUTURE WORK

The field of Homomorphic encryption is continuously evolving. The present schemes are not so developed that they could cater to current needs. The community is working on much improved and practical implementations.

निष्कर्ष

होमोमोरफिक एन्क्रिप्शन का क्षेत्र लगातार विकसित हो रहा है। वर्तमान योजनाऐं इतनी विकसित नहीं हैं कि वे मौजूदा जरूरतों को पूरा कर सके। इसका समुदाय ज्यादा बेहतर और वास्तविक कार्यान्वयन पर काम पर काफी काम कर रहा है।

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ब्लाइंड स्टेग विश्लेषणः कलर मॉडल पर आधारित पिक्सल स्तर फीचर निष्कर्षण, पेलोड स्थान की पहचान

Blind Steganalysis: Pixel-Level Feature Extraction Based on Colour Models, to Identify Payload Location

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सारांश

गुप्त संचार के लिए, स्टेग्नोग्राफकि तकनीकों का उपयोग किसी भी मीडिया में गुप्त संदेश या इमेज को छिपाने के लिए किया जाता है जैसे कि इमेज या ऑडियो या वीडियो कवर मीडिया माने जाते है। मानव दृश्य प्रणाली (एच वी एस) इमेजेस के साथ छुपी हुई सामग्री से अवगत नहीं हो सकती है। यह स्टेग्नोग्राफी की महान सफलता है जिसमे संचरण की सच्चाई का पता नहीं लगाया जा सकता। दूसरी ओर, स्टेग विश्लेषण स्टेग्नोग्राफी के लिए प्रतिवस्तु है जो कवर मीडिया से छुपे हुए कन्टेन्ट को निकालती है। ब्लाइंड स्टेग विश्लेषण कवर मीडिया में गुप्त सूचना को जोड़ने के लिए प्रयोग की जाने वाली प्रणाली के बारे में जाने बिना स्टेगो इमजेस पर हमला करने की कला है जबकि टरगेटिड स्टेग विश्लेषण कवर मीडिया में गुप्त सूचना को जोड़ने के लिए प्रयोग की जाने वाली प्रणाली को जानने पर ही स्टेगो इमजेस पर हमला करते है[15]। मौजूदा पद्धति में, बाइनरी स्टेगो इमजेस के लिए स्टेग्नोग्राफकि पेलोड स्थान गौसीयन स्मूथिंग प्रक्रिया और स्थानीय एन्ट्रापी का उपयोग कर पहचानी गई थी। अनुकूली स्टेग्नोग्राफी पर प्रस्तावित विधि लक्ष्य जो रंग पैलेट के आधार पर संपुटन है जिससे जेपीईजी इमेज के लिए पिक्सेल स्तर विशेषताएँ निकाली जाती है तब इसका रंग मॉडल के आधार पर डेटा सेट के रूप में गठन किया गया है। निकाले गए पिक्सल के डेटा सेट के मान की तुलना उच्च लीस्ट सिग्निफिकेंट बिट (एलएसबी) की इंबेडिड क्षमता के साथ शाब्दिक संदेशों के लिए उच्च डिटेकशन सटीकता का पता लगाने के लिए पेलोड स्थान की पहचान करने के लिए की जाती है, जहां बिट प्रतिस्थापन कार्यनीति का प्रयोग किया जाता है।

ABSTRACT

For secret communication, steganographic techniques are used to hide the secret messages or images in any of the media such as image or audio or video considered as cover media. Human Visual System (HVS) may not be aware of the images with concealed content. This is the great success of steganography in which the truth of the transmission cannot be revealed. On the other hand, steganalysis is the counter part for steganography which reveals the concealed content from the cover media. Blind steganalysis is the art of attacking the stego images without having an idea about the method used for embedding secret information into the cover media whereas the targeted steganalysis attacks the stego image by knowing the method used for embedding secret information in to the cover media[15]. In the existing method, steganographic payload locations for binary stego images were identified using Gaussian smoothing process and local entropy. The proposed method targets on adaptive steganography, i.e., Embedding based on colour palette from which pixel-level features are extracted for the jpeg image then it is formed as data sets based on colour models. The extracted data set values of pixels are compared to identify the payload location to detect the high least significant bit (LSB) embedded capacity with high detection accuracy for textual messages, where in bit replacement strategy is used.

Keywords: Steganalysis, stego images, human visual system, blind steganalysis, least significant Bit, targeted steganalysis, embedded capacity, gaussian smoothing, local entropy

1. INTRODUCTION

The goal of Steganalytic attack is to reveal the full hidden message. Steganalysis are of two types, these are blind and targeted steganalysis[1]. There are many steps involved in stego image analysis. The steps are, determining the availability of concealed message, Identify the steganographic method used for embedding, identifies of payload locations, estimate the concealed message length, Changes in size and file type, last modified timestamp and modifications

in the colour palette might give an exact idea about the existence of a hidden message[7]. A broadly used method for image scanning involves mathematical analysis[3].The classification of image can be done on the basis of distance between the pixels[2] which is considered as a classification technique. The high energy of pixels represents the embedded message. This high energy of the pixels identifies the concealed message bits[9].

2. MOTIVATION

Ker, A.D.[10] experimented how to identify the location of bits of the hidden message by using the residual of the weighted stego image. The residual is computed by the pixel-wise difference between the stego image and the estimated cover image. The author used the same method in different papers to attack least significant bit (LSB) matching steganography for binary stego images and proved to be effective[11].

Chiew, K.L.[12] experimented an attack that identifies the bit locations of the binary images where hidden information is located. The result of Ker, A.D.[10] and Chiew, K.L.[11] method motivated to extend the concept to jpeg stego images and its analysis based on colour models.

3. PIXEL-LEVEL FEATURE EXTRACTION

Features are calculated at each pixel level based on colour models. The features that are extracted are of two types, low-level and high-level features. Low-level features are obtained from the cover image whereas high-level features are obtained from the low–level features. In this proposed method colour values of the pixel are used for identifying the payload location.

4. COLOUR FEATURE

Colour is one of the most important features for image extraction and also for the retrieval of hidden information from the images in steganalysis. Colour features have their own advantages such as simplicity in computation and implementation, accuracy in results and robustness. Colour models are used to represent colour of an image. In the sub-space of a three dimensional coordinate system, colour model represents the colour of an image by a single point[14]. Fig.1, shows that the colour of a pixel is perceived by combination of three colour stimuli, these are called as RGB colour space i.e. red, green, and blue which forms colour space and are called as primary colours. The HSV colour space of the pixel is shown in Fig.2, which is derived from the RGB space cube where H is the Hue, S is the saturation and V is the value[14]. The YCbCr colour space is shown in Fig. 3, which is derived from RGB colour space where Y is luminance, Cb is blue difference chrome, and Cr is red difference chrome. Colour descriptors of images can be global or local. Colour descriptors consist of a number of histogram descriptors and colour descriptors represented by colour moments, colour coherence vectors or colour correlograms [13].The main feature of histogram is that it is invariant for any kind of transformation of an image. The histogram will not provide any meaningful information about an image.

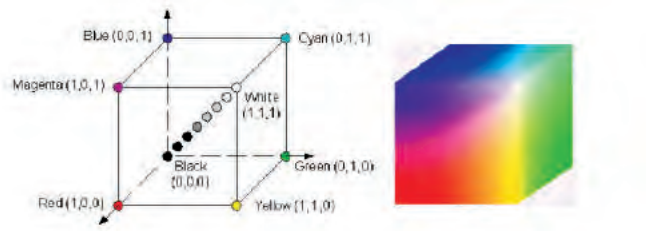

Figure 1. The RGB colour space.

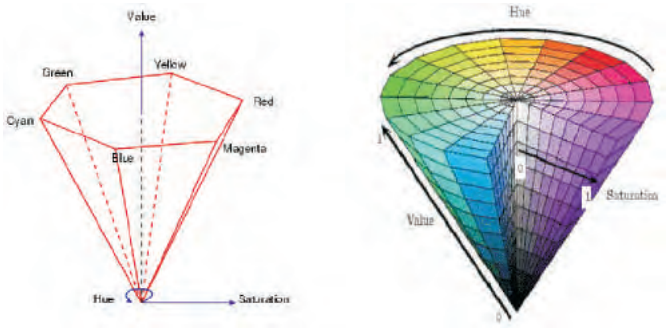

Figure 2. The HSV colour space.

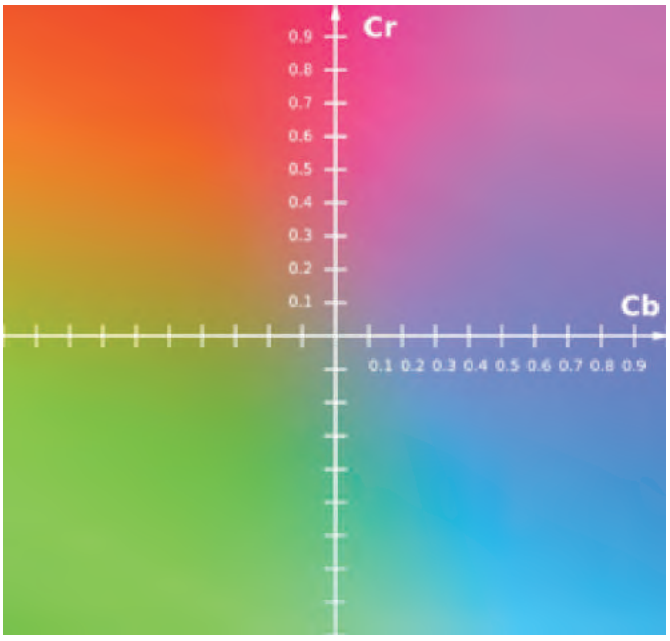

Figure 3. C_bC_r colour space plane at luminance Y=0.5.

5. PROPOSED METHOD

Block diagram for the proposed method is shown in Fig. 4. The proposed method considers the stego images for the identification of payload location.

First, the stego image is considered for pixel level feature extraction. Then RGB, HSV and YCbCr

colour models are considered for the stego image and their corresponding histograms are also generated for comparing the same for identifying the payload location.

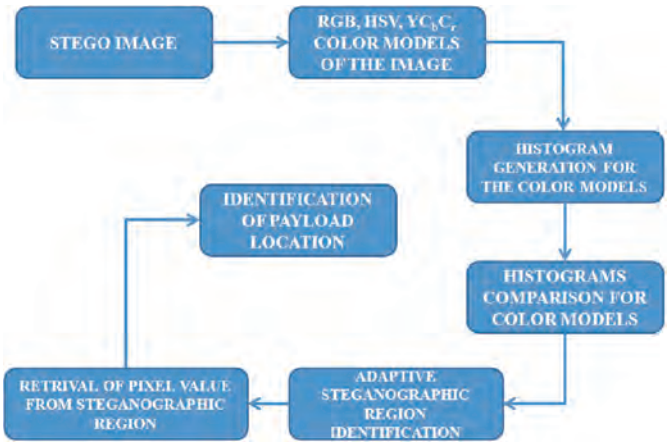

Figure 4. Block diagram for the proposed steganalytic system.

6. DETECTION OF HIGH EMBEDDED CAPACITY USING ADAPTIVE STEGANOGRAPHY

Adaptive steganography involves in embedding the messages at the locations where the texture of the message is closer to the neighbouring pixels. High embedding capacity is that for every N pixel, one pixel is used to carry message, where N is the pixel count. Therefore the lengthy message shows more distortion in the image[6], but it is reversed in the case of adaptive steganography. The detection of high embedded capacity using adaptive steganography can be identified by comparison of histograms and the pixel values.

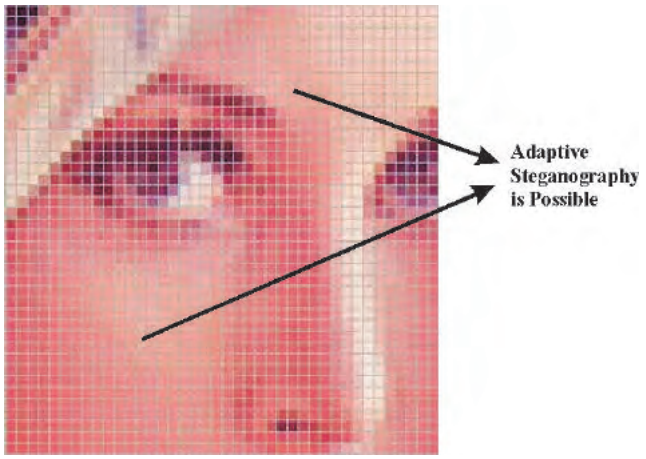

Figure 5. Pixel-level feature extraction.

7. ALGORITHM FOR THE PROPOSED METHOD

The following algorithm discusses about the pixel-level feature extraction

Step 1: Consider the stego image data set to identify the payload location.

Step 2: Convert the image into its RGB, HSV and YCbCr colour Model.

Step 3: for each colour model of every stego image from the data set.

3.1 Generate histograms for the colour models.

3.2 Compare the histogram representation of every colour model of the image.

3.3 Based on histogram colour models, select the adaptive steganographic region where embedding is possible.

3.4 Retrieve the pixel value of adaptive steganographic region.

Step 4: The pixel values are compared and analyzed for identification of payload location

8. EXPERIMENTAL RESULTS

The colour models of the original image (Fig. 6) are shown in Fig.7 which represents the RGB colour model, Fig. 8 represents the HSV colour model and Fig. 9 represents the YCbCr colour Model.

Figure 6. Original image.

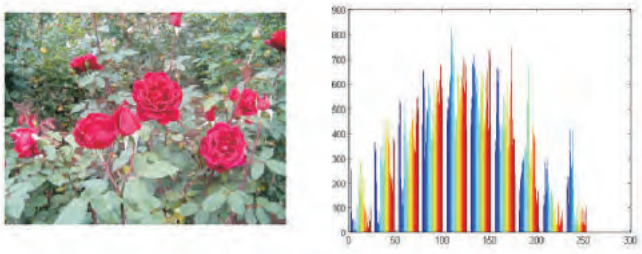

Figure 7. RGB Colour model and its Histogram of the original image.

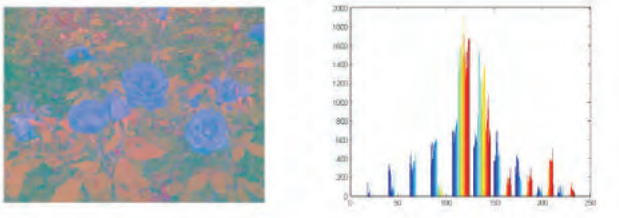

Figure 8. HSV colour model and its Histogram of the original image.

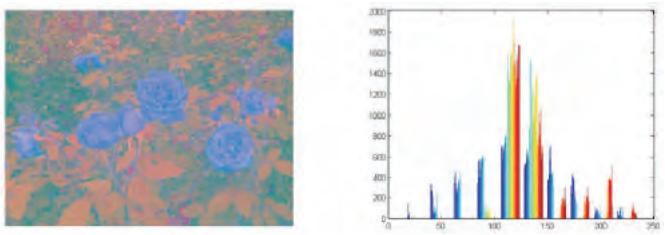

Figure 9. YCbCr colour model and its Histogram of the original image.

The performance of the proposed algorithm is measured based on the high embedding rate usig adaptive steganography. The accuracy is evaluated by considering bits-per pixel (bpp) on the stego images. This accuracy is represented in the form of true positives (TP), false positives (FP) and false negatives (FN) for datasets of stego images. In the proposed method two datasets are used i.e., dataset 1 and dataset 2 with different embedding ratio in the form of bits per pixel.

Dataset 1 has the set of stego images with the embedding ratio of about 0.05 i.e. for every 100 pixels 5 pixels are used for embedding the hidden information and non stego images (Fig.10). Dataset 2 has the set of stego images with the embedding ratio of about 0.10 i.e. for every 100 pixels 10 pixels are used for embedding the hidden information bpp and non stego images(Fig.11). The experimental results demonstrated that the proposed algorithm is much better in identifying the hidden information which is embedded based on adaptive steganography of colour of the image.

Table 1. The accuracy for payload location identification for dataset[1]

No. of images	100	150	200	250	520
True positive (tp)(0.05bpp)	98	96.2	95	93	92
False positive (fp)(0.05bpp)	1.2	2.2	4.5	5.3	6.2
False negative (fn)(0.05bpp)	0.8	1.6	0.5	1.7	1.8

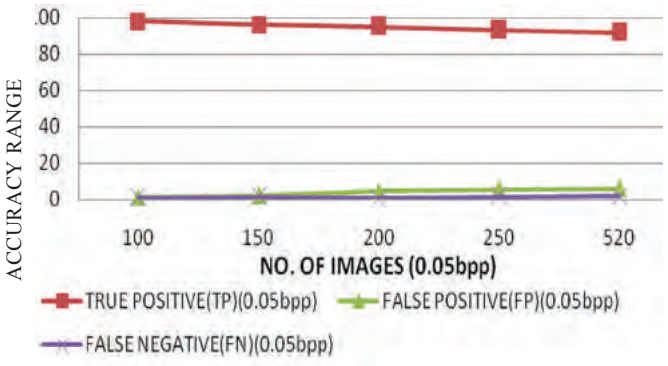

Figure 10. Graphical representation of the accuracy for payload location identification of dataset[1].

Table 2. The accuracy for payload location identification for dataset[2]

No. of Images	100	150	200	250	520
True positive(tp)(0.10bpp)	99	97	97	96	95
False positive(fp)(0.10bpp)	0.8	2.5	2.1	3.1	3.8
False negative(fn)(0.10bpp)	0.2	0.5	0.9	0.9	1.2

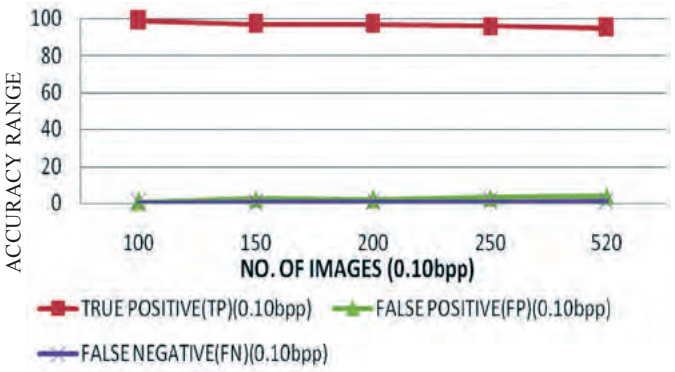

Figure 11. Graphical Representation of the accuracy for payload location identification of dataset[2].

9. CONCLUSION

The proposed algorithm determines the payload location for jpeg images with an accuracy of about 99 per cent when the bit per pixel is 0.10. Payload location Identification of an image for two different datasets shows that the proposed method works well in identifying payload location for an adaptive steganography. Through experimental analysis it is concluded that this method works faster and also effectively detects the payload locations. The length of the message, that is embedded in the stego images, may be the future work after finding the payload location

निष्कर्ष

प्रस्तावित एल्गोरिथ्म 99 प्रतिशत की सटीकता के साथ जेपीईजी इमेज के लिए पेलोड स्थान को निर्धारित करता है जब बिट प्रति पिक्सल 0.10 है। दो अलग अलग डेटासेट के लिए इमेज के पेलोड स्थान की पहचान से यह पता चलता है कि प्रस्तावित विधि अनुकूली स्टेग्नोग्राफी के लिए पेलोड स्थान की पहचान करने में अच्छी तरह से काम करता है। प्रयोगात्मक विश्लेषण के माध्यम से यह निष्कर्ष निकाला गया है कि यह पद्धति तेजी से काम करती है और प्रभावी ढंग से पेलोड स्थानों का पता लगाती है। पेलोड स्थान का पता लगाने के बाद स्टेगों इमजेस में संदेश की लंबाई को अंतर्निहित करने का काम भविष्य में हो सकता है।

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औद्योगिक स्वचालन और नियंत्रण प्रणालियों के लिए प्रमुख प्रबंधन मुद्दे
Key Management Issues for Industrial Automation and Control Systems

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सारांश

स्वचालन कृषि से लेकर अंतरिक्ष तक प्रत्येक पहलू के लिए आवश्यक है। औद्योगिक स्वचालन उत्पादन प्रक्रिया को इष्टतम करने और मैनुयल वर्क को न्यूनतम करने में उद्योगों की मदद करता है। चूंकि इन नेटवर्कों पर साइबर हमलों की गंभीरता बढ़ती जा रही है, सुरक्षित संचार सुनिश्चित करने को गत वर्षों से उच्च प्राथमिकताएं मिली हैं। इस पत्र में, औद्योगिक स्वचालन और नियंत्रण प्रणाली (आईसीएस) तथा ऐसी प्रणालियों के लिए सुरक्षा संबंधी मुद्दों के सिंहावलकोन पर चर्चा की गई है। इन आईसीएस प्रणालियों में सुरक्षा को शामिल किए जाने के लिए प्रमुख प्रबंधन अवसंरचना (केएमआई) पर विचार किया जाना अनिवार्य हो जाता है। यह पत्र आईसीएस के लिए एक केएमआई डिजाइन करने के लिए विचार किए जाने वाले मानदंडों और आईसीएस में सुरक्षित संचार के लिए क्रिप्टो सिस्टम्स के विकल्प पर विचार करता है।

ABSTRACT

Automation is essential in every aspect, right from agriculture to space. Industrial automation helps the industries to optimize the production process and minimize the manual work.As the severity of the cyber attacks on these networks is increasing, ensuring secure communication has gained a high precedence over the past years. In this paper, an overview of the industrial automation and control systems (ICS) along with security issues for such system is discussed. To integrate security in these ICS systems makes it essential to consider the key management infrastructure (KMI). This paper addresses the parameters to be considered in designing KMI for ICS and the choice of crypto systems for secure communications in ICS.

Keywords: Attacks, key management, key pre-distribution, SCADA security

1. INTRODUCTION

To achieve greater levels of efficiency, safety and quality, the industries have revolutionized industrial automation and control systems.The goal of the industrial automation and control systems (ICS) is to automate the operations of industrial processes and minimize the manual work. Incorporating ICS in industries enables accuracy, optimized actions, on time delivery of products, and reliability by managing the distributed and complexity of growing critical infrastructures. Thus, it helps to increase the profit and provides good reputation for the organisations. The ICS system encompasses several types of control systems used to automate and monitor the industrial processes which are distributed over remote sites. These systems include supervisory control and data acquisition (SCADA) systems, distributed control systems (DCS), programmable logic controllers (PLC) and devices such as remote terminal units (RTU), smart meters, sensors and actuators. The optimised actions and reliability of ICS makes the industries to widely accept, and thus it is playing vital role in the industries such as paper and pulp, oil and gas refining, water treatment and distribution, chemical production and processing, etc.

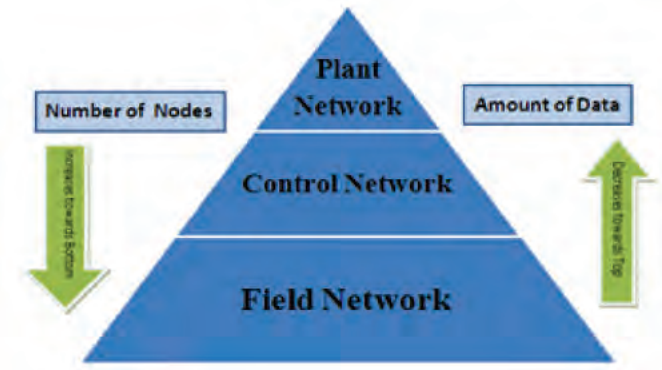

Figure 1. Industrial automation pyramid.

Figure 1 shows the ICS system is portrayed in form of pyramid. It consists of field network, control network and plant network. The bottom level is field network which consists of devices such as sensor and actuators. The middle layer is control network, which consists of controllers, control devices such as PLCs and RTUs, and connectivity servers. The plant network is the supervisory level which consists of engineering and monitoring stations, workplace, and servers such as aspect server, application server, and connectivity servers. The plant network is connected to internet with firewall and virtual private network (VPN). The pyramid shape gives an idea of the number of nodes at different levels and the amount of information at different levels. From bottom to top level, the amount of information gets reduced. At the bottom, many short data from field devices (sensors and actuators) need to be gathered and transferred to the control level. The control network processes that data and sendsthe data to plant network that is relevant to operators. The plant network collects the information about product quality and quantity. Higher the hierarchy level of automation networks, more is the relaxed constraints in latency, resource, and real-time properties.

2. SECURITY ISSUES IN INDUSTRIAL AUTOMATION AND CONTROL SYSTEMS

In the past, these systems were completely isolated from the corporate network. Thus security was not a major issue. But in today's industrial infrastructure, due to cost-effectiveness and fast decision-making, and asset management, these networks are integrated with the outside network. So the interconnection and use of IP-based technology and wireless solutions in these systems are common, and thus, leverage to use standard IT components, open protocols, and solutions. In mean time, the interconnection and increasing move from isolated, closed and proprietary protocols to open and IP-based communication makes the SCADA systems vulnerable to security attacks.The severity of cyber threats on these systems from past decades accelerates the industrial systems to give attention for security awareness and to incorporate the security features in the industrial automation systems.Because any damage to these critical systems will cause a serious impact on society, human race, and economic loss. Many such incidents have been already occurred and cause serious issues on industries[1, 2]. The SCADA safety in numbers[3], gives a report on security vulnerabilities onIndustrial control systems, which includes number of vulnerabilities in ICS systems of various vendors, ICS hardware and software components and percentage of vulnerable ICS Systems by macroregions. Fig. 2 shows the different regions vulnerability incidents related to configuration management and updates installation. It

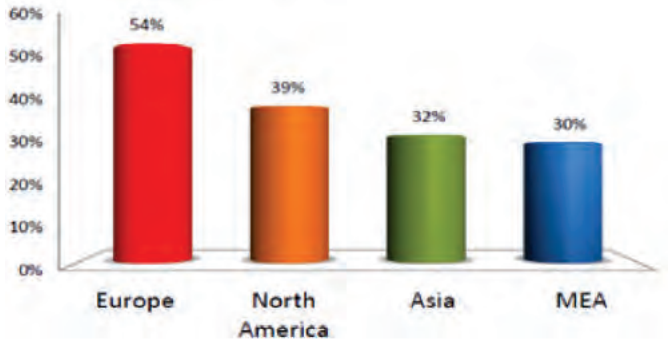

Figure 2. Percentage of vulnerable ICS systems by regions. [3]

can be observed that among different regions, Europe has faced 54% of vulnerable ICS systems. In Asia 32% of ICS systems are insecure.

Some of the recent incidents and threats to ICS (SCADA) systems are discussed in[4,5], which includes in 2010 the malware Stuxnet was detected at Iran's Natanz Uranium Enrichment Plant, in October 2011 penetration test held at the Idaho National Laboratory has detected the presence of vulnerabilities in their chemical facilities, In December 2012, Iranian civil defense reported that the power plant in Bandar Abbas and other industries in the Hormozgan province were found infected by Stuxnet, and in February 2013, a critical vulnerability in the Industrial Control Systems called Tridium Niagara AX Framework–widely used by the military and hospitals–was found. These are the few examples but the discovery of weapons like virus and worms on ICS is in progress and researchers are still identifying and analyzing the new malwares that makes these systems vulnerable.

Any damage to ICS disturbs the society in an extreme manner and its impact on industries, workers, public health and society is unimaginable and also it leads to the enormous economic losses. The sources such as hostile governments, terrorist groups, industrial spies, disgruntled employees, malicious intruders, and natural sources such as system complexities, human errors and accidents, equipment failures and natural disasterswould be the reasons for violating the normal operations of ICS systems.The vulnerabilities whose impact is serious on ICS systems may take pathbecause of improper security management work flows and security policies and practices, not adapting suitable device security mechanisms and not securing the communication between the entities of the ICS. Therefore, integrating security with proper security polices and management in ICS systems is a major issue. The field cryptography addresses the issues of secure communication. In ICS,securing all the communication paths with suitable authentication, digital signatures and encryptions is essential.This requires the use of secret keys. If we make use of key establishment schemes to secure the communications in such networks to ensure

Table 1. Comparisons between information systems and control Systems.

Information system	Control systems
Delay allowed	Delay is not allowed
Not real time	Real Time
Planned tasks	Sequential tasks
Need not be operate 24*7	27*7 operation is required
Confidentialityis important	Availability is important

confidentiality, integrity and authenticity,considering key management infrastructure for industrial automation and control system is essential. However, integrating security into ICS is much different and difficult as compared to normal IT system security, because ICS security has its own challenges and issues.The existing communication protocols which are widely used in ICS such as DNP3 (Distributed Network Protocol), IEC 60870-5-101 and 104, IEC 61850, and Modbus were initially designed without considering security and the unique characteristics of such networks is somewhat difficult to adapt the existing cryptographic techniques. Table 1 shows the differences between the IT systems versus control systems.

Thus while considering the security for ICSsystems; we need to take care of challenges and security issues of ICSs.

3. KEY MANAGEMENT INFRASTRUCTURE

The key is the piece of information used to secure the data. The strength of the secure system depends on the secrecy and length of the key. As secure data transmission is very much essential in ICS, the data should be encrypted using a key in such a way that an adversary can't reveal the data. Each key has its own lifecycle; based on the application and their requirement, key plays a vital role from its generation to revocation phase in the crypto system. During the usage of keys in the crypto system there might be the requirement for key deletion and ke-yupdation. Response to these requirements in time is crucial for reliable operations of the secure system. Effectively managing the keys during their life cycle will reduce the risks, help to preserve data protection and handle the keying relationships between the entities smoothly. Poor Key management leads to following risks:

- If keys are available to unauthorised persons or applications, they may get valuable and sensitive information.
- The key loss or unrecoverable situations make the encrypted data useless. Key loss leads to disruptionto business operations and makes the sensitive data unreadable.
- Improper synchronize of keys between the communicating entities leads to Key synchronization problems.
- The unrestrained model of key management provides easy way to retrieve the key as compared to breaking crypto algorithm. Thus it does not guarantee the desired level of security, and hence, leads to disclosure, misuse, alteration or loss of keys.
- Usage of more keys for the large system with fragmented key management systems increases the complexity and cost of security management. Also, it introduces the risk in making the system scalable and manageable.

Key management enables the proper management of cryptographic keys which are used in the secure system and ensures effective use of cryptography. KMI is an infrastructure that provides access and sharing the information securely between the authorized devices with the aim of incorporating secrecy and creating secure environment in the network. Since in ICS securing the communications is essential, providing an effective design of key management is thus given high precedence. By secure key management process for industrial automation we can improve the business process, reduce financial losses, endangerment of public, to excide the damage to equipment and to create a secure and safe environment in industry. Key management phases are broadly classified into four phases; preoperational, operational, post-operational and obsolete/destroyed. Figure 3 shows the functions foreach key management phase. A complete overview of key management life cycle and details of each function is discussed[6].

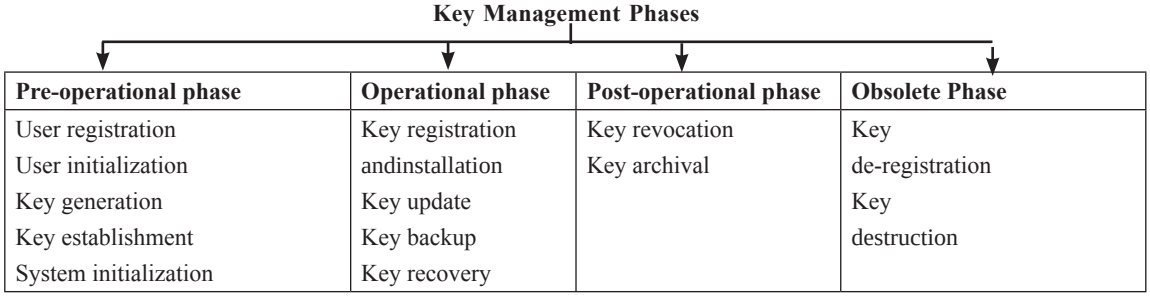

Figure 3. Key management phases and functions.

4. KEY MANAGEMENT INFRASTRUCTURE ISSUES FOR INDUSTRIAL AUTOMATION AND CONTROL SYSTEMS

ICS which includes SCADA and DCS are hierarchical instructure. Fig. 4 shows the model of the ICS systemswith different levels of control and components used for monitoring the plant. It consists of field level at the bottom layer, control level at the next layer; and plant level at the top layer.

In this section, we will discuss some of the identified issues and challenges of integrating security, in turn key management infrastructure issues for industrial automation and control systems. Following are the identified issues:

- *Variability:*Considering resource constraints at different levels of automation system is one of the major issues because in ICS, devices at each level are varying in features. At each level, devicesand functionalitiesare varying in size, computation and communication ability, storage, accessibility, power requirement and latency. So while choosing key establishment schemes, the above mentioned factors need to be considered. Choosing different crypto system at each level or same crypto mechanism for the whole network is optional, but consideringthe cost of key management and its complexity in implementing and deploying the same is essential.
- *Architecture:*The foremost step in integrating the secure communication to ICS is considering the architectural framework for key management. A particular industry may implement security for the whole network or only a part of the network. Identifying entities, critical areaand secure communication pathsin such networks is essential.
- *Preference:* As compared to normal IT systems, ICS has its own preference in considering the security objectives.In case of IT systems CIA-confidentiality, integrity and authentication are the major concerns. But in ICS the preference is Availability, Integrity, Confidentiality and performance. Integrating security is requirement but it should not disturb the existing production or operations of the plant. For example, taking more time to compute session or secret key, introducing delay for crypto operations is not encouraged.
- *Communication types:* In ICS, considering the communication types is also important-because ICS uses both wired and wireless communications. According to the requirement, suitable lightweight crypto techniques should be considered.
- *Interoperability:* Since ICS are in use from the past years, the network consists of old hardware systems and platforms along with new devices and equipments. The crypto system should also consider this issue to supportinteroperability in the ICS systems.
- *Initial bootstrapping of trust:* Atypical automation system has large number of devices for instance 100 to 800 devices. Secure communication can be handled in three ways. First method to establish secret keys is by using public-key protocols, another approach is using KDC which acts as the trusted arbiter for key establishment, and third method is using key predistribution. Whatever may be secure communication technique, a suitable initial preloading of keys into the devices prior to their deployment in the field is the requirement. Many existing key predistribution schemes just make an assumption or just consider the use of band channel for preloading the keys, but in reality a simple and efficient way of key pre-loading mechanism is required and also a feasible solution of secure communication technique for that large number of devices is required.
- *Physical protection:* In ICS, many devices are placed in the open fieldfor monitoring the activities of the industries. Physical protection of all the devices is not possible because of cost and time. So while considering crypto system,some precautions should be considered. In case, if one or two devices are compromised, the impact from the compromised devices on the ICS should be very low and the adversary could notbe able to disturb the other secure communications. Thus considering resiliency is important.
- *Crypto system:* In cryptography, we have two kinds of crypto systems. First is symmetric crypto system and second is a symmetric crypto system. In symmetric method, same key is used for encryption and decryption between the communicating entities. In case of asymmetric method, pair of keys, i.e., public and private key are used for securing the communications. Each of the cryptosystem has

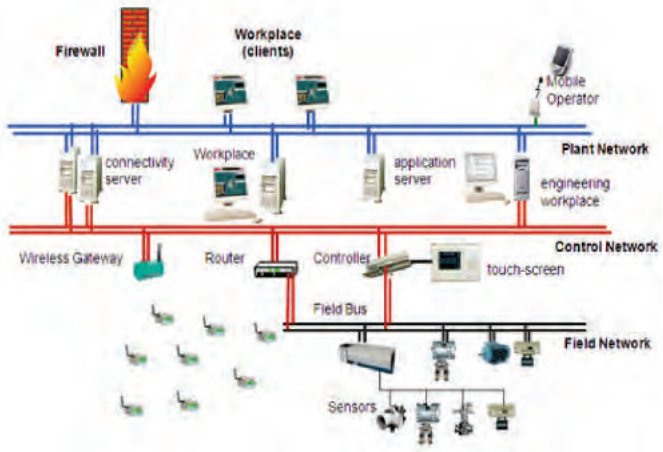

Figure 4. Industrial automation system.

its own advantages and disadvantages.In ICS, considering the suitable crypto system is very important because at the lower and intermediate level of ICS devices have much resource constraints as compared to plant level. So according to the suitability and capability, selecting the suitable crypto system is important.

- In case of each crypto system, storing pre-crypto parameters is essential. Storageoccupied by the parameters,which are essential to generate the secret keys should be considered.
- In some devices, for example, sensors have less memory. Installing the crypto algorithm in such devices is a big problem. In such cases, selecting the direct and straight-forward key pre-distribution system is suitable.
- Considering capability of the device, both in communication and computation, to generate the secret key is also essential.
- Considering the key pre-distribution for whole network is also problematic because cryptographic keys may be needed by thousands of devices.
- *Performance:* The key management scheme used in ICS should be scalable, flexible, adaptable, and simple to manage.
- *Key transmission:* Once the devices are preconfigured with crypto parameters and placed in the network, requirement for additional messages for secret key generation for any device to device communication should be minimized or nullified.
- ICSs include devices and technology from variety of vendors. So securing the third party devices, software's and securing the connection with joint ventures, alliance partners and outsourcing is also prominent.
- Many existing communication protocols used in ICS do not support security features. In corporating cryptographic techniques to provide security may require protocol modification.
- From key management perspective, manually facilitating key replacement/updation; key deletion in large systems would be impractical. Thus a suitable mechanism, such as self-computation, self-updation of keys may be feasible in such systems.
- From SCADA systems key management perspective considering the following issues is important because these systems have limited computational capacity, limited space capacity, low bandwidth and real-time processing requirement:
- Generic security considerations such as availability, confidentiality, integrity and authentication. Since availability of these systems has highest priority, crypto systems should be incorporated in such a way that, authenticated users have option to quit crypto code and provide faster access to devices.
- Number of keys used should be less at resource constraint devices.
- Support for direct communication between the devices.
- Key management should support broadcasting and multicasting.
- Key management should consider join and leave of the devices.
- Key updation and deletion is required with or without key compromise. The cost of computation and changes required while doing this operation should be considered. In existing key management schemes for these systems, if we update/delete the keys at one level, the devices at different levels of the system should alsorequire updation of some or all the pre stored keys. Also, in case of join and leave of device, the disruption to existing devices of system is more, and thus, it should be minimal.

Within cryptography, key management is a major and crucial field of research. The severity of cyber attacks on ICS require a secure system, and because of its constraints and nature, key management in these networks is challenging.The above discussed issues help to understand the complexity and requirement of key management infrastructure for industrial automation system.

5. CONCLUSIONS

Industrial automation and control system are playing a vital role in the industries. As deliberate cyber attacks on these systems is increasing,ensuring security in communications has critical importance. Key management enables the proper management of cryptographic keys which are used to secure the system and ensures effective use of cryptography. This paper addresses the issues and challenges in the design of key management infrastructure for industrial automation and control systems. In future by considering the identified issuesand challenges of key management, we would like to address various key management operationsrequired for industrial automation and control systems.

निष्कर्ष

औद्योगिक स्वचालन और नियंत्रण प्रणाली उद्योगों में महत्वपूर्ण भूमिका निभा रही है। चूंकि इन प्रणालियों पर जानबूझकर किए जाने वाले साइबर हमले बढ़ते जा रहे हैं, संचार में सुरक्षा सुनिश्चित करने का बहुत महत्व हो गया है। प्रमुख प्रबंधन क्रिप्टोग्राफिक कुंजियों के समुचित प्रबंधन को संभव बनाता है जिन्हें प्रणाली को सुरक्षित रखने में प्रयोग किया जाता है और क्रिप्टोग्राफी का प्रभावी उपयोग सुनिश्चित करता है। इस पत्र

में, औद्योगिक स्वचालन और नियंत्रण प्रणाली (आईसीएस) के लिए प्रमुख प्रबंधन अवसंरचना के डिजाइन से संबंधित मुद्दों और चुनौतियों पर चर्चा की गई है। भविष्य में, प्रमुख प्रबंधन के पहचाने गए मुद्दों और चुनौतियों को समझकर हम औद्योगिक स्वचालन और नियंत्रण प्रणालियों के लिए अपेक्षित विभिन्न प्रमुख प्रबंधन प्रचालनों पर विचार करना चाहेंगे।

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मोबाइल संचार के बुनियादी सिद्धांत
Basic Principles of Mobile Communication

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सारांश

अवधि मोबाइल रेडियो आमतौर पर एक रेडियो ट्रांसमीटर या रिसीवर की परवाह किए बिना यह वास्तव में चलता है या नहीं की, ले जाया जा रहा करने में सक्षम है, जहां बेतार संचार के घर के अंदर या आउटडोर रूपों धरना के लिए होती है। चैनल किसी भी संचार के लिंक के साथ, बेतार संचार प्रणालियों के प्रदर्शन पर मौलिक सीमाओं देता है। प्रचार चैनल ऑपरेटिंग वातावरण के साथ बदलता रहता है। वर्तमान अध्ययन मोबाइल संचार के बुनियादी सिद्धांत को समझने के लिए एक प्रयास है।

ABSTRACT

The term mobile radio is usually meant to encompass indoor or outdoor forms of wireless communications where a radio transmitter or receiver is capable of being moved, regardless of whether it actually moves or not. The channel places fundamental limitations on the performance of wireless communication systems, with any communication link. The propagation channel varies with the operating environment. Present study is an effort to understand the basic principles of mobile communication.

Keywords: Mobile communication, cellular system, wireless communication systems

1. INTRODUCTION

Due to the stochastic nature of the mobile radio channel, its characterization mandates the use of practical measurements and statistical analysis.The aim of such an evaluation is to quantify two factors of primary concern:

1. *Median signal strength*: which enables us to predict the minimum power needed to radiate from the transmitter so as to provide an acceptable quality of coverage over a predetermined service area.
2. *Signal variability:* which characterises the fading nature of the channel.

Our specific interest in wireless communications is in the context of cellular radio that has the inherent capability of building mobility into the telephone network. With such a capability, a user can move freely within a service area and simultaneously communicate with any telephone subscriber in the world. An idealised model of the cellular radio system illustrated in Fig.1, consists of an array of hexagonal cells with a base station located at the centre of each cell; a typical cell has a radius of 1 to 12 miles. The function of the base stations is to act as an interface between mobile subscribers and the cellular radio system. The base stations are themselves connected to a switching centre by dedicated wire lines.

The mobile switching centre has two important roles. First, it acts as the interface between the cellular radio system and the public switched telephone network. Second, it performs overall supervision and control of the mobile communications. It performs the latter function by monitoring the signal-to-noise ratio of a call in progress, as measured at the base station in communication with the mobile subscriber involved in the call. When the SNR falls below a prescribed threshold, which happens when the mobile subscriber leaves its cell or when the radio channel fades, it is switched to another base station. This switching process, called handover or handoff, is designed to move a mobile subscriber from one base station to another during a call in a transparent fashion, that is, without interruption of service.

The cellular concept relies on two essential features, as described here:

2. FREQUENCY REUSE

The term frequency reuse refers to the use of radio channels on the same carrier frequency to cover different areas, which are physically separated from each other sufficiently to ensure that co-channel interference is not objectionable. Thus, instead of covering an entire local area by a single transmitter with high power at a high elevation, frequency reuse makes it possible to achieve two commonsense objectives: keep the transmitted power from each base station to a minimum, and position the antennae of the base stations just high enough to provide for the area coverage of the respective cells.

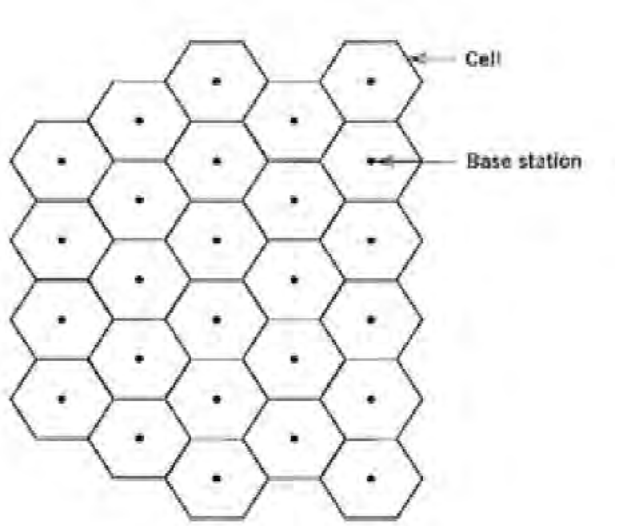

Figure 1. Idealised model of cellular radio system.

3. CELL SPLITTING

When the demand for service exceeds the number of channels allocated to a particular cell, cell splitting is used to handle the additional growth in traffic within that particular cell. Specifically, cell splitting involves a revision of cell boundaries, so that the local area formerly regarded as a single cell can now contain a number of smaller cells and use the channel complements of these new cells. The new cells, which have a smaller radius than the original cells, are called micro cells. The transmitter power and the antennae height of the new base stations are correspondingly reduced, and the same set of frequencies are reused in accordance with a new plan.

For a hexagonal model of the cellular radio system, we may exploit the basic properties of hexagonal cellular geometry to lay out a radio channel assignment plan that determines which channel set should be assigned to which cell. We begin with two integers i and j ($i \geq j$), called shift parameters, which are predetermined in some manner. We note that with a hexagonal cellular geometry there are six 'chains' of hexagons that emanate from each hexagon and that extend in different directions. Thus, starting with any cell as a reference, we find the nearest co-channel cells by proceeding as follows:

Move i cells along any chain of hexagons, turn counter clockwise 60 degrees, and move j cells along the chain that lies on this new direction. The jth cells so located and the reference cell constitute the set of co-channel cells.

This procedure is repeated for a different reference cell, until all the cells in the system are covered. Figure 2 shows the application of this procedure for a single reference cell and the example of i = 2 and j = 2.

In North America, the band of radio frequencies assigned to the cellular system is 800-900 MHz. The subband 824-849 MHz is used to receive signals from the mobile units, and the subband 869-894 MHz is used to transmit signals to the mobile units. The use of these relatively high frequencies has the beneficial feature of providing a good portable coverage by penetrating buildings. In Europe and elsewhere, the base-mobile and mobile-base subbands are reversed.

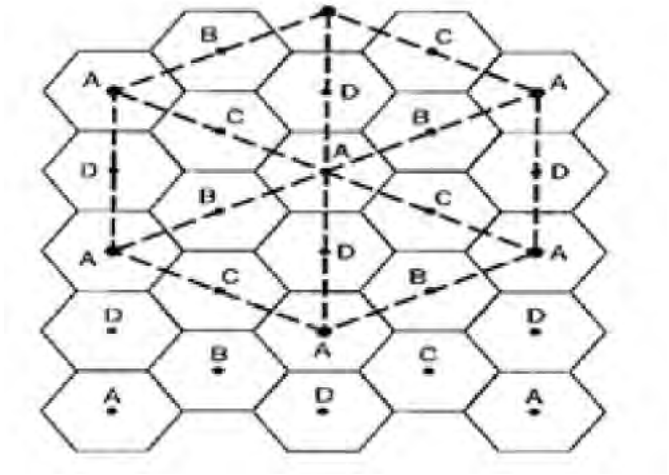

Figure 1. Idealised model of cellular radio system.

4. PROPAGATION OF RADIO WAVES

The major propagation problems encountered in the use of cellular radio in built-up areas are due to the fact that the antenna of a mobile unit may lie well below the surrounding buildings. Radio propagation takes place mainly by way of scattering from the surfaces of the surrounding buildings and by diffraction over and/or around them, as illustrated in Fig. 3. The important point to note from Fig. 3 is that energy reaches the receiving antenna via more than one path. Accordingly, we speak of a multipath phenomenon in that the various incoming radio waves reach their destination from different directions and with different time delays.

To understand the nature of the multipath phenomenon, consider first a static" multipath environment involving

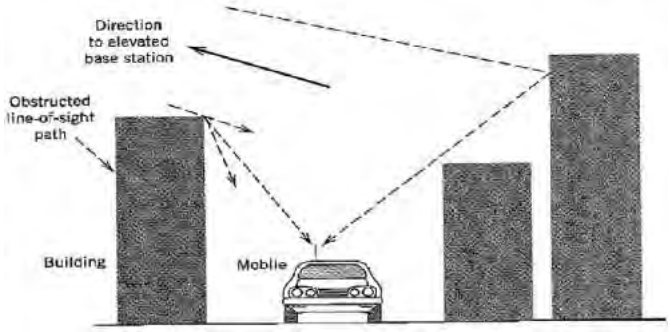

Figure 3. Propagation of radio waves.

a stationary receiver and a transmitted signal that consists of a narrow band signal. Let it be assumed that two attenuated versions of the transmitted signal arrive sequentially at the receiver. The effect of the differential time delay is to introduce a relative phase shift between the two components of the received signal. We may then identify one of two extreme cases that can arise:

The relative phase shift is zero, in which case the two components add constructively, as shown in Fig. 4 (a).

The relative phase shift is 180 degrees, in which case the two component add destructively, as shown in Fig. 4(b).

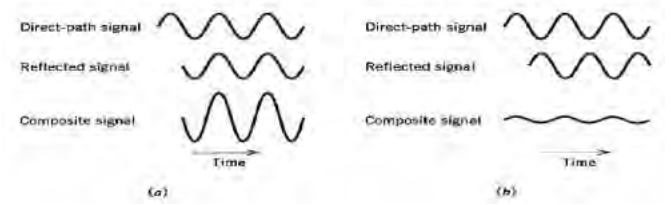

Figure 4. (a) The relative phone shift is zero, and (b) relative phone shift is 1800.

Consider next a "dynamic" multipath environment in which the receiver is in motion and two versions of the transmitted narrowband signal reach the receiver via paths of different lengths. Due to motion of the receiver, there is a continuous change in the length of each propagation path. Hence, the relative phase shift between the two components of the received signal is a function of spatial location of the receiver. As the receiver moves, we now find that the received amplitude is no longer constant as was the case in a static environment; rather, it varies with distance, as shown in Fig. 5. At the top of this figure, we have also included the phasor relationships for the two components of the received signal at various locations of the receiver. Figure 5 shows that there is constructive addition at some locations, and almost complete cancellation at some other locations. This phenomenon is referred to as signal fading.

In a mobile radio environment encountered in

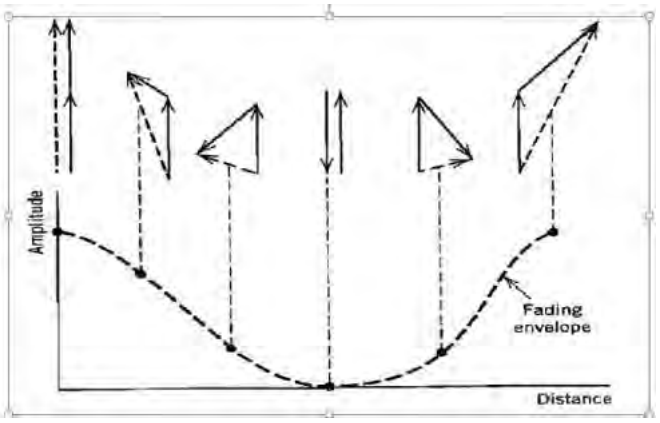

Figure 5. Constructive addition at some location.

practice, there may of course be a multitude of propagation paths with different lengths, and their contributions to the received signal could combine in a variety of ways.

Signal fading is essentially a spatial phenomenon that manifests itself in the time domain as the receiver moves. These variations can be related to the motion of the receiver as follows. To be specific, consider the situation in Figure 6 , where the receiver is assumed to be moving along the line AA' with a constant velocity v.

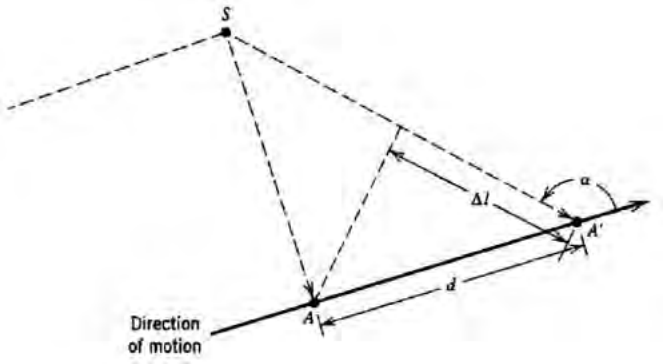

Figure 6. Incremental change in the path length of the radio wave.

It is also assumed that the received signal is due to a radio wave from a scatterer labelled S. Let Δt denote the time taken for the receiver to move from point A to A'. Using the notation described in Figure 6, the incremental change in the path length of the radio wave is deduced to be

$$\Delta l = d\cos(180-\alpha) \quad (1)$$
$$= -v\,\Delta t\cos\alpha$$

where α is the spatial angle between the incoming radio wave and the direction of motion of the receiver. Correspondingly, the change in the phase angle of the received signal at point A' with respect to that at point A is given by

$$\Delta\phi = 2\pi/\lambda\ \Delta l \quad (2)$$
$$= -2\pi v\Delta t/\lambda\ \cos\ \alpha$$

where α is the radio wavelength. The apparent change

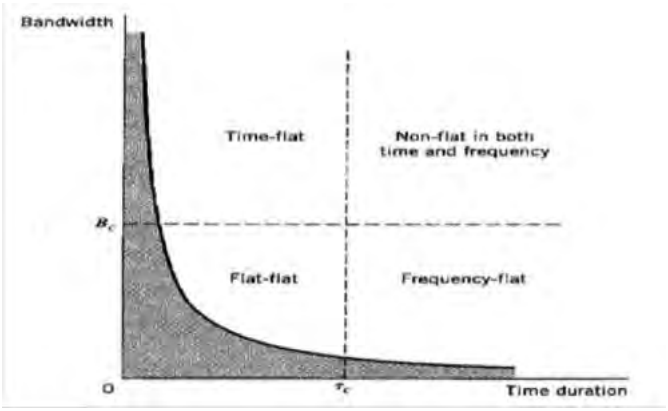

Figure 7. Fading experienced by a multipath channel.

in frequency, or the Doppler-shift, is therefore

$$v = -\frac{1}{2\pi}\frac{\Delta\phi}{\Delta t} = \frac{v}{\lambda}\cos\alpha \quad (3)$$

The Doppler-shift v is positive (resulting in an increase in frequency) when the radio waves arrive from ahead of the mobile unit, and it is negative when the radio waves arrive from behind the mobile unit.

5. CLASSIFICATION OF MULTIPATH CHANNELS

The particular form of fading experienced by a multipath channel depends on whether the channel characterization is viewed in the frequency domain or the time domain.

When the channel is viewed in the frequency domain, the parameter of concern is the channel's coherence bandwidth, Bc which is a measure of the transmission bandwidth for which signal distortion across the channel becomes noticeable. A multipath channel is said to be frequency selective if the coherence bandwidth of the channel is small compared to the bandwidth of the transmitted signal. In such a situation, the channel has a filtering effect in that two sinusoidal components, with a frequency separation greater than the channel's coherence bandwidth, are treated differently. If, however, the coherence bandwidth of the channel is large compared to the message bandwidth, the fading is said to be frequency nonselective, or frequency flat.

When the channel is viewed in the time domain, the parameter of concern is the coherence time, τc which provides a measure of the transmitted signal duration for which distortion across the channel becomes noticeable. The fading is said to be time selective if the coherence time of the channel is small compared to the duration of the received signal (i.e., the time for which the signal is in sight). For digital transmission, the received signal's duration is taken as the symbol duration plus the channel's delay spread. If, however, the channel's coherence time is large compared to the received signal duration, the fading is said to be time nonselective, or time flat, in the sense that the channel appears to the transmitted signal as time invariant.

In light of this discussion, we may classify multipath channels as follows:

- *Flat-flat channel*: which is flat in both frequency and time.
- *Frequency-flat channel:* which is flat in frequency only.
- *Time-flat channel*: which is flat in time only.
- *Nonflat channel*: which is flat neither in frequency nor in time; is such a channel sometimes referred to as a doubly dispersive channel.

6. CHARACTERIZATION OF MULTIPATH FADING CHANNELS

The channel places fundamental limitations on the performance of wireless communication systems, with any communication link. The propagation channel varies with the operating environment. Electromagnetic waves in a realistic environment undergo diffraction, reflection, and scattering. Among other effects, a typical received signal contains multiple components reflected off buildings or other large objects that arrive with different time delays and phases. Waves scattered off irregular surfaces or diffracted around objects add to a cluttered received signal. The semi-transparent electrical objects contribute to attenuating the signal that finds these objects in its path.

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ओफडीएम और पीएपीआर न्यूनीकरण परिरूप कतरत विधि
OFDM and PAPR Reduction using Clipping Method

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सारांश

वायरलैस माध्यम विभिन्न प्रकार के हमलों के लिए खुले और संवेदनशील है और घुसपैठिये अनायास ही नोड्स हैक कर सकते हैं। गोपनीयता और प्रमाणन सुरक्षा ढांचे के मूल तत्व हैं। वायरलैस नेटवर्क अक्सर सांस्थिति topology परिवर्तनों, सीमित आवेष्ट विशदता इंदकूपकजी और केन्द्रीय नियंत्रण के अभाव जैसे कई कारकों की वजह से अस्थिर और अविश्वसनीय हैं। एक मानक सुरक्षा ढांचे को लागू करने के लिए एक विश्वसनीय मूल प्रबंधन की आक्वयकता है। महत्त्वपूर्ण जानकारी को साझा करने, महत्त्वपूर्ण जानकारी को वितरित करने और निरसन मध्य हमलों में पुरुषों को रोकने जैसे प्रस्तावित कार्यों में वक्र फिटिंग के फायदों का लाभ उठाया जाता है ।

ABSTRACT

Due the increase in demand of high data rates in mobile communication, OFDM system is used in many applications. It efficiently overcomes the effect of inter-symbol interference caused due to the fading of the channel but peak to average power ratio (PAPR) is one of the disadvantages in OFDM system. In the first stage of the work, OFDM system is design with different modulation techniques like QAM, BPSK and QPSK and their Bit Error Rate is defined. In the latter stage we work on reduction of PAPR by using a clipping Technique and we found the significant reduction in PAPR as compared to conventional clipping technique.

Keywords: OFDM, peak to average power ratio, BER, ISI

1. INTRODUCTION

In a wireless broadcast system, OFDM plays an important role and reduce the complexity of receiver, but in this process, channel estimation and synchronization is very important. The increase in data-speed in a mobile is a demand of many applications. It still uses a single carrier than due to the fading of the channel there will be a inter-symbol interference which greatly affects the performance of OFDM system[1]. OFDM system is a multi carrier transmission technique where the entire bandwidth is splitted into the number of orthogonal subcarriers. The symbol duration of subcarrier is set larger than delay spread of channel in order to reduce the ISI effect[2]. However, one of the drawbacks of OFDM system is PAPR which is due to the fluctuation of the amplitude which make the system much in-efficient[3]. The first multi-carrier technique was proposed by Chang[4]. Doelz, et. al. had designed a multi-carrier system for a single sideband channel[5]. The designed of multi-carrier system with equalizer are discussed[6,7,8]. Septh had designed an OFDM receiver and has demodulated the signal and delivered the soft information to outer receiver for decoding[9]. Lu[10] has consider space time codded OFDM and his results show a significant improvement in performance of OFDM by efficiently exploiting the spatial diversity and selective fading[10]. The OFDM system is designed by combining the different blocks as shown in Fig. 1 and its main function is to transmit the number of signals containing the different information at the same time[11].

2. BASIC OFDM SYSTEM MODEL

Let us consider a complex symbol to be transmitted using an OFDM technique. The modulated signal can be represented by following mathematical expression:

$$Yn(t) = \sum_{(k=0)}^{(n-1)} Y(n),\ Ke^{j2\pi k\Delta ft},\ o \leq t \leq Ts$$

where Ts = Symbol duration, Δf = sub carrier spacing, N = Number of Sub-channel.

To make the signal orthogonal,it should satisfy the

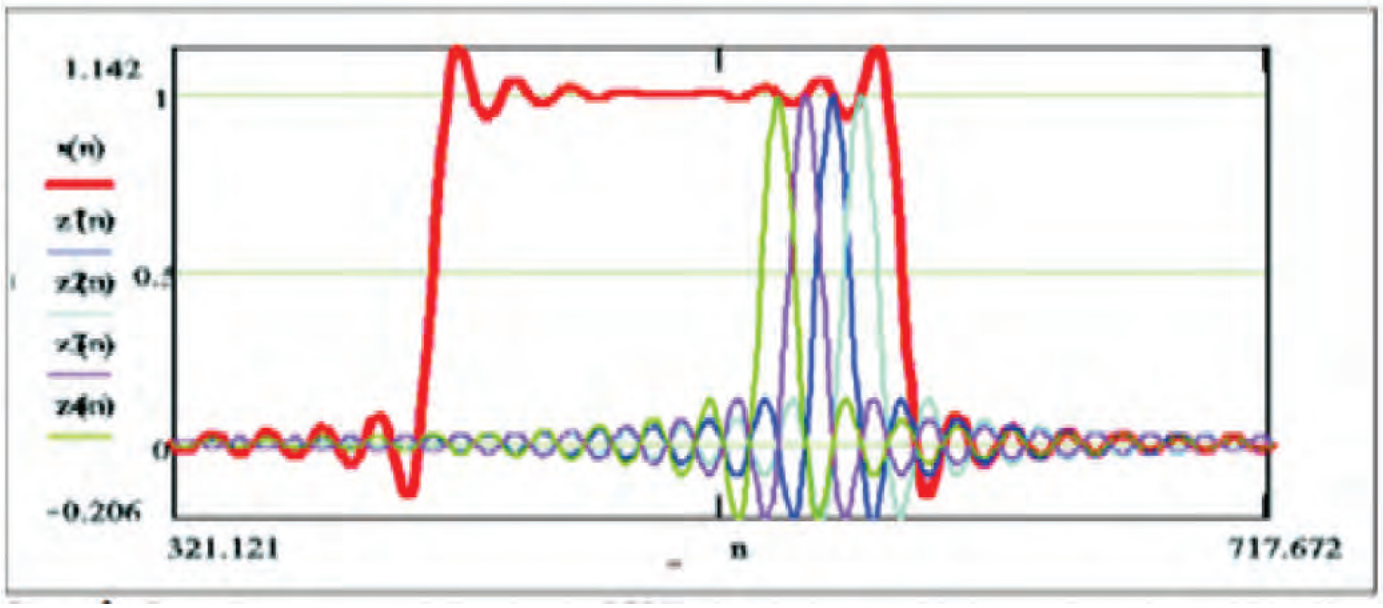

Figure 1. Overall spectrum or simple OFDM singnal shown with for sub-carriers within. Note the zero crossings all correspond to peaks of adjacent sub-carriers.

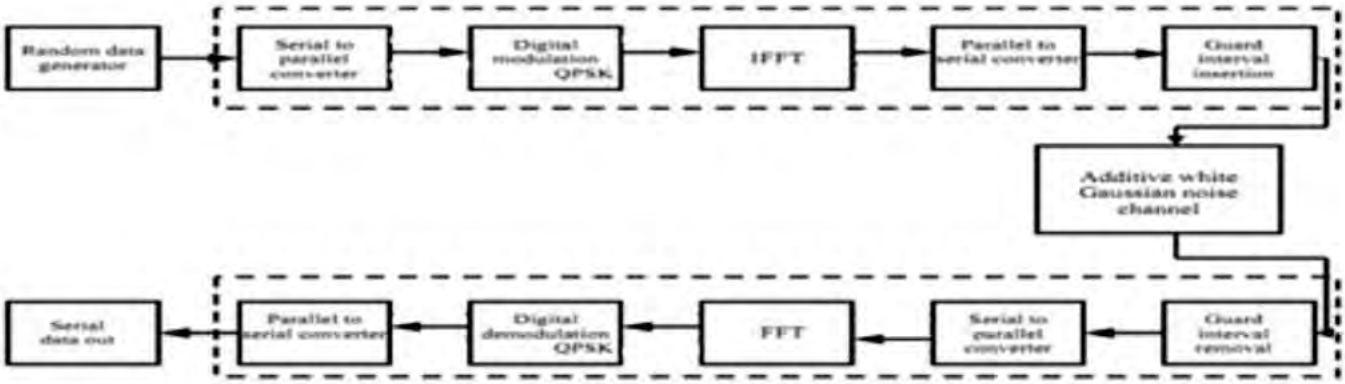

Figure 2. Block diagram of OFDM system.

following condition, Ts.Δf = 1. With the orthogonal condition,the transmitted symbol Yn,k can be received by the receiver as described in following equation:

$Yn(k)=1/Ts \int_{o}^{Ts(Yn(t)\ e(-j2\pi k\Delta ft)}dt$

With the cyclic Prefix the transmitted signal can be written as: T= Tg+Ts,Therefore

$Yn(t+Ts)=\sum_{(k=0)}^{(N-1)}Yn,\ K\ e^{(J2\pi k\Delta f(t+Ts))},-Tg\leq t\leq Ts.$

The impulse response of a channel is given by the following equation:

$h\ (t)=\ h(t)=ai\delta(t–ti)$

where ai and ti are delay and complex amplitude2 of ith path.

The received signal is given by:

$Xn(t)=\sum\_iYnx\hat{}k\ (t-ti)+\ n\ (t),$

where n(t) is noise of a signal.

3. CHARACTERISTICS OF OFDM SIGNALS

Let us consider a block of N symbols Y= [Yk], where k=0, 1, 2, 3….N-1] is formed with modulating symbols with set of subcarriers. The sub-carriers are orthogonal to each other, i.e., FL = LΔF. The OFDM symbols can be written as:

$y(t)=1/\sqrt{N}\ \sum\_(L=0)^{(N-1)}XL\ e^{(j2\pi fLt)},\ 0<=\ t<=NT$

where $J=\sqrt{(-1)}$.

Now let us consider that input of OFDM signals are statistically independent and identically distributed if real part and imaginary part of OFDM signal ssare uncorrelated and orthogonal to each other. So considering the Central Limit Theorem, where N is large, than the distribution of both real and imaginary signals approaches to Gaussian distribution with Zero and mean variance, i.e.,:

$a\hat{}2=F\ [Re\{y(t))^2+im(y(t)^2\ )]/2$. So the probability distribution function is

$Pr(y(t))=1/\sqrt{2\pi\sigma}\ e^{(-y(t)2/2\sigma2)}$. The probability distribution function of OFDM signals when it is subjected to Rayleigh Channel is express as: $Pr(r)=2re^{(-r2)}$, where r is the amplitude.

4. REVIEW LITERATURE

ISI is a distortion between two signals. The presence of ISI degrades the performance of communication system so it becomes necessary to eliminate the effect of ISI by designing an efficient transmitter and receiver or by using an appropriate equalizer. Although with use of equalizer, the hardware implementation of system become so complicated[12]. A work done by Guner shows that reduction of ISI by using a zero forcing equalizer, MMSE and decision feed back equalizer[13]. Yang has reduced the ISI by using a decision feed back equalization technique[14]. The techniques like partial response maximum likilyhood (PRML) can also mitigate the ISI Effect[15].

a. Time domain liner equalization used in Frequency selectivity of Channel[16]
b. Maximum ratio combiner used where signal is mainly corrupted due to noise[16]
c. Minimum Mean Square: Trade off between corruption due to noise and frequency selectivity of channel[16].

PAPR can be defining as the ratio of square peak of amplitude to the ratio of square peak of rms valu. Mathematically it may be define[17] as

$PaPr=IxIpeak^2/xrms^2$

Woo Kim introduced a novel method to reduce the PAPR using a Walsh Hadamard Transform (WHT). His work include a two PAPR reduction method that combine SLM (selective mapping) and DSI (dummy sequence Insertion) with WHT. The result shows that 1db better PAPR reduction is achieve then already existed SLM and DSI methods[18]. Gouda made use of PTS method for reduction PAPR and his work shows a better PAPR reduction as compared to other technologies[1]. Zhonpeng Weng proposed a joint PAPR reduction technique by combining a discrete cosine transform with companding[20]. Reshma Elizabeth proposed a new SLM method which rotate the phase of input data after IFFT and his work shows a lower PAPR as compared to conventional SLM combine with clipping technique. Joong Heo, et. al. proposed a new PAPR reduction scheme known as modified mapping SLM scheme which has reduced the complexity in multiplication by 63.54 % with similar PAPR reduction as compared to SLM scheme 16 binary phase sequence[22]. Tao Jieng proposed a new technique based on non-linear optimization approach known as simulated annealing to search the optimal combination of phase factor with low complexity[23]. Yue proposed a method known as low complexity partial transmit sequence. In his work, he has analyzed and utilizesdthe the correlation among the candidate signals generated in PTS so as to simplify the computational complexity[24]. Alvi proposed an algorithm for computing the optimal PTS weights that has lower complexity as compared to existing search[25]. Chen Peng Li introduced a novel classes of perfect sequence each of which comprise of certain basic level and their cyclically shifted[26]. P. Van proposed a scrambling technique and his result show that PAPR reduced to 2% of max possible value[27]. Le shows a good DAPR reduction at the receiver output provide that the number of sub-carrier should be large[28]. Mr. Jrukulapati proposed a row of normalized Riemann matrices which are selected as a phase sequence vector for SLM technique and his result shows that PAPR reduction og about 2.3 db using his approach[29]. L.Wang proposed a sub-optimum partial transmit sequence for PAPR reduction. His simulation shows that sub-OPTS can reduce the computational complexity and he achieve a almost same PAPR reduction performance as compared to OPTS[30]. J. Armstrong shows that repeated clipping and frequency domain filtering reduces the PAPR of transmitted signal[31]. Ghassemi work shows a significant reduction in computational complexity while delivering a Comparable PAPR reduction to oridinary PTS[32]. Ochiai analyzes the BER performance of OFDM system with the Nyquist rate clipping combining with adaptive symbol selection[33]. Mobasher proposed a cubic constellation technique and his result shows a reduction in PAPR as compared to best technique[34]. YajunWang proposed a new sub optimal method based on artificial bee colony method and result shows that reduction in complexity for larger PTS sub block and low PAPR at same time[35]. Xia Huang proposed the companding method and his work shows that PAPR is significantly reduced by carefully choosing the companding form and parameter[36]. Varaharamp proposed a technique to reduce the number of IFFT and his work examine a QPSK modulation with OFDM signal and saleh model power amplifier[37]. Taun work there is a PAPR reduction upto 2 db[38].

5. PROPOSED METHODOLOGY

5.1 Binary Phase Shift Keying

BINARY PSK Phase-shift keying (PSK) is a digitalmodulation scheme that conveys data by changing, or modulating, the phase of a reference signal (the carrier wave). Any digital modulation scheme uses a finite number of distinct signals to represent digital data

The BPSK technique is given by the following equation:

$Xo(t)=ACos\omega t$ for 0

$X1(t)=Acos(\omega t+\pi)$ for 1

The demodulation signal is given by:

$Y(t)=\int_0^t X(t)Cos(\omega(t)dt)$.

5.2 Quadrature Phase Shift Keying

The implementation of QPSK is more general than that of BPSK and also indicates the implementation

Table 6. Bibliographical distribution of citations

BPSK	QPSK	QAM
Bernoulli Binary	Bernoulli Binary	Bernoulli Binary
	Probability of zero=0.5	Probability of zero=0.5
Probability of zero=0.5	Initial Seed= 20394875	Initial Seed=20394875
Initial Seed=20394875	Sample time =(4e-6)/48	Sample time =(4e-6)/144
Sample time =(4e-6)/24	Sample per frame=48	Sample per frame=144
Sample per frame=24	Output data type= boolean	Output data type= boolean
Output data type= boolean		
		Rectangular 16-QAM:
	QPSK modulator :	M-ary number=16
BPSK modulator Baseband :	Phase offset = pi/4	Input type=Bit
Phase offset (rad)= 0	Constellation Ordering= gray	Constellation ordering=Gray
Output data type = double	Input Data Type= bit	Normalisation method= Min.distance
	Output data type = double	between symbols
Gain block		Minimum distance=2
Gain=1	Gain block	Phase offset(rad)=0
Multiplication= Element-	Gain=1	Output data type= Double
wise(k.*u)	Multiplication= Element-wise(k.*u)	Gain block
Sample time=-1 for inherited.	Sample time=-1 for inherited.	Gain=1
Integer routing mode= floor.	Integer routing mode= floor.	Multiplication= Element-wise(k.*u)
Output data type= Inherit:	Output data type= Inherit: same as input	Sample time=-1 for inherited.
same as input		Integer routing mode= floor.
	AWGN Channel:	Output data type= Inherit: same as input
AWGN Channel:	Initial seed= 1	
Initial seed= 1	Mode= signal to noise ratio(SNR)	AWGN Channel:
Mode= signal to noise	SNR=15	Initial seed= 1
ratio(SNR)	Input signal power=.01	Mode= signal to noise ratio(SNR)
SNR=15	Input processing=inherited	SNR=15
Input signal power=.01		Input signal power=.01
Input processing=inherited	QPSK Demodulation:	Input processing=inherited
State metric word length=16	Phase offset = pi/4	
	Constellation Ordering= gray	QAM Demodulator Baseband:
error rate calculation block	Output data type = bit	M-ary number=16
Receive Delay=34	Decision type=Hard decision	Normalisation method= Min.
Computation Delay=0		Distance between
	error rate calculation :	Minimum distance=2
	Receive Delay=34	Phase offset(rad)=0
	Computation Delay=0	Costellation ordering= gray
	Computation Mode=Entire Frame	Output type= Bit
	Output data=port	Decision type= Hard decision
		Parameters of theerror rate
		calculation:
		Receive Delay=34
		Computation Delay=0
		Computation Mode=Entire Frame symbols Output data=port

of higher-order PSK. Writing the symbols in the constellation diagram in terms of the sine and cosine waves used to transmit them:

$$\delta n(t)=\sqrt{2}Es/Ts \cos(2\pi fct+(2n-1)\ \pi/4,\ n=1,2,3,4$$

This results in a two-dimensional signal space with unit basis functions

$$\Phi 1(t)=\sqrt{2}/Ts \quad \cos(2\pi fct)$$
$$\Phi 1(t)=\sqrt{2}/Ts \quad \sin(2\pi fct)$$

The first basis function is used as the in-phase component of the signal and the second as the quadrature

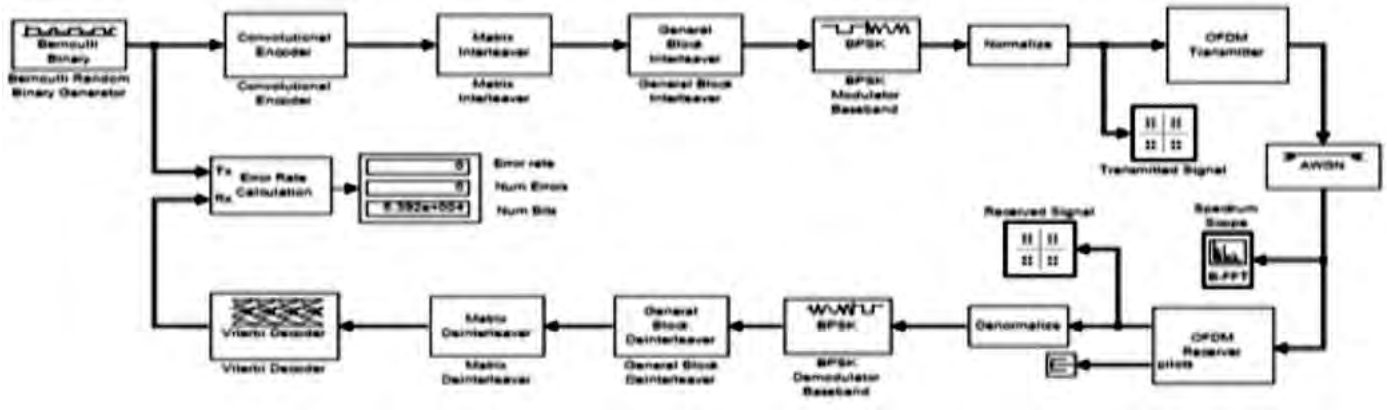

Figure 3. Methodology of OFDM by using BPSK modulation technique.

component of the signal.Therefore, the signal constellation consists of the signal-space 4 points is given by:

$\pm\sqrt{Es}/2 \pm \sqrt{Es}/2$

The factors of 1/2 indicate that the total power is split equally between the two carriers. Comparing these basis functions with that for BPSK show clearly how QPSK can be viewed as two independent BPSK signals.

5.3 Quadrature Amplitude Modulation

When transmitting two signals by modulating them with QAM, the transmitted signal will be of the form:

$S(t)=R[i(t)+q(t)\ ]\ e^{i2\pi fot}$,

where I2 =–1, I(t) and Q(t) are modulating signals At the receiver, these two modulating signals can be demodulated using a coherent demodulator. Such a receiver multiplies the received signal separately with both a cosine and sine signal to produce the received estimates of I(t) and Q(t), respectively.

In the ideal case I(t) is demodulated by multiplying the transmitted independently[39]. Signal with a cosine signal:

$r(t)=1/2\ i(t)[1+\cos(4\pi fot)\ ]–1/2q(t)[\sin(4\pi fot)]$

$=1/2\ i(t)+1/2\ i(t)\cos(4\pi fot)–Q(t)\sin(4\pi fot)$

Using standard trigonometric identities, we can write it as:

$r(t)=s(t)*\cos(2\pi fot)$

$= I(t)[\cos(2\pi fot)*\cos(2\pi fot)]–$

$Q(t)[\sin(2\pi fot)*\cos(2\pi fot)]$

Low-pass filtering remove the high frequency terms leaving only the i(t) term. This filtered signal is unaffected by q(t), showing that the in-phase component can be received separately of the quadrature component. Likewise, we may multiply by a sine wave and then low-pass filter to extract. The phase of the received signal is supposed to be known exactly at the receiver. If the demodulating phase is even a little off, it results in cross-talk between the modulated signals. This concern of carrier synchronization at the receiver must be handled somehow in QAM systems. The coherent demodulator needs to be exactly in phase with the received signal, or otherwise the modulated signals cannot be independently received[40].

6. SIMULATED RESULT

The simulated result of An OFDM System with different modulation Techniques are described below.

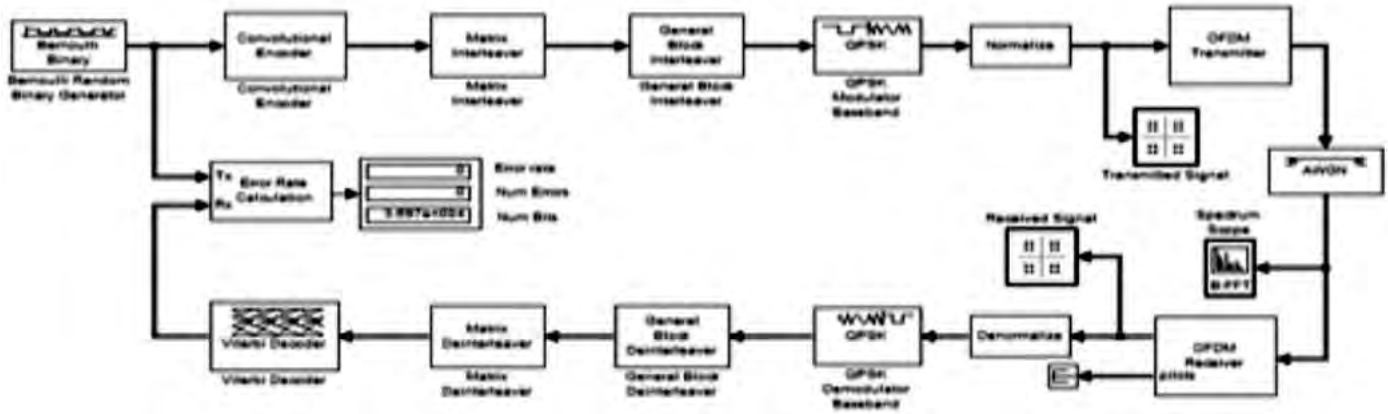

Figure 4. Block diagram of OFDM by using QPSK modulation technique.

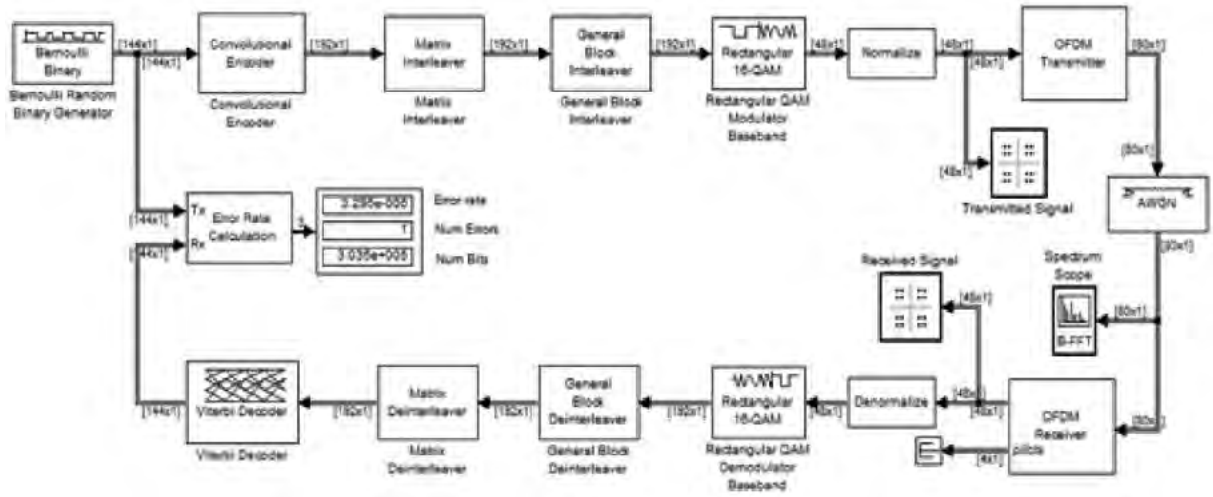

Figure 5. Block diagram of OFDM by using QAM modulation technique.

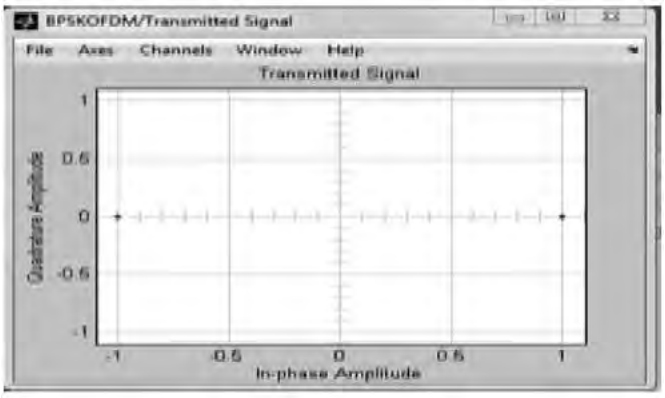

Figure 6. Scatter plot of OFDM transmitted signal.

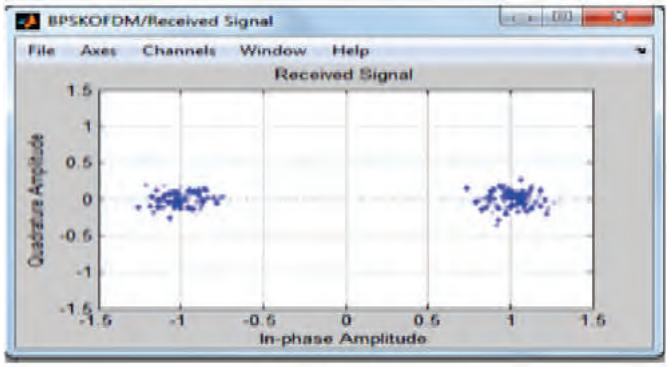

Figure 7. Scatter plot of OFDM received signal.

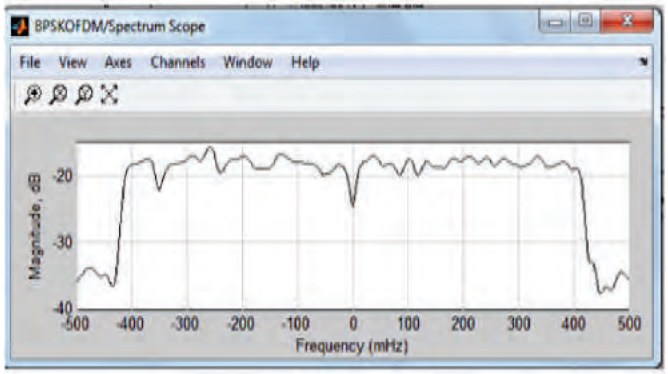

Figure 8. Transmitted OFDM BPSK signal.

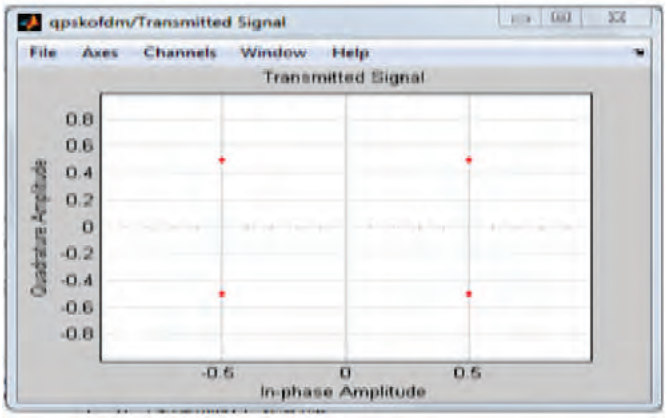

Figure 9.Sscatter plot of OFDM transmitted signal for Qpsk.

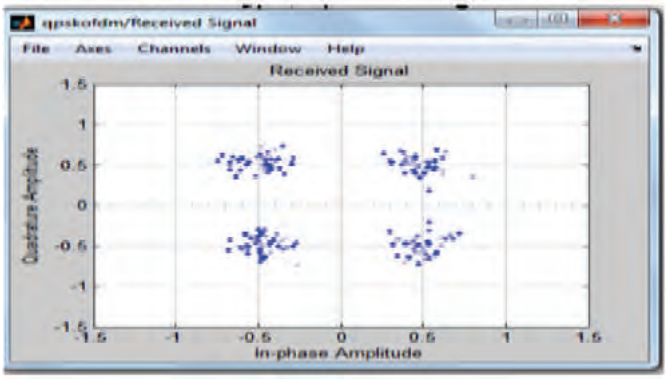

Figure 10.Scatter plot of OFDM QPSK received signal.

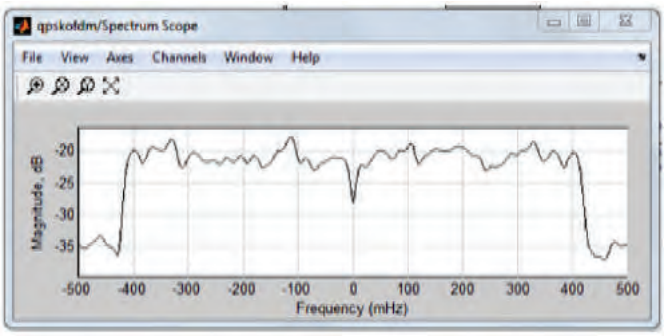

Figure 11. Spectrum scope of OFDM model for QPSK.

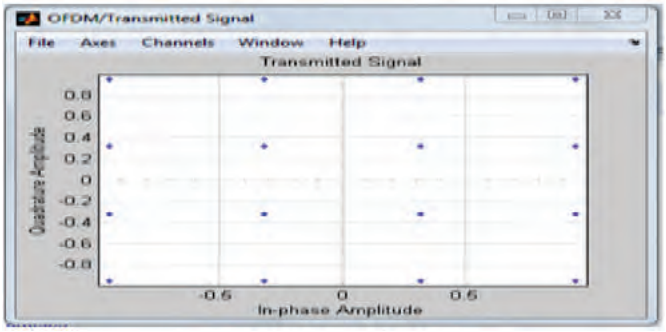

Figure 12. Scatter plot of OFDM transmitted QAM signal.

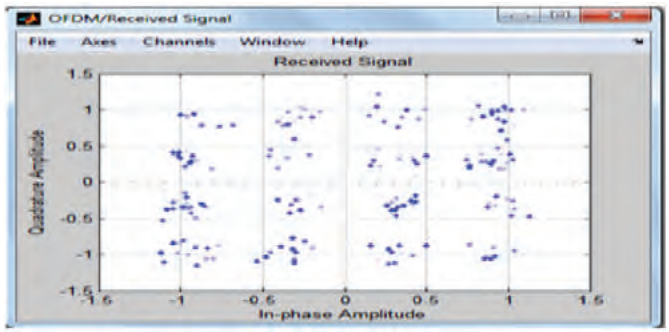

Figure 13. Scatter plot of OFDM Received Signal.

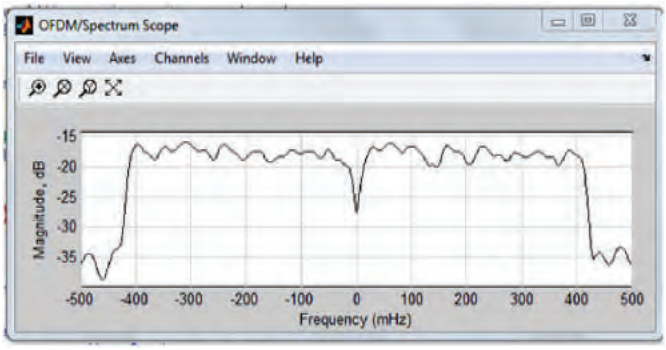

Figure 14. Spectrum scope of OFDM QAM signal.

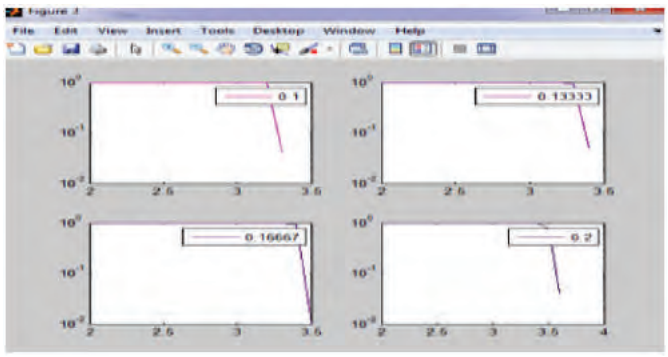

Figure 15. PAPR reduction of OFDM using BPSK.

7. CLIPPING TECHNIQUE

This technique cancels the amplitude of the signal that exceeds the threshold value of amplitude. Thus decreasing the PAPR in the system. It also adds a clipping noise which is due to the distortion of power and expand the signal spectrum of transmitter which cause the interference in the signal. Clipping is a non linear technique that produces in-band noise distortion which reduces the performance and efficiency of BER and out-band noise which reduces the overall spectrum efficiency[41].

7.1 System Model of Clipping Technique

In our simulation we have consider an OFDM signal of N= 2464 sub-channels and length of 2048. We have over sample the OFDM signal by 2. The Outputs of the simulation is reduction of PAPR, CCDF vs. SNR. The detail methodology is described in the following Table 2.

The graph calculates peak-to-average power ratio (PAPR) reduction in OFDM. PAPR reduction graph is calculated. PAPR reduction is calculated for proposed PAPR reduction technique for M-ary modulation schemes such as BPSK, QPSK, 64-QAM. The complementary cumulative distribution functions (CCDF) of the PAPR for the transmitted signal are plotted in Figure 16, 17 and 18. Where the PAPR technique being employed by clipping for clipping ratios are plotted in subplot. From figure the PAPR is reduced up to 3.3. The simulation Graph is repeated for modulation schemes such as BPSK, QPSK, and 64-QAM,. In the system, clipping technique significantly reduce PAPR.

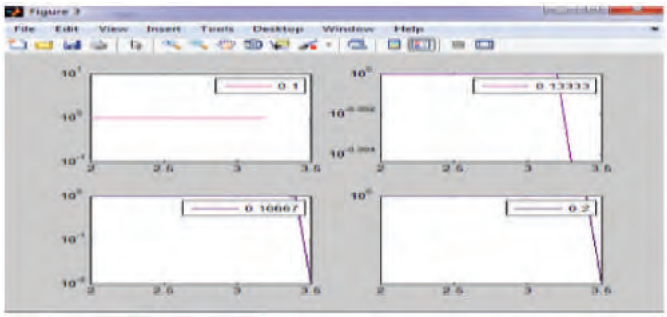

Figure 16. PAPR reduction of OFDM using QPSK.

Table 2. System model of clipping technique

BPSK	QPSK	QAM
Enter the M - ary value : 2	Enter the M - ary value : 4	Enter the M - ary value : 64
Enter the length of FFT : 2048	Enter the length of FFT : 2048	Enter the length of FFT : 2048
Enter the number of input symbols : 2000	Enter the number of input symbols : 2000	Enter the number of input symbols : 2000
Oversampling : 2	Oversampling : 2	Oversampling : 2

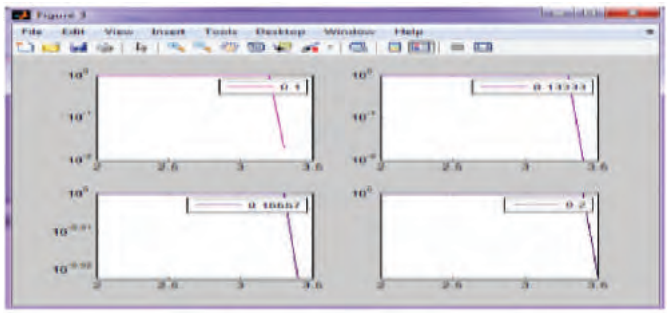

Figure 17. PAPR reduction of OFDM using QPSK.

8. CONCLUSION

In Initial, The simulated of OFDM is performed for different modulation technique like BPSK, QPSK and QAM. It is seen from the simulation that the capacity is doubled in QPSK as compare to BPSK at same Bit Error Rate and also it is seen that For QAM-16, BER is 3.296e-006.In Second Stage the PAPR is reduced to 3.3 for BPSK, QPSK and QAM-64by using a clipping technique.

निष्कर्ष

प्रारंभिक चरण में, बीपीएसके, क्यूपीएसके और क्यूएएम जैसे अलग–अलग मॉडुलन तकनीकों के लिए कृत्रिम ओएफडीएम पर कार्य किया जाता है। अनुकरण से यह देखा गया कि क्यूपीएसके में बीपीएसके की तुलना में उसी बिट त्रुटि दर पर क्षमता दोगुनी हो गया और क्यूएएम–16 के लिए बीईआर 3.296e-006 देखी गयी। दूसरे चरण में, कतरन तकनीक का उपयोग कर बीपीएसके, क्यूपीएसके और क्यूएएम के लिए बिट त्रुटि दर 3.3 तक कम हो गयी।

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Table 3. PAPR reduction using clipping technique

Modulation technique	Original signal PAPR	Clipping PAPR
BPSK	16	3.3
QPSK	16	3.3
64 QAM	16	3.3

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बेएशियन संरचना आधारित विशेषता मानचित्रण का उपयोग करके मोबाइल युक्तियों में दक्षतापूर्ण संसाधन उपयोग

Efficient Resource Utilization in Mobile Devices Using Bayesian Framework Based Saliency Mapping

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सारांश

नई प्रौद्योगिकी की प्रगति के साथ मोबाइल युक्तियां उच्च स्तर की उपयोगिताएं प्रदान कर रहीं हैं। ये युक्तियां विभिन्न प्रयोजनों के लिए व्यापक रेंज के अनुप्रयोग प्रदान करती हैं। वीडियो प्लेयर जैसे अनुप्रयोग उच्च अभिकलन शक्ति की मांग करते हैं। वीडियो नमूनों के लिए भी उच्च भंडारण (स्टोरेज) स्थान की आवश्यकता होती है। इस कार्य में, हमने इन अपेक्षाओं के इष्टतम उपयोग के लिए एक विशेषता मानचित्रण आधारित तरीके को प्रस्तुत किया है। बेएशियन संरचना आधारित विशेषता मानचित्रण शीर्ष से नीचे की ओर और तल से ऊपर की ओर दोनों मानचित्रण को ध्यान में रखने के कारण बहुत कार्यदक्ष होता है। विशेषता वाले क्षेत्र के बाहर पिक्सलों को धुंधला कर दिया जाता है ताकि वीडियो प्लेयिंग के डिकोडिंग फेज के दौरान उन विशेषताओं को बाहर निकालने के लिए अभिकलन को घटाया जा सके। चूंकि धुंधलापन निर्विघ्नता के लिए जिम्मेवार होता है, यह एनकोडिंग के दौरान अधिक संपीड़न प्रदान करता है। विशेषता मानचित्रण का उपयोग करके संरचना में आंशिक परिवर्तन के कारण वीडियो की गुणवत्ता समान बनी रहती है।

ABSTRACT

Mobile devices are providing a high level of usability with the advancement of new technology. These devices provide a wide range of applications for various purposes. The applications like video players have a demand of high computation power. Video samples also require a high storage space. In this work, we have presented a saliency mapping-based approach for optimizing these requirements. The Bayesian framework based saliency mapping is efficient due to the consideration of both top-down and bottom-up mapping. Pixels outside the salient region are blurred to decrease the computations for extracting those features during the decoding phase of video playing. Since blurring is responsible for smoothing, it gives more compression during encoding. Because of the partial modification in a frame using saliency mapping, the quality of the video remains the same.

Keywords: Mobile devices, usability, saliency map, region of interest

1. INTRODUCTION

The advancement in technology has increased the mobility of computational resources. A major shift has been observed in recent years, from traditional computing to mobile one. The new class of mobile device is equipped with various features like Wi-Fi, graphics processing unit, high definition camera and display, GPS, etc. The development of a new range of operating systems like Android and iOS has added support to it. While these features are very promising in terms of usability and availability, but lacks in terms of resources like computing power and local storage memory.[1] Various approaches have been proposed in the past for sharing the computational loads through the grid and pervasive computing. But these are limited by the availability and quality on the interconnection of computational point[2]. Video players are one of the important features of mobile devices. Playing video in a mobile device is very costly in terms of computation and storage requirement.

To manage the resources efficiently on mobile devices, it is necessary to optimize the existing computational capacity. The work presented here manages the features of video playing on mobile devices based on Bayesian framework saliency mapping. The saliency map helps in maintaining the quality of video while features are modified to optimize the processing power and storage. The work is implemented and tested on Android-based Akash UbiSlate7C+ tablet.

2. RELATED WORK

Android devices are equipped with various sensors. So it is very easy to define the context of usage. Using this *Nishihara, et al*. have proposed a method to make a minimum number of peripherals active[3]. This approach is helpful in reducing the power consumption by 45 per cent. Features play an important role in mobile learning applications. In the method proposed by *Jalal, et al.* features of mobile learning application are reduced without affecting the quality so that power-consumption of multimedia device should decrease[4]. The user model for this approach is based on individual user preferences. For sharing the computational load *Bianzino*[5]*, et al*. have proposed the formation of proxy group. These groups are based on network traffic and believed to be efficient in terms of improving the quality of service. In a similar approach Chunlin and Layuan[6] have developed a procedure for better interaction between mobile agent and service agent to share the computational load for giving high quality of service. Jiao and Hurson[7] have proposed multi-database for the same architecture.

Saliency algorithms are responsible for finding the region of interest in the display of a computational device. *Longhurst*[8]*, et al*. have given a GPU-based model to calculate saliency map for an image or a video without any prior information about it. The architecture is efficient enough to generate the map in milliseconds. Barendregt and Bekker[9] model is based on using a coding scheme using 8 out of 14 breakdowns of saliency map. *Ong*[10]*, et al*. have given a new dimension to a saliency map by referring perceptual quality of a video for referring subjective quality. *Song*[11]*, et al.* have proposed a model specific to the mobile device by referring zooming aspect of a sport video. *Shao*[12]*, et al*. used segmentation method with foveation-based method to generate the saliency map. *Li*[13]*, et al*. approach is based on topological map generated from conspicuousness of a location in an image. *Ndjiki-Nya*[14]*, et al.* have used perception based saliency model for encoding the video.

3. PROPOSED METHOD

Bayesian framework for saliency mapping is a combination of top-down and bottom-up approachs. The first approach is based on the features of the image and other one is based on the features which an individual is searching.[15]

$$\log sp = -\log(\text{probability of } (A=az)) + \log(\text{probability of } (A= az \mid B=1)) \quad (1)$$

$$= \log \frac{probability\ of\ (A = a_z, B = 1)}{probability\ of\ (A = a_z) * probability\ of\ (B = 1)} \quad (2)$$

Here, *sp* is the saliency value of point *p, A* is feature to be searched and *az* is value of a feature at point *z, B* is the target class. In eqn (1), probability of (*A*=*az*) is a bottom-up saliency value, whereas the probability of (A= AZ |B=1) is the top-down saliency value. Eqn. (2) represents the overall saliency. The proposed method utilizes the Bayesian framework for saliency mapping, so that the modified video does not suffer in terms of usability. As shown in Fig. 1, after finding the region of interest in a video sample, the region outside it is diminished. Due to this, the features at a pixel become similar to the neighbours. The similarity is exploited during encoding and decoding. Here three video codecs have been used for analyzing: MPEG-4, Xvid, and Div[3]. The samples obtained after the entire procedure are compared in terms of average CPU utilization and size.

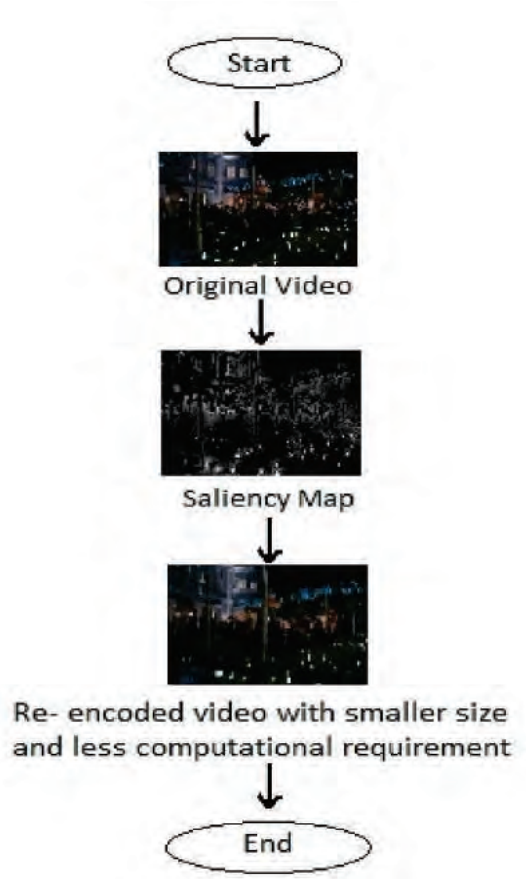

Figure 1. Overview of the proposed method.

4. EXPERIMENTAL METHOD AND RESULTS

The experiment is conducted on six different samples from different genres. First, the samples are decoded into uncompressed form. Then Bayesian framework-based saliency map applies to the video. Initially the uncompressed video is encoded into the three standards: XVID, DIV3, and MPEG. The region of interest identified through a saliency map is left intact. Pixel values outside it are blurred using an averaging filter based on eight neighbouring pixel values. Due

Table 1. Comparison of average CPU utilization by different samples

	Duration (Min: Sec)	Average CPU utilization for original samples			Average CPU utilization for modified samples		
		XVID	DIV3	MPEG	XVID	DIV3	MPEG
Sample1	4:05	7.36%	7.85%	7.42%	7.19%	7.63%	7. 42%
Sample2	3:47	7.21%	7.66%	7.37%	7. 13%	7. 48%	7. 33%
Sample3	9:08	7.17%	7.74%	7.51%	7. 04%	7. 54%	7.26%
Sample4	5:20	7.31%	7.91%	7.62%	7.24%	7. 73%	7.51%
Sample5	7:35	7.16%	7.54%	7.29%	7.07%	7.41%	7. 27%
Sample 6	6:15	7.38%	7.83%	7.51%	7. 17%	7. 70%	7. 39%

to this, pixel value becomes identical to neighbours in spatial domain. So while encoding, it gives better compression. Since different encoding algorithms have different method of compression, so the method is analyzed over three widely used codecs. Samples are played on UbiSlate7C+ Android 4.0.4 based tablet for checking their computational efficiency. The size of the sample is observed for checking the compression done by the standard codecs and their effect after saliency-based modification. Table 1 shows the average CPU utilization of the application used for playing the video. It is clear from the observation that for all three codecs the CPU utilization is less for modified samples as compared to the original one.

Table 2 shows the comparison of size before and after modification for the three video codecs. The observations indicate 18.39 per cent to 21.34 per cent reduction in file size. Among three codecs, XviD is giving maximum compression. The trend is followed by DIV3 and MPEG for the original as well as for modified samples. The size of the file is not correlated to the duration of the video because the quality of video used is different.

The usability test is conducted over six users based on the standard procedure. The samples are randomized and the users have given the quality rating to these videos on the scale of 10. The graph presented in Fig. 2 infers that the modified videos also maintain optimal usability as compared to the original one.

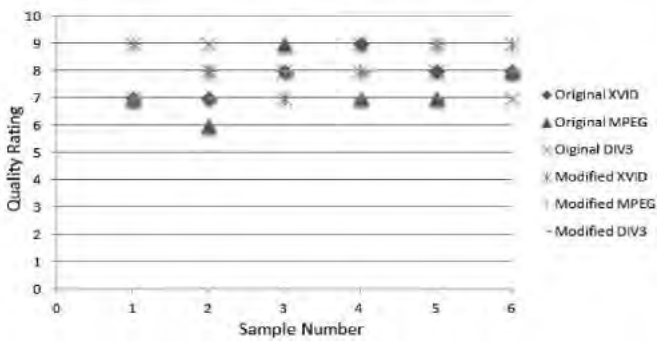

Figure 2. Usability test on the samples.

5. CONCLUSION AND FUTURE WORK

Bayesian framework for saliency map is an efficient way to determine region of interest as it considers both top-down and bottom-up methods. This makes saliency mapping, accurate in both the cases: when the user is simply watching a video and when he is searching for some feature in the video. The efficient calculation of saliency region maintained the quality of the modified video. The reduction in average CPU

Table 2. Comparison of files size for different samples

	Duration (Min: Sec)	File size of original videos (MB)			File size of modified videos (MB)		
		XVID	DIV3	MPEG	XVID	DIV3	MPEG
Sample1	4:05	84	87	96	67	70	76
Sample2	3:47	137	146	163	108	118	129
Sample3	9:08	182	203	218	147	163	173
Sample4	5:20	87	99	125	71	79	100
Sample5	7:35	134	158	173	106	126	138
Sample 6	6:15	55	67	89	44	53	70

usage and file size signifies the impact of saliency mapping in resource utilization. The idea can be extended to check the effect of a combination of other saliency mapping for different video codecs in terms of different resources.

निष्कर्ष

विशेषता मानचित्रण के लिए बेएशियन संरचना रूचि का क्षेत्र निर्धारित करने के लिए एक दक्ष तरीका है क्योंकि यह शीर्ष से नीचे की ओर और तल से ऊपर की ओर दोनों पद्धतियों को ध्यान में रखता है। इससे दोनों मामलों मेः जब प्रयोक्ता केवल वीडियो देख रहा होता है और जब वह वीडियो में किसी विशेषता को ढूंढ रहा होता है, विशेषता मानचित्रण सटीक हो जाता है। विशेषता क्षेत्र का दक्ष अभिकलन संशोधित वीडियो की गुणवत्ता को बनाए रखता है। औसत सीपीयू उपयोग और फाइल के आकार में कमी संसाधन उपयोग में विशेषता मानचित्रण के प्रभाव को रेखांकित करते हैं। इस विचार को विभिन्न संसाधनों की दृष्टिकोण से विभिन्न वीडियो कोडेक्स के लिए अन्य विशेषता मानचित्रण के संयोजन के प्रभाव की जांच करने हेतु उपयोग किया जा सकता है।

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व्याख्यान संकेतों के लिए डिजिटल सिग्नल प्रोसेसिंग
Digital Signal Processing for Speech Signals

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सारांश

इस आलेख में व्याख्यान संकेतो के लिए डिजिटल सिग्नल प्रोसेसिंग (डीएसपी) तकनीकों की अनुप्रयोगिताएँ, उपयोगिताओं और नुक्सानों का संक्षिप्त विवरण प्रस्तुत करता है। डीएसपी तकनीकों का विकास पिछले चार दशकों में किया गया है और यह विज्ञान और अभियांत्रिकी के क्षेत्र में आता है। लेकिन जब हम चार दशक पहले के समय के बारे मे बात करते हैं तो उस समय डिजिटल कम्पयूटर और उससे सम्बन्धित हार्डवेयर बहुत बडे आकार के और बहुत महंगें होते थे और उनका उपयोग सीमित था। इसलिए इस क्षेत्र में तेजी से हुए बदलाव ने डिजिटल कंप्यूटर प्रौद्योगिकी और इनटीग्रेटिड सर्किट फेबरिकेन में लाभ किया है। फिर भी डीएसपी मे होने वाली सभी संकेतों प्रसंस्करण की मुसीबतों में कुछ सुधारों की आवश्यकता है। डीएसपी संचरण माध्यम में इलेक्ट्रोमेगनेटिक संकेतों के सम्बन्धित हैं और यह व्याख्यान प्रसंस्करण समस्याओं में पहली बार लागू किया गया है।

ABSTRACT

This paper gives an overview of digital signal processing (DSP) techniques for speech signals its applications, advantage and disadvantage. About 4 decades ago digital computers and associated digital hardware were large in size and more expensive, also their uses were limited. Hence the fast changes in this field provide the advantage in digital computers technology and integrated circuit fabrications. Still there are some improvements needed for all signal processing troubles in DSP. DSP concerns with electromagnetic signals across a transmission medium and it is first time implemented in speech processing problems.

Keywords: Digital Signal Processing, analog signal, digital signal, sampling, systems and signals

1. INTRODUCTION

A Digital Signal Processing is an integrated circuit designed for high speed data handling and it is also a method of examining and modifying a signal to improve its effectiveness. It involves applying various mathematical and computational algorithms to produce a signal that's of higher value than the original signal. Fast and continuous development in the field of digital signal processing techniques, provide procedures in many areas in reference to analog signal processing. In recent times DSP is used in many types of signal analyses such as speech signal processing, biomedical signal processing, geophysical signal processing, and telecommunication, etc[1,2].

Digital Signal Processing is the discipline of using computers to understand digital models of the existing technology today. 1960s is known as the uprising year for DSP now it is necessary to the development of radar, sonar and space exploration etc. DSP used for implementation and many other fields that utilize it has developed technology with their specialized techniques, specific algorithms and their arithmetic[3]. DSP improves the accuracy and reliability in the field of digital communication. Usually DSP first converts an analog signal into a digital signal and then be relevant signal processing techniques and algorithms; DSP also helps to reduce noise and distortion. The fundamental of DSP is that it works by standardizing the levels of a signal. As it is known that all communication channels hold some background noise whether the signal are analog or digital, and apart from what type of information is conveyed. This noise in reference to some signal is known as signal to noise ratio for communication system, and one always tres to find how it improves. Suppose that an incoming analog signal such as a television broadcast station, the signal is first converted to digital using analog-to-digital converter (ADC) and resulting digital signal has two or more levels, these levels are always knowable. Since incoming signal contains noise hence many times levels are not at the typical values, so the DSP circuits correct the values

of levels and remove the noise. And the digital signal gets converted back to analog signal by using digital-to-analog converter (DAC)[4].

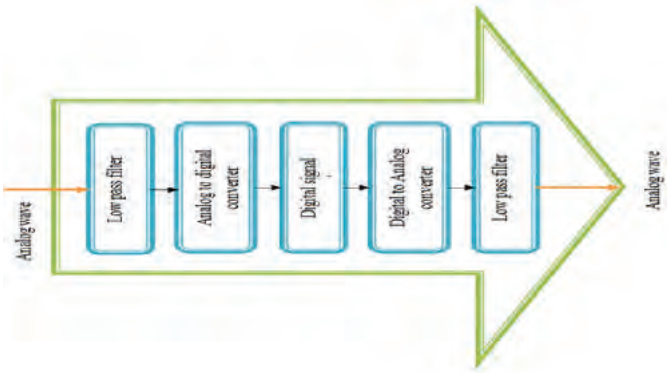

Figure 1. Block diagram of DSP system.

Figure1 describes block diagram of digital signal processing system. Here low pass filter is used for anti-aliasing. Aliasing will occur if the sampling frequency (f_s) is less than twice of highest frequency (f_m) i.e. $f_s < 2f_m$, contained by the signal. Analog to digital converter and use the sampling period $T = 1/f_s$ (here $f_s >= 2f_m$). DSP is for processor and lastly again low pass filter use to reconstruct the filter[5].

We can differentiate between analog and digital such as analog or continuous time method is described as analog is ancient technique used for signal processing. Analog signals for processing use some elements such as resisters, capacitors, diodes, transistors, etc. Also analog signal processing is based on natural capability of the analog system to solve differential equations that described a physical system and result are acquired in real time. The digital signal processing leading now a days, and it works on numerical calculations. Also it is not able to provide real time solutions. However digital processing technique has two main advantages over analog signals flexibility and repeatability. These term can be defined as in digital processing the same hardware is used for more than one signal processing operations while in analog signal processing for every type of operations one has to design a system that's why called flexible. And repeatability means the same operation can be repeated for giving same the outcomes whereas in analog signal processing systems parameter variation because of supply voltage or temperature. So the conclusion is that what signal processing used, it depends on the requirements or applications[6].

2. SIGNALS AND SYSTEMS

A well known definition of signal is that it is at physical quantity that changes with time and space and also some other independent variables. For example electrocardiogram (ECG) and electroencephalogram (EEG) are examples of natural signals. A signal can be classified either as analog and digital signal. Analog signals have infinite number of values in a range while digital signals have only a finite number of values. Generally in communication are use either periodic analog or aperiodic digital signals. Human voice is an example of analog signal, when a human utters a wave is generated in the air and this wave is an analog wave. And when voice is captured by a microphone then it is converted to an analog signal and after that when it is stored in the computer then it become digital data, i.e., in the form of 0s and 1s. Further when this data is transmitted from one computer to another or transferred from one emplacement to another then this data is converted to digital signal[7,8]. The signal processing has in many applications for example instrumentation, communication, radar and sonar signal processing, biomedical signal processing etc[9].

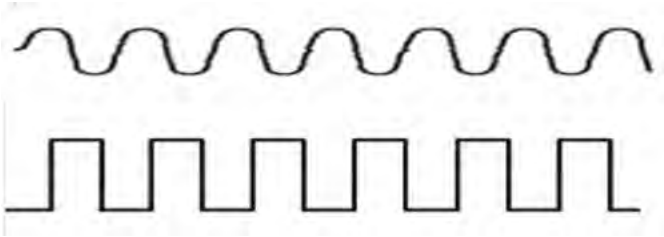

Figure 2. Analog and digital.

A system can be defined as a physical device that is able to execute an operation on a signal for example a filter used to cut down noises occur in desired information bearing signal is called a system. Also system can be describe by the type of operation performed on the signal and these types of operations concern to as signal processing[10]. Here the filter carries out a number of operations on the signal and these operations use to reduce the noise. When signal proceed through a system then performed operation is either linear or nonlinear. If the operation is linear, then system is called linear and if the operation on signal is nonlinear then system is called nonlinear[8].

3. DIGITAL SPEECH PROCESSING

Speech is a communication medium, a speech can be characterized in terms of signal and signal contains significance information and this information is in acoustic waveform. Speech signal is the application of digital signal processing technique. For a speech signal has three main tasks, i.e., represent a speech signal in digital form, implementation of complex technique, and classes of applications which depend more on digital processing. To represent a speech signal in digital form, use sampling theorem in case of sampling a band limited signal can be represented samples which are periodic in time[11].

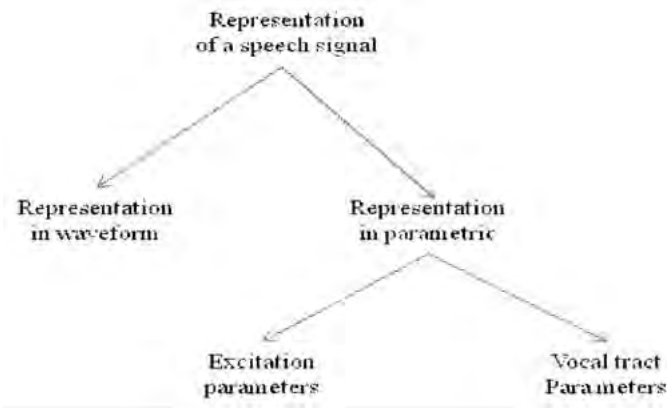

Figure 3. Classification of speech signal.

Representation of speech signal can be classified as waveform representation and parametric representation. In case of waveform representation just keep out wave shape of a speech signal (analog) by using sampling and quantized method while in parametric representation speech signal represents as the output of a model for speech production. Again, parametric representation classified as excitation parameters and vocal tract parameter. Excitation parameters means related to source of speech sound and vocal tract parameters are related to the single speech sounds. There are many areas where speech processing is used, for example speaker recognition, speech recognition and synthesis, digital transmission etc[11,7,8].

4. PROS AND CONS OF DIGITAL SIGNAL PROCESSING SYSTEM

The most suitable reason to using digital signal processing techniques is that the highly advanced signal processing functions can be implemented using digital signal processing techniques. It can be determined as to find discrete representations of signals. DSP is more complex in nature than analog signal processing on the other hand it has many advantages in excess of analog signal processing. Following are the advantage of DSP technique[5,10,12].

- DSP provide the facility of reproducibility i.e. digital system allows reconfiguring the digital signal processing functions while in case of analog it is essential to redesign hardware.
- DSP has the Capability of being changed since the digital processing can be simply changed by programming.
- DSP make available better signal quality.
- This processor is small in size and economical to implement.
- In analog signal it is complex to execute accurate mathematical operations but these operations can be normally implemented on a digital computer.
- For analog require numerous filters but in digital same DSP processor is used for many filters.
- Storing digital data is inexpensive and also digital data can be encrypted, coded and compressed.
- These systems more reliable and easily modify by changing software.
- It can be implemented to linear (complex) or nonlinear algorithms.

There is also some disadvantage of DSP such as [13]-

- General purpose microprocessors & micro controllers are cheaper than DSP hardware.
- We not able to amplify signal after it is digitized if the signal is weak (few tenths of milivolts).
- It is happening that sampling loss some data.
- Using converter of Analog to digital & digital to analog may be expensive.
- Sometimes digital processing is not possible.

5. APPLICATIONS OF DIGITAL SIGNAL PROCESSING SYSTEM

There are a lot of applications in different areas for which the Digital Signal Processor becomes an ultimate solution and for these DSP makes available the finest promising combination of performance. Mainly the DSP applications can be simplified into multiplications and additions. Hence the MAC formed a main functional unit used in early DSP processors. Later on researcher/designers integrated more features such as pipelining, SIMD, VLIW etc, to improved performance. Today's DSP used in too many fields for example[10,12,14].

- *Speech recognition*- Speaker verification, voice mail and speech synthesis etc.
- *Signal analysis*- analysis of Audio/video signals.
- *Space photograph*- development and data compression.
- *Wave form generation*- to represent speech signal.

- *Filtering the background noise*- to remove white noise from a speech/signal
- *Image processing*- image compression, image enhancement, 3-D rotation and animation.
- *Telecommunication and Data communication* (using pulse modulation system)
- *Compression and expansion* of speech which is used in radio voice communication.
- *Biomedical*- MRI, ultrasound and patient monitoring. And for storing medical image.
- *Sonar and Radar*- missile control, radio frequency, secure spread spectrum radios and so on.
- *Control system and Instrumentation*- connecting device control e.g. laser printer control, robot, spectrum analysis, signal generators etc.
- *Oil and mineral vision*, process monitoring and control.
- For earthquake investigation and data acquirement.

There are lots of areas where DSP can be used but here we have discussed only few popular applications. The main objective of DSP is to measure, filter and compress analog or digital signals. DSP basically is used for signal processing which is done on digital signal to improve the quality of signal. It is described by in the term of discrete representation such as discrete domain signals/frequency, discrete time. DSP contains some sub-fields as radar signal processing, communication signals processing, digital image processing, etc[15].

6. SAMPLING OF A SIGNAL

Sampling is the process of converting a continuous time signal into a discrete time signal acquire by taking samples of the continuous time signal at discrete time instants. Sampling rate /frequency (Fs) can be defined by the number of samples per seconds obtain from analog signal (continuous signal) to construct a discrete signal. And sampling period/interval is the inverse of sampling frequency or it is time between successive samples. The unit of sampling rate in time-domain is hertz or samples per second (Sa/s) [7] [8] [16]. Assume S1 (t) is an analog signal to the sampler, then the output is –

$S1(nT) \equiv S(n)$

where- *T* is called the sampling interval, S(n) is discrete time signal.

There are lot of methods for sampling an analog signal, in this study discussion about periodic sampling because in general periodic sampling is used and it can be described by

$S(n) = S1(nT) - \infty < n < \infty$

where – S1(nT) = analog signal in every *T* seconds.

The time interval *T* between successive samples is known the sampling period/sample interval.

$\frac{1}{T} = F_s$ are called the sampling rate/frequency.

There are a question that how we select the sampling period T or its equivalent and the sampling rate F_s the answer is that we must have common information concerning the frequency content of the signal. For example television signals generally contain frequency components up to 5 MHz.

For sampling a signal mostly used theorem is Nyquist Shannon sampling theorem. Using this theorem a signal can be reconstructed faultless but the condition is that the sampling frequency is greater than twice maximum frequency ($F_s > 2F_{max}$) or its equivalent. If lower sampling rate is used then may be original signal information fully not recoverable from the sampled signal. Since human hearing range is 20Hz to 20 kHz i.e. the minimum sampling frequency is 40 kHz[16,14]. Sampling rate for phonemes is between 5Hz to 4 kHz because human speech usually sampled at much lower rate i.e. all the energy is enclosed between this and allocate sampling rate 8 kHz, and this sampling rate used by telephony system. Since for voice frequency transmission bandwidth allocated for a channel is typically 4 kHz.

7. CONCLUSION

In this paper we try to provide some basic properties of DSP which is useful for new researchers in this field.DSP known as core technology and is used in rapidly growing areas such as audio & video signal processing, telecommunications, instrument control etc. There is continuous development in the field of DSP and because of this it has become a key component for many applications which apply signal processing using microprocessor. DSPs are microcomputers/processors whose hardware, software and instruction sets are optimized for high-speed numeric data processing applications. In last few years DSP processors have become more popular and used vastly due to various advantages as reprogram ability, cost effectiveness, speed of data processing, size etc.

निष्कर्ष

इस आलेख मे हम डीएसपी के कुछ बुनियादी गुण बताने की कोशिश की गई है जो इस क्षेत्र के नये शोधकर्ताओं के लिए उपयोगी है। डीएसपी को मूल प्रौद्योगिकियों के रूप में जाना जाता है और तेजी से बढ़ते क्षेत्रों जैसे ऑडियो व वीडियो सिग्नल प्रोसेसिंग, दूरसंचार, यंत्र नियंत्रण इत्यादि में इस्तेमाल किया जा रहा है। डीएसपी के क्षेत्र में निरंतर विकास हो रहा है और इसकी वजह है कि यह कई अनुप्रयोगों जो माईक्रोप्रोसेसर का उपयोग करके संकेतो का प्रसस्करण करते हैं के लिए प्रमुख घटक हैं। डीएसपी एक माइक्रोकम्पयूटर प्रोसेसर है जिसके हार्डवेयर,

सॉफ्टवेयर और इंसटक्शन सेट का उच्च गति संख्यात्मक डेटा प्रसंस्करण अनुप्रयोगों हेतु बेहतरीन प्रयोग हो रहा हैं। पिछले कुछ वर्षों में डीएसपी प्रोसेसर काफी लोकप्रिय हो गए हैं और पुनः प्रोगाम की योग्यता, किफायती दामों, डाटा प्रोसेसिंग की गति, आकार आदि विभिन्न फायदों के कारण बहुत उपयोग किया जा रहा हैं।

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एस एल 4 ए और रास्पबेरी पाई का उपयोग कर स्मार्टफोन आधारित गृह स्वचालित
Smartphone Based Home Automation System using SL4A and Raspberry Pi

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सारांश

स्वचालन घर पर मिलने वाले आराम और सुरक्षा स्तर को बढा देता है। स्मार्टफोन जो आजकल आसानी से उपलब्ध हैं और रासबेरी पाई माड्यूल के साथ सरल, किफायती दाम पर गृह स्वचालन प्रणाली का निर्माण किया जा सकता है। गृह स्वचालित प्रणाली को स्मार्टफोट जो एंडरोएड और एंडरोएड (एसएल4ए) की स्क्रिप्ट लेयर से युक्त हैं की आवाज और ई–मेल से नियन्त्रित किया जा सकता है। एसएल4ए स्मार्टफोन के इंटरफेस के रूप में कार्य करता है और आवाज का विश्लेषण गूगल वायस रिगोनिशन से करता हैं। ई–मेलों को पायथन लिपि और पारसिस इनपुट से भेजकर रासबेरी माड्यूल को आदेश (कमांडस) दिये जाते हैं। रासबेरी पाई माड्यूल ई–मेल बक्से से आदेश (कंमांड) निकालकर उनका पालन करता है।

ABSTRACT

Automation increases the comfort and safety levels of a home. Using smartphones that are ubiquitous these days and with a Raspberry Pi module, a very simple, cost – efficient home automation system can be built. The Home Automation System can be controlled by voice or email through smartphones running Android and equipped with Scripting Layer for Android(SL4A). SL4A acts as the smartphone interface and does speech analysis using Google Voice Recognition and issues commands to a Raspberry Pi module by email through a Python script that parses input. The Raspberry Pi then carries out the commands fetched from the e-mail inbox.

Keywords: Home automation, raspberry Pi, SL4A

1. INTRODUCTION

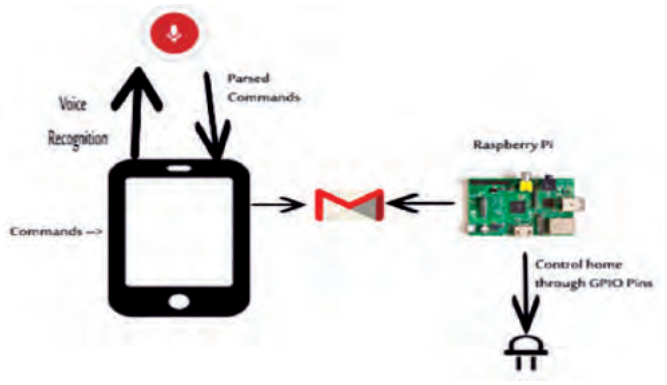
With the advancements in Information Technology, the next generation homes are going to be smart and powerful with complete automation. The user interface is desired to be more user-friendly and powerful. It should also be intuitive and the users should interact with it as they interact with other humans. As the choice for natural and expressive means of communication, speech is the most desirable for this interaction. Speech has the potential to provide a direct and flexible interaction for the embedded system operations [1]. Generally speaker independent systems are more widely used, since the user voice training is not required. Speech recognition is classified as connected word recognition and isolated word recognition[2]. For embedded devices like Raspberry Pi, implementation of isolated word recognition is sufficient. Generally, speech recognition is a kind of pattern recognition.

Google Speech Recognition can be used for the recognition of commands given by the user to the home automation system. It is the most up-to-date and continuously updated and therefore provides a better accuracy compared to other voice recognition systems. The commands thus analysed are mailed to a preset email id which the Raspberry Pi continuously monitors for commands. When a command is received through email, the Raspberry Pi carries out the necessary actions. LEDs have been used to implement the working of the system. The backend of the system is designed using the Python programming language.

2. SYSTEM ARCHITECTURE

The system is developed using Raspberry Pi and an Android phone with SL4A(Scripting Layer for Android). The voice recognition is carried out by Google Voice Recognition and the commands are issued using SL4A's Python interpreter. These commands are analysed by the Python interpreter of Raspberry Pi and the commands are implemented by the General Purpose Input and Output(GPIO) pins of Raspberry Pi.

The Raspberry Pi is a credit card-sized single-board computer developed in the UK by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools[3]. The Raspberry



Pi is based on the Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF-S 700 MHz processor, VideoCore IV GPU and was originally shipped with 256 megabytes of RAM, later upgraded (Model B & Model B+) to 512 MB. The system has Secure Digital (SD) or MicroSD (Model B+) sockets for boot media and persistent storage.

The Scripting Layer for Android (abridged as SL4A, and previously named Android Scripting Environment or ASE) is a library that allows the creation and running of scripts written in various scripting languages directly on Android devices. SL4A is designed for developers and (as of late 2014) is still alpha quality software.

These scripts have access to many of the APIs available to normal Java Android applications, but with a simplified interface. Scripts can be run interactively in a terminal, or in the background using the Android services architecture[4].

```
while("exit" not in userCommand):
  userCommand = set(droid.recognizeSpeech().result.split())
  body = ""

  for room in userCommand.intersection(set(["kitchen","hall","bedroom",
                                            "bed"])):
    if "on" in userCommand:
      body = room + " light on"
      if (sendemail(email_name, email_user, email_pswd,
                    mailto, subject, body, attachments)):
        sys.exit(0)
      else:
        droid.makeToast("Failed to send email")
    elif "off" in userCommand:
      body = room + " light off"
      if (sendemail(email_name, email_user, email_pswd, mailto, subject,
                    body, attachments)):
        sys.exit(0)
      else:
        droid.makeToast("Failed to send email")
    else:
      pass
    time.sleep(5)
```

3. EXTRACTING COMMANDS FROM THE USER INPUT

The most important step in the entire architecture is the parsing of the user input(speech) and understanding the commands issued by the user. Since speech is a very natural form of interaction, we look for certain words in the input. The parsing is to be done in an effective manner such that the system should understand different types of user input such as:

1) Turn on the kitchen light.
2) Can you please turn on the kitchen light?
3) Would you turn on the kitchen and hall lights please?

As seen, the commands are all very different and have different semantic structures. Therefore, a proper parsing system should be created to identify what the user is trying to say. We have implemented such a parser using the following code:

The parser converts the user input into commands in the following steps. At first, the voice is recogised using Google Voice Recognition that is present in every Android smartphone. The recognized speech which is in the form of a sentence is split into individual words using the string.split( ) function of Python. This function returns an array of individual words in the user input. This array is then converted into a set 'A' for further operations. A set 'B' consisting of all the locations(such as kitchen, hall, etc.) is already built into the parser. The parser performs set intersection operation on these two sets 'A' and 'B' and returns a set 'C' with the locations that have been specified by the user. Then this set 'C' is iterated upon by the parser for each element(location) and it is checked to see if the word 'On' is present in the input. If yes, the command is issued to turn on the equipments at that location. Otherwise, if the word 'Off' is present in the user input, turn off command is issued. If both are not present, the parser carries out the next iteration.

4. IMPLEMENTING COMMANDS THROUGH RASPBERRY PI

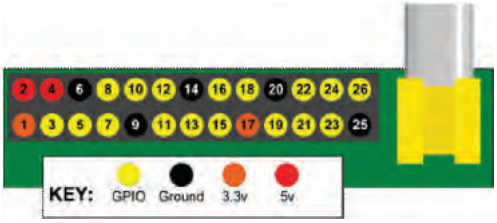
The Raspberry Pi module monitors the inbox of the email id using the PyGmail module. When a mail arrives at the inbox with "SL4A" as the subject the commands specified in the body of the mail are carried out. Also, selecting only mails with this subject enables it to use the email id for general purposes also and preventing the Home Automation System from accessing other emails.

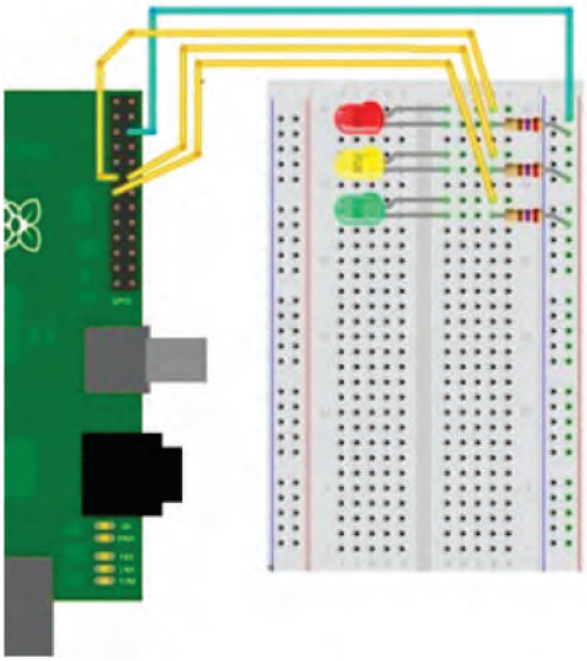
- The code for this system is as follows: The mails that have been fetched and whose commands have been executed are trashed by the module thereby cleaning up the inbox and keeping it clean for other purposes.
- The commands are carried out using the GPIO pins of the Raspberry Pi. The pin configuration of the Raspberry Pi is as follows.
- Raspberry Pi has 26 pins out of which 17 are programmable(GPIO pins)[5]. This can be further increased by adding expansion modules. Equipments are connected to these pins . The schematic for connecting LEDs(to emulate home appliances) is as follows:

```
import gmail
import RPi.GPIO as GPIO
import time

GPIO.setmode(GPIO.BOARD)
GPIO.setwarnings(False)
GPIO.setup(7, GPIO.OUT)
GPIO.setup(13, GPIO.OUT)
GPIO.setup(3, GPIO.OUT)

while(True):
    try:
        g = gmail.login("username", "password")
        commandMails = g.inbox().mail(
            sender = "emailid@gmail.com",
            unread = True, subject = "SL4A")
        commandMails[0].fetch()
        print commandMails[0].body
        command = commandMails[0].body
        commandMails[0].delete()
        if command = "hall light on":
            GPIO.output(7, True)
        elif command = "hall light off":
            GPIO.output(7, False)
        elif command = "kitchen light on":
            GPIO.output(13, True)
        elif command = "kitchen light off":
            GPIO.output(13, False)
        elif command = "bedroom light off":
            GPIO.output(3, True)
        elif command = "bedroom light off":
            GPIO.output(3, False)
    except:
        time.sleep(5)
```





The Raspberry Pi module has assigned each of its GPIO pins to one equipment each. Based on the command obtained by reading the email's body, the GPIO pin of that corresponding equipment is turned on/off and this helps in preventing interference with the other devices connected to the Raspberry Pi module.

5. SAFETY MECHANISMS

The Raspberry Pi module only reads those mails with the subject "SL4A". This configuration has several advantages. The most important of all is that the module only accesses those mails that are meant for the home automation system. Also, the user can directly mail to this email id instead of using his mobile phone if required. This will be handy in situations where the mobile might have been lost. An override mechanism has been included in the system so that the user can block the RPi module from carrying out instructions issued in case of theft of mobile, etc. thereby preventing unauthorized access and increasing the safety of the system.

By attaching a camera module to the Raspberry Pi module, it is possible to enable remote monitoring of the home. This can help in monitoring babies when the parents are away, theft alarm, etc.

6. AUTOMATED MODE

The module can be configured to handle the process automatically using the android phone's GPS and sensors. A database with the rooms can be built into the Raspberry Pi module and once the user nears a room at night, the lights in that room can be turned on based on the distance read using the GPS sensors and the time. The lights can then be turned off using the same mechanism. By using a weather API along with the module, the air-conditioners and room heaters can be turned on depending on the weather forecasts. Android phones are also equipped with light sensors and the lights in the user's current location can be turned on by combining the readings of the GPS and light sensor readings. This further increases the efficiency of the system and the need of the user to issue commands has been decreased.

7. CONCLUSION

Thus, a low cost voice and email based home automation system has been implemented. This will improve the comfort levels of home and make these future ready in addition to making these more friendly to the aged and the impaired. The total budget of the system is very affordable and will include only the cost of the Raspberry Pi module and a basic smartphone which combined together will be below INR. 12,000.

निष्कर्ष

इस प्रकार, एक कम लागत की आवाज और ईमेल आधारित गृह स्वचालन प्रणाली लागू की गई है। यह घर में आराम के स्तर में बढोतरी करती हैं और इसे भविष्य लायक बनाती हैं और इसके अतिरिक्त इसे वृद्ध और विकलांग के लिए अधिक अनुकूल बनाती हैं। इस प्रणाली की कुल खर्चा वहनयोग्य हैं और केवल रास्पबेरी पाई मॉड्यूल और एक स्मार्ट फोन की लागत जो कि मिलाकर 12000 से कम हैं तैयार किया जा सकता हैं।

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उपयुक्त तकनीकों के उपयोग द्वारा सैटेलाइट चैनल क्षमता का अनुकूलन
Optimising Satellite Channel Capacity by Utilising Appropriate Techniques

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सारांश

उपग्रह चैनल की क्षमता उपलब्ध बैंडविथ (बीडब्ल्यू), ट्रांसमिट पॉवर, रिसीवर संवेदनशीलता पर निर्भर करती है, कभी–कभी इसे शोर तापमान अनुपात (जी/टी), परिवेश शोर घनत्व के लाभ के रूप में संदर्भित किया जाता है। मॉडुलेशन योजना का प्रकार, उपयोग तकनीक, एफईसी का उपयोग (आगे त्रुटि सुधार) तकनीक, बिट त्रुटि दर के लिए जरूरी संभावना के प्रकार, चैनल शर्तों की समान धारणा के तहत चैनल क्षमता को नियंत्रित करने वाले अन्य मानक हैं। अध्ययन और विश्लेषण के प्रयोजन के लिए डिजिटल जानकारी पारेशण और प्राप्ति पर विचार किया जा रहा है। सेटकॉम नेटवर्क थ्रोपुट का अनुकूलन उचित मॉडुलेशन योजना का उपयोग, वाहक में वाहक (सीएनसी) जैसी उपयुक्त पहुँच योजनाओं जैसी कई तकनीकों पर निर्भर करता है, जिसे उपग्रह के लिए युग्मित वाहक बहु–उपयोग (पेयर्डकैरियर मल्टीपल एक्सेस) (पीसीएमए) भी कहा जाता है जिसमें वाहन पर पर्याप्त विद्युत उत्पादन क्षमता पर उपलब्ध है। एमआईएमओ जैसी तकनीक, जो कम जगह, कम वजन और उपलब्ध डीसी बिजली की वजह से आज के स्थान की कमी जैसी उपग्रह की बाधाओं के लिए वाहन पर एक एंटीना और कई जमीनी स्टेशनों के दोहरे–परिपत्र ध्रुवीकरण के रूप में सबसे उपयुक्त है। एमआईएमओ सीमित शक्ति के उपग्रह चैनल के लिए अधिक उपयुक्त है। टीसीपी/आईपी त्वरक, फायरवॉल, वर्चुअल प्राइवेट नेटवर्क (वीपीएन), यातायात को आकार देने, अतिक्रमण निवारण प्रणाली (आईपीएस)– एंटीवायरस/एंटीस्पाईवेयर/एंटीमॉलवेयर, वेब फिल्टर और इंटरनेट आवेदन के लिए एंटीस्पाज्म जैसी उपयोग तकनीकें एक निश्चित उपग्रह की क्षमता को आगे अनुकूलित करेंगी।

ABSTRACT

The satellite channel capacity depends on available bandwidth (B_w), transmit power, receiver sensitivity, sometimes referred as gain-to-noise temperature ratio (G/T), ambient noise density etc. The other parameters which dictate channel capacity are type of modulation scheme, access technique, use of FEC (forward error correction) technique, required probability of bit error rate, under identical assumption of channel conditions. Digital information transmission and reception is being considered for study and analysis purpose. The satcom Network throughput optimization depends on many techniques like using proper Modulation scheme, appropriate access schemes like carrier-in-carrier (CnC), also called paired carrier multiple access (PCMA) for satellite where enough onboard power generation capability is available. Techniques like MIMO, which in the form of Dual-Circular polarization for one onboard antenna and multiground stations fits best into requirement as on today's limitations of satellite having constraints of less space, weight and available DC power still exists. MIMO is more suitable for Power limited satellite channel. The access techniques like TCP/IP accelerator, firewall, virtual private network (VPN), traffic shaping, intrusion prevention system (IPS) – antivirus/antispyware/antimalware, web filter and antispasm for internet application will further optimize the capacity of a given satellite channel.

Keywords: PEMA, paired carrier multiple access, MIMO, multi input multi output, tcp, transmission control protocol, EB/NO- Bit energy-to-noise Power spectral density, IP, internet protocol

1. INTRODUCTION

Satellite communication is specifically useful for wide area coverage, communication on mobile platforms like moving vehicles, trains and aircraft, etc. Network topology and the 'anywhere and everywhere', benefit of global voverage, better reliability, immediacy and scalability versatility, point-to-multipoint and broadcast capability. The communication is distance-insensitive and end-to-end, it does not depend upon the terrain in between two stations. It is attractive, particularly for hilly, unreachable and remote areas. The major limitations of satellite communication are latency,

expensive, large upfront capital costs, congestion of frequencies and limited orbital slots. There are specific situations where only satellite communication is a viable solution. There are numerous applications of satellite communication but the B_w spectrum is limited. There is always a move to increase the channel capacity of satellite links by utilizing different latest techniques like modulation schemes, access techniques, higher and higher power generation both at ground station as well as onboard satellite. Bigger and bigger aperture antennae are being installed onboard satellite depending on the design and cost of satellite in question.

However there are some disadvantages like, latency, limited spectrum for GEO satellite, the number of satellites that can be placed in the equatorial plan are limited to 180 in number with 2° separation.

To enhance throughput improvements required in the subsystem/system, software, hardware, choice of suitable type of protocol for specific applications, etc as following:

- Using most B_w efficient modulation scheme.
- Using power efficient modulation schemes as power onboard satellite is a limiting factor.
- Use of suitable modulation schemes to be suitable for operation even when power amplifier onboard satellite working in saturation i.e. minimum I/P backoff and minimum O/P backoff. These channel coding schemes should require E_b/N_o near to Shannon's Limit of – 1.59 db E_b/N_o for near error free communication.
- Maximum gain-to-noise temperature (G/T) of earth station receiver and onboard satellite Transponder utilizing best state-of-the-art LNAs and other components, for a fixed diameter antenna at both places, i.e, onboard and at ground station.
- Suitable protocol for specific applications so that B_w is not wasted in re-transmissions and making available required bit error rate (BER) for protocol to work optimally.
- Using appropriate access scheme for specific applications[1].

With the continuous developments in technology we are in a position to generate higher power onboard satellite as well on ground station. It is also possible to improve the G/T of onboard transponder by both optimizing gain of a fixed dia Antenna and reducing the noise temperature of electronic components being used. New modulation/demodulation schemes are being developed with lesser and lesser E_b/N_o required for particular BER requirement. New access techniques suitable for specific applications are being used. Better channel codes are being evolved to give maximum coding gain with minimum latency. Polarization diversity is being used to increase the channel capacity. Space division multiple access techniques in the form of MIMO are being used to increase channel capacity and improve BER for a given satellite system. it is also used to encounter fading due to rain, fog, etc. MIMO technique is also used to provide communication at locations up to 75° latitude satisfactorily, i.e., at sites where satellite elevation angle is of the order of 15°.

2. CHOICE OF SUITABLE MODULATION/ DEMODULATION SCHEME[2]

The schemes will be normalized to bits/S/Hz over the existing satellite channels. It has been observed that terrestrial digital radio systems use high level amplitude modulation (QAM) to increase spectral efficiency, but this is not feasible in satellite communication due to following reasons:

I. Even as on today, satellite links are severely power limited.
II. The onboard satellite transponder amplifier has to run in nonliner region to get more power efficiency, due to the fact that dc power puts a constraint on satellite.

In satellite communication, the decrease in bit error rate provides better quality of service, must not be dependent at the expense of scarce power resource onboard satellite. At the same time, modulation schemes which do not work well with nonlinear amplifiers are not suitable for satellite applications as power amplifier onboard satellite cannot be backedoff considerably to run it into linear region at the cost of reduced power efficiency.

It may be observed that for a long time, QPSK was at a powerful position as being almost the only exclusive modulation method in virtually all-digital satellite systems. It may be observed that as the modulation levels increase, constant envelope M-PSK becomes in efficient. On the other hand, QAM suffers more degradation in a nonlinear environment such as a satellite channel.

Table 1 shows the relative spectral efficiency and radio frequency (RF) power utilisation for four common modulation and coding schemes. The spectral efficiencies assume a channel filter alpha value of 20 per cent.

Table 1. Relative spectral efficiency and radio frequency (RF) power utilisation for four common modulation and coding schemes.

Modulation and coding	RF Power required (Eb/ No Required) at 10 BER	Spectral efficiency bits/S/Hz
QPSK 3/4	Low	1.3
8PSK 3/4	Moderate	1.9
16 APSK 3/4	High	2.5
32 APSK 3/4	Very high	3.1

Due to costly satellite bandwidth and limited spectrum available, there is ever increasing demand for higher information rates, B_w efficient modulation schemes are the demand of the time. While trying to increase B_w efficiency, care must be taken to design "balanced" link design so that onboard power amplifier I/P may not be required to backed off as much as 10db or more, to strike a balance between bandwidth and satellite power resources, at least for the time till we can generate 4-6 times more power as compared to present day's power levels being generated with the help of solar panels onboard a satellite.

Using high-level modulation schemes requiring E_b/N_o more than the order of 10 db for 10^{-6} BER are not recommended on power-limited satellites. For example Insat series satellites in C-Band 40 dBw of EIRP in 36 MHz of bandwidth are available. In a hired carrier of 128 Kbits, the Max(saturated) power available will be 37.5 watt i.e., 15.74 dB_w. For multicarrier operation the power amplifier will have to be backed off by 4-6 dB. The available power will be 11.74 dB_w in 128 Kbits B_w. This available power will have to satisfy the power Budget equation as:

(C/N)down = (Set)down EIRP – Pathloss + Earth station G/T-Bandwidth + 228.6 dB

=11.74 - 196.5 + 21 – 51 + 228.6 dB

=13.84 dB

12.84 dB, considering 1 dB as the consolidated loss like antenna-pointing loss, loss in power cables, etc. i.e, maximum EIRP in 128 Kbit carrier will be 15.74.4.0 = 11.74 dB_w. Accordingly $(C/N)_{down}$ for a GEO satellite, (taking a distance of 40,000 km, the receiver station may be at high altitude) will be 13.84 dB. Taking 1 dB as overall loss due to miss pointing of antenna, etc. the available $(C/N)_{down}$ will be 12.84 dB using M array modulation schemes like 16 APSK, 8PSK to increase the data rate will not help since E_b/N_o for 10^{-6} BER is of the order of 16 db for 8PSK. Undoublingly, using QPSK will give an advantage of 3 db since B_W gets reduced by 50 per cent, for the same date rate, accordingly C/N goes up by 3 db whereas E_B/N_O remains same (as data rate doubles up). By employing QPSK instead of BPSK, one can double the information capacity with the same available B_w4 power. However to transmit 3 bits/Hz, i.e., 8 PSK, one will need E_B/N_O which is of the order of 14 dB. Since there will be 33 per cent savings in spectrum B_W, the inband white noise decrease will push the E_B/N_O by 1.23 dB, making available E_B/N_O = 11.84 + 1.23 = 13.07 dB. Whereas E_B/N_O requirement is of the order of 17 dB, obviously the link will not function and BER will increase beyond designed value of 10^{-6}.

To achieve the optimum result, one has to go in for appropriate FEC which will reduce random errors and will provide a coding gain of the order of 5 dB. The suggested scheme is conditional encoding and Viterby decoding along with concatenated Read Solemon (RS) codes. The Read Solemon codes will reduce the bunch errors due to some spike, etc. Accordingly, a concatenated code is suggested.

3. USING TCP/IP PROTOCOL[3]

The round trip transmission delay (RTT) in case of GEO satellites for TCP is of the order of 560 ms. The maximum throughput which can be obtained is giver by

$$\text{Throughput}_{MAX} = \frac{\text{Receiver buffer size}}{\text{RTT}}$$

The maximum buffer size in TCP is 64 Kbps, so the maximum throughput = 64 Kb/.560 = 117 Kbytes, i.e, 936 Kbps. Even if one error occurs in 936 Kbits the packet will be discarded, which corresponds to a BER of 1 $\approx 10^{-6}$, where the efficiency of link falls to 50 per cent. Accordingly for TCP/IP Protocol to work satisfactorily well on GEO satellite, a BER better than 10^{-7} has to be made available to get better efficiency, to permit TCP flow at the rate of 1 Mbps for a buffer size of 64 KB.

In TCP receiver window is defined as the number of bytes a sender can transmit without receiving an acknowledgment. TCP uses a receiver window that is 4 times the size of the maximum segment size (MSS) negociated during connection set up time, up to maximum of 64 K Bytes.

4. CHOICE OF APPROPRIATE ACCESS TECHNIQUES

There are many multiple access techniques for satellite communication. These are frequency division multiple access (FDMA), time division multiple access (TDMA), code division multiple access (CDMA), SDMA, paired carrier multiple access (PCMA), multiple input-multiple output (MIMO), etc. Each multiple access technique has specific advantages and disadvantages, but FDMA is almost outdated and in most digital applications TDMA is being used. CDMA has specific advantages of low probability of intercept, and anti-jamming capabilities along with selective addressing. The techniques of spread spectrum, namely direct sequence and frequency hopping are used for military applications. Since the spectrum is precious and limited in nature, we want to use it most efficiently. The recent techniques to maximize bits/s/Hz are MIMO and paired carrier multiple access (PCMA). The MIMO increases channel capacity with no additional power, whereas PCMA needs more power.

PCMA can be applied to FDMA, TDMA, CDMA and SDMA (MIMO). The utility of PCMA power-limited satellite may not be there at all since the power is

consumed by both carriers of station A and station B while being transmitted through satellite. But in future, more powerful satellite with higher rating power amplifiers will be available onboard satellite to support PCMA. The PCMA may not yield the same B_w saving in case of asystematic carrier which is being used in the most internet applications.

5. MIMO

Multiple input multiple output (MIMO)[4] is a technique in which by using multiple antennae and both transmitter and receiver, the information carrying capacity of the channel can be increased many-folds. If there are M transmit antenna and N receiver antennae, the capacity gain is expressed as:-

$G = \min(M, N)$

In case there are two transmit antennae and two receiver antennae, the capacity of the links nearly doubles with the same bandwidth and transmit power. The concept is shown in Fig. 1.

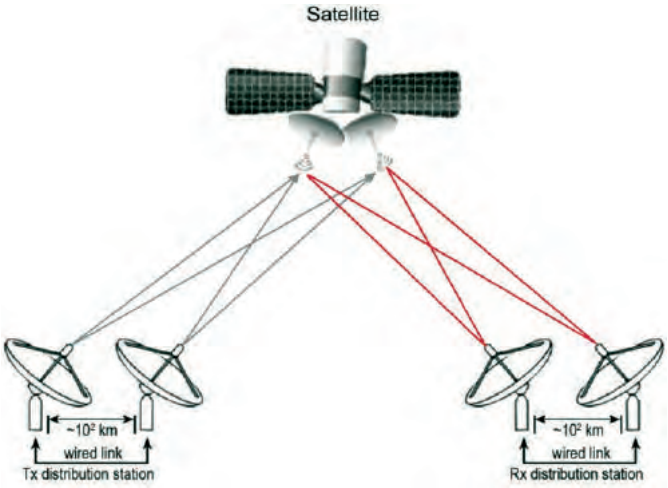

Figure 1. 2x2 Satellite MIMO nearly double channel capacity for the same Transmit Power and B_w.

The MIMO is relatively a new concept in satellite communication. This is due to restrictions of space, weight carrying ccapcity of satellite, etc. To minimize additional weight and space requirements, the circular dual-polarized MIMO system is proposed. At ground station 2 antennae are required, the concept is shown in Fig. 2., whereas onboard satellite only one antenna with proper feed to respond to both RHCP and LHCP with one common antenna is proposed to be used to minimize the increase in weight onboard a satellite. This will nearly double the information carrying capacity of the satellite channel with the available B_w and available onboard Power.

One antenna each on two separate satellites and two antennae on land mobile system (LMS) is shown in Fig. 3. However the limitation is that two satellites are

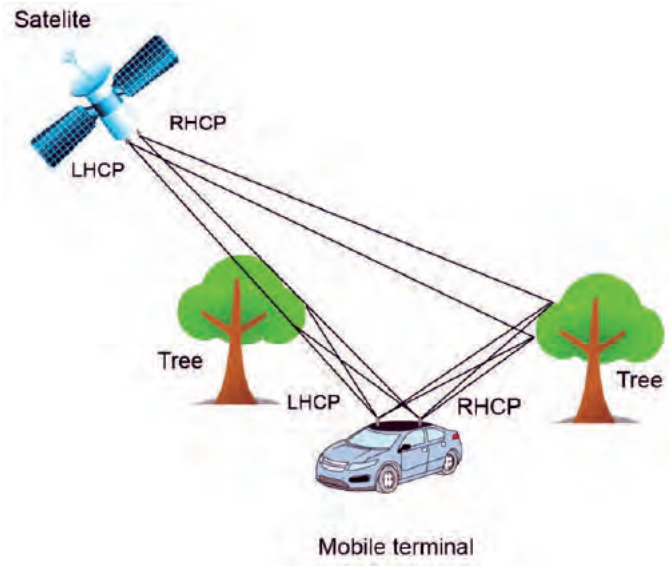

Figure 2. SDMA (MIMO) duel circular polarisation

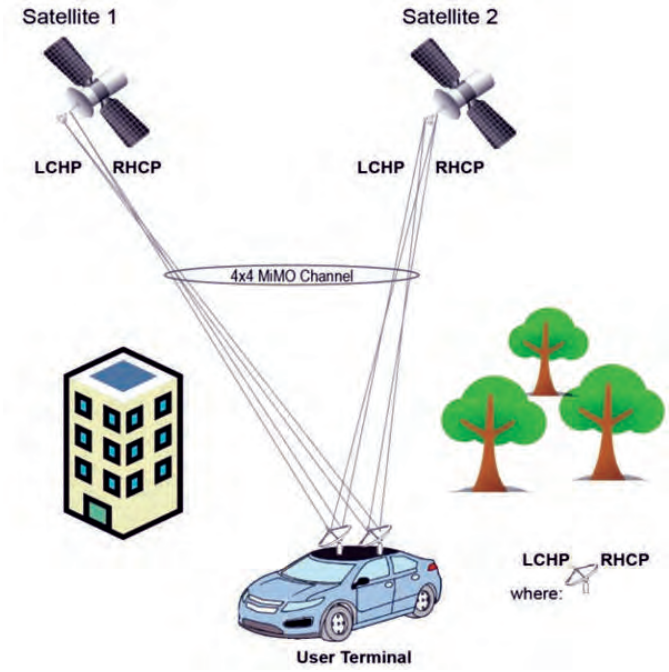

Figure 3. 4x4 Satellite MIMO System Will provide nearly 4 Multiplexing gain.

required to be used and inter-satellite synchronization is also needed.

6. PCMA (PAIRED CARRIER MULTIPLE ACCESS)[5]

Paired carrier multiple access almost multiply the channel capacity by two, whereas MIMO can multiply channel capacity by Min(M, N) with the same available satellite onboard Power and B_W. The techniques PCMA is described in little more detail. As shown in Fig. 5, the carrier f_1 carrying the information of station A is going to satellite. The satellite being a bentpipe passes it to station B, which may need

frequency of W_{Hz}. Similarly, the station B fires a carrier f_2 carrying station B's information and which is received by satellite and passed on to station A. It is obvious that two frequencies f_1 and f_2 are needed for full duplex link. But in the case of PCMA, the station A and station B use the same frequency (f_0) to send their information, still the signal is extracted satisfactorily. The technique used is that while station A transmits carrier f_0 to satellite, keeps a digital copy of the carrier at its own location. The station B, now transmits its information on carrier with the same frequency f_0 instead. As the carrier f_0 from station B reaches to station A through satellite, the station A is having two carriers, both at f_0 (composite carrier) one transmitted by station A and the other received form station B. The station A subtracts its own carrier f_0 from the composite carrier f_0 and is left with the information carrying carrier of station B and demodulates and extracts the information. The same process is carried out at station B to demodulate the information received from station A. The concept is shown in Figs. 4, 5(a)-5(b). In this way we save nearly 45 per cent of B_w. for symmetric bandwidth carrier. The percentage of B_W saved decreases as carrier become asymmetric, which is the case when we are using internet through satellite. The forward carrier B_W is very small, whereas backward carrier B_W is very large. Accordingly, the B_W saving is less compared to symmetric carriers.

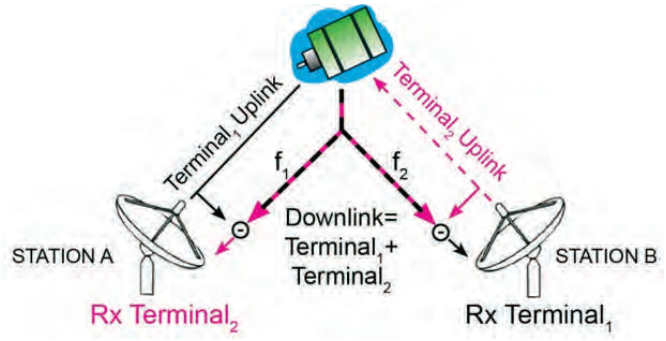

Figure 4. PCMA Through Satellite, for symmetric channels saves B_w up to 45%.

7. CONCLUSION

Satellite communication is having unique features of broadcasting, point-to-multipoint communication, wide area coverage, communication on move, access to difficult and infrastructure deficient locations, etc. It has become an active area of research to find how to optimize different techniques like modulation schemes, FEC coding, access techniques especially the newly discovered ones like PCMA and MIMO, to increase the channel capacity. Since the spectrum is limited and most satellites at present are also having power-limited systems. Accordingly, it has been shown that

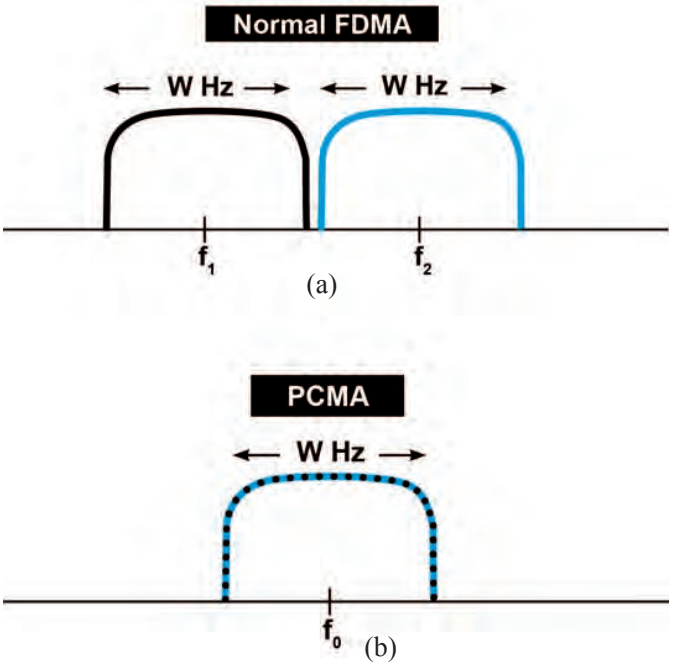

Figure 5. How PCM saves B_w up to 45% by subtracting its own Transmitted signal.

modulation schemes like QPSK, FEC yielding more gain by utilizing B_w optimally with the fast speed digital signal processing are being used. We can afford to introduce more processing power (complexity) to achieve the objective.

निष्कर्ष

उपग्रह संचार में प्रसारण, एक बिंदु से बहुबिंदुओं के लिए संचार, व्यापक क्षेत्र कवरेज, चलते हुए संचार, कठिन और बुनियादी ढांचे की कमी वाले स्थानों के लिए उपयोग जैसी अनोखी विशेषताएं हैं। यह अनुसंधान का एक सक्रिय क्षेत्र बन गया है कि चैनल क्षमता को बढ़ाने के लिए मॉडुलेशन योजना, एफईसी कोडिंग, उपयोग तकनीक, विशेष रूप से पीसीएमए और एमआईएमओ जैसी उपयोग की नई तकनीकों का अनुकूलन कैसे किया जाए। चूंकि वर्णक्रम (स्पेक्ट्रम) सीमित है और वर्तमान में मौजूद अधिकतर उपग्रह भी सीमित शक्ति से युक्त हैं। तदनुसार यह दर्शाया गया है कि क्यूपीएसके, एफईसी योजनाएं तेज गति डिजिटल सिग्नल प्रोसेसिंग के साथ बीडब्ल्यू का सबसे इश्टतम उपयोग करके अधिक लाभ उत्पन्न कर रही हैं, इनके साथ हम हम उद्देश्य को प्राप्त करने के लिए अधिक संसाधन शक्ति (जटिलता) लागू कर सकते हैं।

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मुड़ी (बेन्ट) पाइप उपग्रहों पर दोहरे परिपत्र ध्रुवीकृत एमआईएमओ की चुनौतियां
Challenges of Dual Circuler Polarised Mimo over Bent Pipe Satellites

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सारांश

जानकारी की जरूरत बहुत तेज दर से बढ़ रही है, लेकिन उपग्रह परिदृश्य (स्पेक्ट्रम) सीमित है और इसका विस्तार नहीं किया जा सकता। उसी उपलब्ध वर्णक्रम (स्पेक्ट्रम) में अधिक से अधिक जानकारी संचारित करने के लिए उपग्रह संचार में बहु आदान – बहु उत्पादन तकनीक का इस्तेमाल किया जा रहा है। स्थलीय माइक्रोवेव संचार में, जहां वर्णक्रमीय दक्षता 25 बिट/सेक/हर्ट्ज के क्रम में है, इस तकनीक को बेहद उपयोगी पाया गया है। मुड़े पाइप सैटेलाइट पर एमआईएमओ तकनीक का उपयोग करते समय अधिक स्थान, वजन और बिजली की खपत की चुनौतियों का सामना करना पड़ रहा है। एमआईएमओ स्थलीय संचार की बहुपथ राइले धूमिलता विशेषता का दोहन करता है जबकि उपग्रह संचार में चैनल और कमोवेश एक एलओएस (लॉस) चैनल होता है। बहुपथ धूमिलता काफी हद तक खोती जा रही है। इसलिए उपग्रह चैनल, खासकर मुड़े पाइप उपग्रह पर एमआईएमओ को लागू करना काफी मुश्किल लगता है।

ABSTRACT

The need for information is increasing at a very faster rate, but the satellite spectrum is limited and cannot be expanded. To transmit more and more information in the same available spectrum multi input multi output (MIMO) technique is being used in satellite communication. The technique is found to be extremely use full in Terrestrial microwave communication, where the spectral efficiency is of the order of 25 bits/sec/Hz. While using MIMO technique on Bent Pipe Satellite there are challenges of more space, weight and power consumption. MIMO exploits the multipath Raighlay fading characteristic of terrestrial communication, where as in satellite communication the channel is more or less a LOS channel. The multipath fading is missing up to large extend. Hence we find it difficult to implement MIMO on satellite channel, especially on bent pipe Satellite.

Keywords: MIMO, multi input multi output, LHCP, left hand circular polarisation, RHCP, right hand circular polarisation, XPD, cross polarisation discrimination, multiplexing gain, array gain, DCP, dual circular polarisation

1. INTRODUCTION

In case dual-circular Polarisation is employed instead of spatial MIMO channel will result in limited MIMO gain over two independent Antennae on board satellite i.e. simple 2 x SISO[1]. It is also important to mention that orthogonal Polarisation (DCS i.e. LHCP and RHCP) acts an extra interference i.e. crosstalk due to various implementation perfection as to how much isolations has been achieved in two orthogonal Polarisation. The maximum Cross Polirzation Discrimination (CPD) achievable is of the order of 30 db where as practical figure is nearly 24-26 db, which is further detorated due to channel impairments.

The satellite channel is not the Rayleigh channel, but is Quasi LOS nature of channel. The two streams LHCP polarised and RHCP Polarised streams will not be fully uncorrelated either at E/S or on board satellite, dragging down the capacity advantage of MIMO considerably[2].

Over and above that these two channels (LHCP and RHCP), when used along with appropriate FEC scheme, the capacity Advantage of MIMO is reduced due to the existence of FEC codes and a very long time interleaver (due to the delay of the order of 250 ms over GEO channel) that effectively absorbs the available channel temporal diversity.

The result suggest that any practical implementation of the Golden code over a non-linear satellite channel will suffer an additional 0.6 db degradation compared to on linear channel.

Recently we use high order amplitude phase shift kaying (APSK) signal constellations, which can effectively cope with non linear power amplifiers driven close to saturation, due to their low Peak-to-average Power ratio (PAPR). Whereas one could expect that a higher power Back off may be needed in a MIMO system in order to cope with constellations having higher Peak to Average Power Ratio. This would be a crucial objection to the feasibility of pre-coded MIMO satellite system because a very large power back off could even cancel the SNR gain achievable through spatial multiplexing.

2. DUAL POLARISATION AND DUAL-SATELLITE CONFIGURATION[3]

MIMO model employing two satellites each with one Antenna each dual circular polarised, and receive mobile station with two Omni directional dual circular polarised antennae (Fig. 1).

Advantages

- It will make 4x4 MIMO system.
- Satellite Diversity is obtained.
- The channels attain more and characteristics of Raighlay fading and correlation between links reduce giving better multiplexing gain and array gain.

Disadvantages

- Cost is more as two satellites are required.
- Due to relative delay between satellites the system becomes asynchronous as the signals do not arrive at receive at the same time (Land Mobile Satellite).

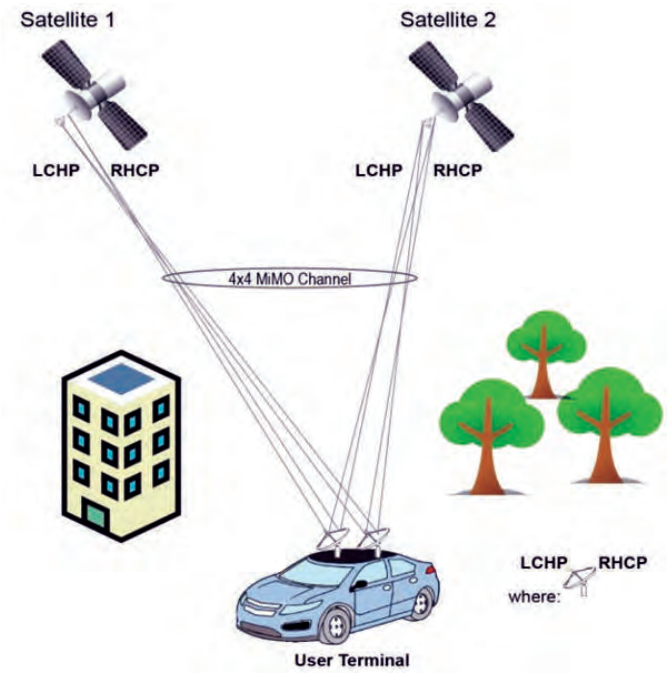

Figure 1. 4x4 Satellite MIMO System Will provide nearly 4 Multiplexing gain.

In order to increase the immunity against Land Mobile Satellite (LMS) Channel impairments, which may be due to multipath, the sources of space diversity and Polarisation diversity is used and terminal cooperation diversity. Hence Polarisation is used to generate space diversity on board satellite. The use of Polarisation diversity is of more importance to handle the widespread and densely scattered distributions around transmitters and receivers. Polarisation diversity is significantly used as a space and cost effective solution mobile satellite Broadcasting competitive with territorial systems.

It has been observed that capacity optimization is generally possible for regenerative payload design using line of right (LOS) channel Model, which is a costly system.

3. SIGNAL PROCESSING CHALLENGES OF SATELLITE MIMO FOR MASSIVE MIMO CONFIGURATION[4]

Among the most attractive multiuser (Mu) scenario of satellite MIMO communication is multibeam illumination on ground station. This will enable frequency re-use and increase spectral efficiency but at the cost of some switching/processing will be required on board satellite. This concept may not find much application in Bent pipe satellites. Multibeam satellite will have number of antennae of the order 100 or more in a way converting it into MASSIVE MIMO. In the next generation satellite there will be multibeam on board satellite to enable frequency reuse and have better effective isotropic radiated power (EIRP). The high level system blocked diagram is shown in Fig. 2.

A major problem by using multibeams on board satellite, is that the interference will be generated by multiple adjacent spot beams that share the same frequency (frequency reuse). This interference between spot beams must be suppressed (eliminated) by suitable digital signal processing techniques/algorithms. The interference suppression techniques must be applied

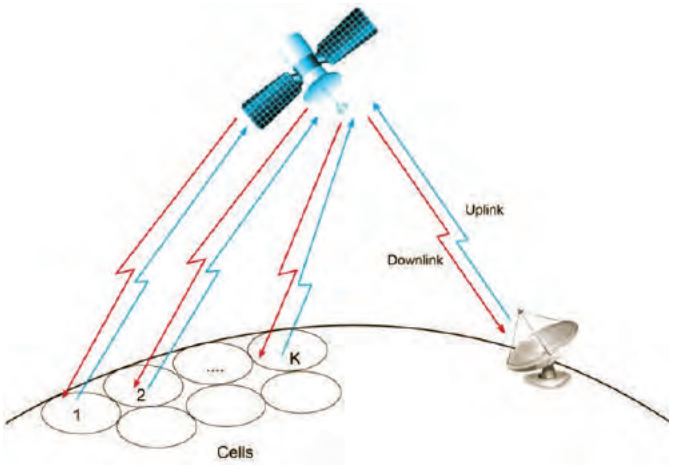

Figure 2. Massive Satellite MIMO with multiple spot beams.

to all antennae radiating signals and not only to the user beams directly.

A complex signal processing on board satellite will have to be implemented to suppress inter beam interference and beam switching on board. A very reliable and power efficient Digital Signal Processing (DSP) hardware will have be used along with software. The hardware should be reconfigurable from ground station to make changes in area coverage algorithm as and when need arises.

At the receiver also a complex DSP signal processing has to be implemented to estimate parameters and detection algorithms. The techniques have to be fast enough to iteratively detect the signal and decode it satisfactory.

4. REQUIREMENTS OF FUTURISTIC RECEIVER

The algorithms used have to be cost effective, fast and power efficient. The algorithms have to made more effective by increasing the number of effective signal processing elements.

4.1 To Convert the Existing Satellites to Dual-Circular Polarised MIMO System following Challenges are to be Overcome.

Design a feed which should provide cross Polarisation discrimination [XPC between Left hand circular Polarisation (LHCP) and Right Hand circular Polarisation (RHCP)] of the order of the order of 30 db. When compared to already existing antenna system w.r.t area coverage, side lobes and should adhare to other emission standards set by regulatory bodies may be international or regional.

The existing bent pipe satellites in use can be represented by following High Level Block diagram (Fig. 3). Whereas, the system with Dual-Circular Polarisation Antenna, on board satellite can be represented by a high level Block diagram as shown in Fig. 4. It can be observed that with DCP the received on board satellite signal comes out in two streams as Right Hand Circular Polarised signal and Left Hand Circular Polarised signal has to be processed parallel in two branches having LNA, MIXER, LOCAL isolator and Power Amplifier. The two streams of (LHCP and RHCP) signal are fed to Ortho Mode Transducer (OTM) and transmitted through common feed and antenna as conventional antenna. The only difference is that the feed has to be redesigned to respond two differently polarised signals.

5. CONCLUSION

It has been observed that by using Dual Circular Polarised MIMO with Bent Pipe Satellite system, we do not get two times multiplexing gain due to some

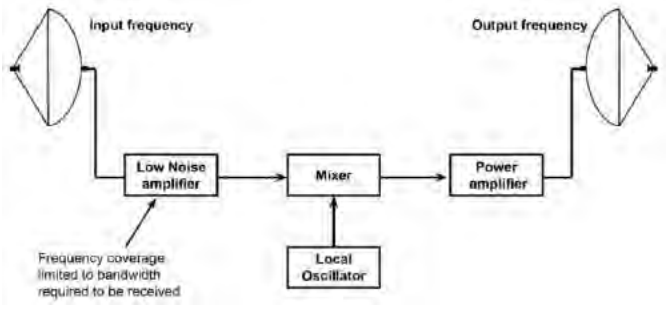

Figure 3. High level block diagram of a Bent Pipe satellite system.

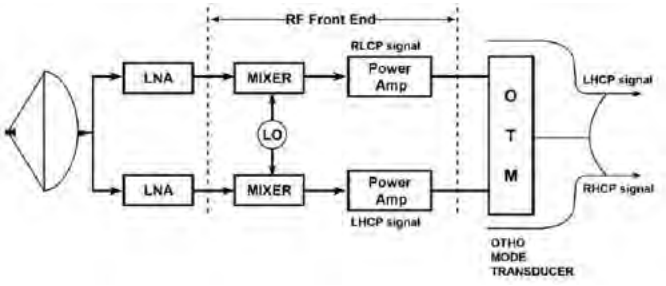

Figure 4. High level block diagram of Duel Circular Polarised MIMO System from composite signal.

interference generated. The Antenna feed design is complex and against a theoretical requirement of Cross Polarisation Discrimination (XPD) of 30 db, practically achievable XPD is of the order of 24 db as on today. Even if we use only one antenna, but new feed is complex to design and more in weight. In addition two parallel chains of signal on board satellite are to be put in place which will further increase the weigh and the new pay load is to be re-designed.

निष्कर्ष

देखा गया है कि मुड़े पाइप की उपग्रह प्रणाली के साथ दोहरे परिपत्र ध्रवीकृत एमआईएमओ का उपयोग करने पर, उत्पन्न कुछ हस्तक्षेपों की वजह से हमें दुगुना बहुसंकेतन लाभ नहीं मिलता है। एंटीना फीड की डिजाइन जटिल है और 30 डीबी की एक सैद्धां. तिक पार ध्रवीकरण अन्तर (एक्सपीडी) की आवष्यकता के खिलाफ है, आज व्यावहारिक रूप से प्राप्त करने योग्य एक्सपीडी 24 डीबी की व्यवस्था का है। यहां तक कि अगर हम केवल एक एंटीना का भी उपयोग करें, तब भी नए फीड को डिजाइन करना जटिल है और यह वजन में भी अधिक है। इसके अलावा बोर्ड उपग्रह पर संकेत की दो समानांतर श्रृंखलाएं रखानी होंगी जो वजन को और बढ़ाएगा तथा नए पे लोड को फिर से तैयार किया जा रहा है।

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विकलांग लोगों और संवादात्मक वेब अनुप्रयोगों की नई प्रौद्योगिकी में अंतर को आवाज की सहायता से पाटना

Bridging the Gap between Disabled People and New Technology in Interactive Web Application with the Help of Voice

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सारांश

भाषा पहचान क्षेत्र में अब तक किए काम को आम इंसान के तौर पर विचार करके किया गया हैं परन्तु प्रौद्योगिकी द्वारा विकलांग लोगों पर ज्यादा ध्यान नहीं दिया गया हैं। इस शोध का मकसद विकलांग लोगों के लिए अधिक कुशल और उपयोग योग्य वेब अनुप्रयोग विकसित करना है। इस आलेख में, हम उपभोक्ता के लिए अधिक संवादात्मक वेब अनुप्रयोग को बनाते हैं और सारे वेब शब्दों की प्राप्ति आवाज की मदद से करते हैं। हम इस शोध में स्पीच अभिस्वीकृति के लिए जावा स्पीच एपीआई के घटकों का इस्तेमाल करते हैं उदाहरण, आवाज और शाब्दिक घटकों के साथ वर्ल्ड वाइड वेब उपयोग के क्षेत्र में नवीनतम विकास हेतु। प्रस्तावित मॉडल विकलांग लोगों के लिए वास्तविक समय पद्धति की मदद से दोनों उपभोक्ताओं के बीच में आवाज सेवा को प्रदान करता हैं।।

ABSTRACT

So far in the area of speech recognition most of the work has been carried out by considering normal human being, but the disabled people haven't got that much attention by the technology. Focus of this research is to develop a web application which will be more efficient and approachable to disabled people. In this paper, we have focused to provide more easy interaction with user and web application to access all web text with the help of voice. We used JSAPI (Java Speech API) components for speech acknowledgment in this research, i.e., the voice and the text components along with the latest development made in the field of World Wide Web uses. The proposed model is able to provide end to end voice service with a real time approach for disabled people.

Keywords: speech recognition; web speech recognition technology; JSAPI, web server

1. INTRODUCTION

In this modern era voice and visual technologies are used in wide horizon. Voder provided the first speech synthesizer[17]. This technology can be certainly used as application on the web servers with optimized sound level. In last decades interaction of human and machine was out of thought but now a day's programmers are coding for effective machine and human interaction with ease, which give the invention of speech recognition. This speech recognition concludes many research areas like mathematics, artificial intelligence, machine learning, statics and other electronics devices (microphone, processor, sound card technology)[1-3]. This developed application is capable to understand specific context of sentences, words, commands and makes the user flexible to input as a voice and also help to control all the web application text available on the web server as well as web reading. Many implementations has already done on language's like English, Hindi, French, etc. speech recognition, but it is not handy with the person with disability. In this paper our main focus on the speech reorganization with effective output in voice for all human beings.

To easily communicate with the people voice is the best medium, not only peoples but also with the web it is more flexible way. In these days for man to machine interaction voice is the best medium to command the computer and other handheld devices for specific task. In recent years more humanly nature like voice to text and text to voice conversion have been studied to recognized all type of signals. The prime motto of this study is to provide error free result. In this study, researcher has not only focused on voice but also in gestures and emotions of tested human.

Hinshelwood in 1917 introduced the term 'congenital word blindness' to describe this disability. Strauss and Warner in 1941 focus to the cases of the person with sufficient intellects are unsuccessful at the school

due to experiencing reading difficulty. This type of difficulty is also define by the national committee like "National joint committee on learning disability" in 1988 emphasis on learning disability, basically learning disability refers to the faction of disorders manifested by important problem in the attainment and use of speaking, writing, speaking, reasoning mathematical disability on the web[4].

For improving the mental process of speech of students, asked to focus on interpretation, relating, classification, these all term may causes disorders in the brain like classification is the consistent arrangement of specific items or things based on certain categories. So from the mental aspect of speech of students should aware of classification of words, objects subjects, sentences, animals, plants, facts, events etc. in the terms of web.

1.1 Speech Recognition

To modify source speaker in to the target speaker voice conversion (VC) system plays an important role. Basically speech signal provides different types of information, different fields of speech technology focuses on different information. The main focus of voice conversion is speaker identity. Voice conversion works on two major problem deals with speech. Firstly, characteristics identification of speaker during analysis phase and secondly in synthesis phase where replacement of source characteristics with the target characteristics. These operations are independent from each other.

1.2 Objective of Study

It is an era of Internet that have responsibility where individuals use, follow and web development technology for better communication language is the key for personnel and cultural development[5]. Due to the increasing use of audio visual communication tools invites people to use new modernized tools in education. For the success of students is to adapt the modernized educational equipment by voice. Multi tools are always beneficial then single tool for educational purposes in web application. This is a modernized period where the teaching based upon web technology and media is better than verbal teaching. It increases the level of learning, teaching and also provides solid information. Furthermore it improves students speaking and listening comprehension skills by the help this application[6].

1.3 Required Material & Techniques

In this paper we introduces the software and API that contribute to the problem regarding to the problem mentioned above like bridging the gap between disabled people and new technology in interactive web application with the help of voice. This software contains many distinctive features like integrated speech reorganization as well as audio visually enriched boundary, which provides user better pronunciation activities and recognize the word.

2. RELATED WORK OF SPEECH RECOGNITION IN WEB APPLICATION

Speech awarding software is available in large quantities in the market. Many renewed software are developed by many prestigious company like IBM[11], Google[12]. IT giant Microsoft has also done research in this area by developing genie. In the market of software various voice navigation applications and speech recognizer are floating like Sphinx[7], Sonic, X-voice[9,10].

In speech recognition process surroundings voices are the worst part, it confuses the recognizer to understand the real voice that are supposed to hear [8]. This type of voice recognizer is used in robots. Major applications of this research are working in medical field as robots[13]. This virtual man complete it task efficiently while environment is full of other voice like motor noise. Such noises may change the input which was given by a voice. Currently we are using acoustic model for web based speech. To recognize speech for better results many IT giants are working on optimized research. Hewlett Packard (HP) is using Smart Badge[15] hardware in its product by which we can save energy of device for longer period.

Another technology was proposed in this field named distributed speech recognition[14] (DSR) for web based application. By this technology we can get result from different servers. This protocol provides very scalable system with maximum throughput from server side.

In the research[16] many application is used for simulation like voice banking (VB) and directory help to show result sets between man and device. By our voice we can give command to machine for specific task in the area of speech recognition (SR). There is no need of extra hardware for input like touchscreen or mouse.

Now days microphone is using as voice receiver as input. While you are surfing the internet or video chat this hardware is using as voice receiver. For example, if we might say something like "Hi, how do u do? To which your input to be converted into text tokens. Now this input sent will be send to server and server replies to local machine on the form of text and again this text will be converted in the form of voice as output.

Figure 1 shows speech reorganization engine recognized speech. The main function of this engine is to translate the speech into text so that application

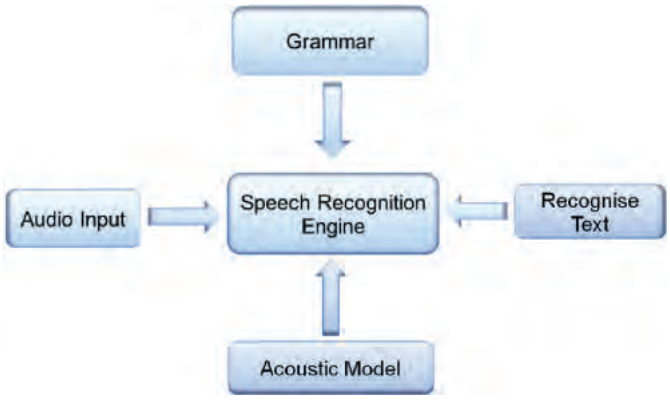

Figure 1. Process of converting voice input into text.

can understand it. The application basically does one of the two things:

- Does interruption of the result is recognizing of the speech.
- Appear as a dictation application.

Some of the Fundamental of Speech Recognition:

2.1 Utterances

When the user tries to speak something is called utterance. It is steam of speech between the salience.

2.2 Pronunciations

Basically speech reorganization engine takes inputs of data, models, and algorithms to convert the text in to the speech. A particular piece of conformation that the process uses in the engine is called pronunciation.

2.3 Grammar

Speech reorganization engine works on certain domain is called grammar. In this all the utterances of speech is compared with the words and phrases in the active grammar.

Here are some voice reorganization programs are available:

- Windows 7: Most recent version of Microsoft contains this type of reorganization system. It provide the many application are controlled by the voice such as opening browser, opening and closing of paint and also other work being done.
- Dragon Naturally Speaking: Dragon is the world's best-selling speech recognition software. It turns your talk into text and can complete our task with ease. In daily routine we can use such applications.
- Google Chrome browser: In the current system the Google chrome browser provide application of searching text into by the help of voice but it is limited to work that is only search in the form of text.

3. PROPOSED METHODOLOGY

Two main technologies required are as: speech reorganization and synthesis. Speech synthesis for commercial technology and speech reorganization is also supported by the academic and commercial systems, but in certain boundaries. Versatility and accuracy is the main trade off principle between the speech recognition. The desired speech technology it is impossible to investigate the real aspects of voice such as acceptance or satisfaction.

We have to be focused on realistic studies so that we can focus on the future developing of the applications. The crux problem related with the designing to determine the user acceptance without use of technology, so we decided to use a wizard of web speech API approach, with the human operator performing the speech reorganization.

The group meetings are occurring to focusing on services and interaction techniques. These groups contain 6-8 participants and 2 moderators. The participants give brief descriptions of the proposed applications. These participants also helps to determine the scenarios that how the application can be used. They portraying the users while other performing other different services. Some recording is also made for the future perspective. These meetings helps to develop a list of potential services and to get original glance of what interaction might look like for using of web.

There are large list of inputs like brainstorming, focus groups and literature survey randomly we take four prototype us weather, headline news, messages

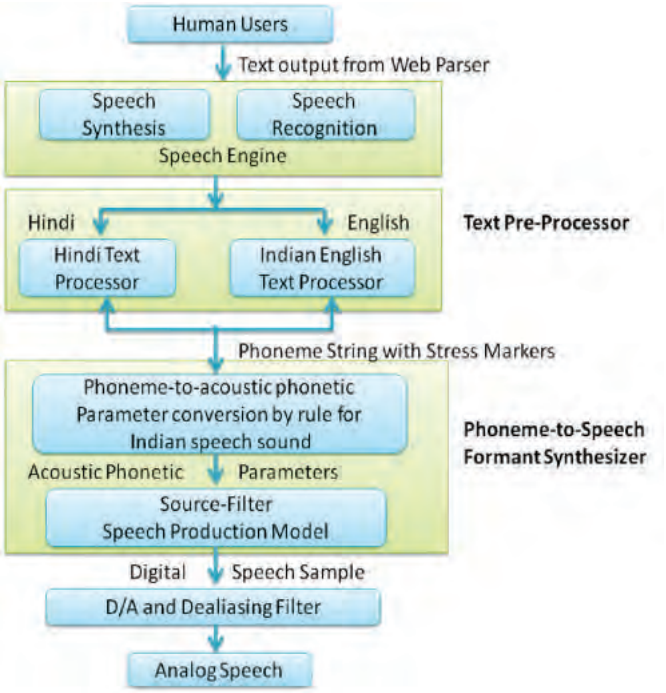

Figure 2. Proposed model for voice to voice in web application.

and stock market results on the web application that input given by the voice and get the result with the help of voice.

The usability studies carried out with the help of prototype. These studies are helps to determine the usefulness of the provided services, common navigation path between and with i n the services. The usability studies are performed in to two stages: with small groups and with the large groups.

Both are performed in the same manner. Firstly a short description is given to the participants after that list of task is performed. A participant use natural voice language to complete assigned tasks by this user got the result to explore the system freely. Generated log file for the users contains time stamp's requests and replies, for later analysis of performance audio recording get stored on the server.

4. IMPLEMENTATION OF MODEL

Through web speech API speech synthesis and speech recognition adds up in the process. The post temporarily covers the last e.g. API recently added in Google chrome is X-Webkit.

For supporting command and control recognition dictation systems and speech synthesis the java speech API is used as an application programming edge.

Two core technology used in this proposed model are:

4.1 Speech Synthesis

Speech synthesis is used to produce synthetic speech from the text produces from different applications, an applet and the users. It is basically the technology if text to speech, there is following steps for producing text from the voice.

(1) Structure analysis: In this we evaluate that where the sentences and paragraphs starts and ends. it is also preferable for different punctuations and formatting of data.

(2) Text pre-processing: This processing is special constructs of languages like English for their abbreviations, date, time, numbers, accounts and email address.

The remaining steps convert the spoken text to speech:

(3) Text-to-phoneme conversion: In it we convert each words in the basic unit of sound in a language.

- Text pre-processing: This is a special constructs of some languages like English for their abbreviations, time, numbers, date and accounts and email address.

The remaining steps convert the spoken text to speech:

- Text-to-phoneme conversion: Here each word in the basic unit of sound is converted in a language.
- Prosody analysis: It determine the appropriate words, structure and prosody of the sentences.
- Waveform production: To produce waveforms for each sentence by using phoneme and prosody information.

In the above steps there is the possibility of errors. The java speech API markup language is used to improve the quality of output of the speech synthesizer.

4.2 Speech Recognition

This is basically used for determining the spoken language means what has been said. It converts speech in to the text.

It contains following steps:

- Grammar design: It determines the words and patterns used in the spoken words.
- Signal processing: Analyzes the occurance characteristics of the recoreded audio.
- Phoneme recognition: Assessment of patterns between spectrums and phonemes.
- Word recognition: It links the phonemes in respect of words identified by active grammar.
- Result generation: It provides the result of information about the words detected in incoming audio.

Grammar is one of the important part of speech reorganization because they contain the recognition process. These constraints provide more accuracy and more speedy.

"Rule making grammars and dictation grammars are the two elementary grammar types that are being buoyed by java speech API. These two types are different from each another in various ways how result is delivered, types of sentences it agree, set up of grammar in the applications, the amount of computational resources required and how the application design is used. JSAPI uses the java speech grammar format for defining rule grammar.

Speech API's are combined by different packages. These packages contain class and interfaces. The main three packages are:

javax.speech: For generic speech engine contains classes and interfaces.

javax.speech.synthesis: For speech synthesis contains classes and interfaces.

javax.speech.recognition: For speech recognition contains classes and interfaces'

All the applications of java speech API's uses the engine manager class. This engine manager provides the stagnant method for accessing dialogue acknowledgment and synthesis.

Applications related to speech uses methods. These methods perform various actions like allocating and re-allocating resources for speech engine, retrieving the properties and state of speech engine. The engine

Figure 3. Demonstration of web speech.

imparts the mechanism of pause and resuming the audio stream. Audio manager can be manipulated by engine interfaces.

The whole java speech API is work on event handling. Event generated can be easily identified and handled. Basically speech events handled through engine listener interface and also by synthesizer listener and recognizer listener.

5. CONCLUSION

The speech recognizer that we used in our proposed work for making better interaction of web application with the help of voice is first open source. Implementation of this research can be enhanced according use and ease. This recognizer is workable on real time mode with medium vocabulary speech recognition. By this we can recognize both words and numbers provided as input in the form of voice and get the result in the form of voice. We basically runs it live mode but contains certain limitations. After all the boundaries we can group up this software with usable hardware (Sound-card). The current trending software's don't support voice to voice (V-to-V) application on the web. This can be made more adaptable for any kind of web application. We have enhanced the efficiency of the voice recognition by this work.

Also, in the present work, we have hard coded the using of web speech by voice to voice. This can be further programmed for making all web application is controlled by the help of voice. This open source implemented idea is not only limited to static devices but also any user can exploit these services on dynamic devices too.

निष्कर्ष

हमारे प्रस्ताविक कार्य में व्याख्यान पहचानक जो आवाज की सहायता से वेब अनुप्रयोगों से बेहतर संवाद करता हैं वह प्रथम मुक्त स्त्रोत साफ्टवेयर हैं। इस शोध के कार्यान्वयन को उपयोग और सहजता अनुसार बढ़ाया जा सकता है। यह पहचानक वास्तविक समय में मध्यम शब्दावली व्याख्यान पहचान के साथ काम कर सकता हैं। इसके द्वारा हम शब्दों और संख्या दोनों को आवाज के रूप में इनपुट कर सकते हैं और परिणाम को आवाज के रूप में प्राप्त कर सकते हैं। हम इसे सीधे प्रसारण पर चला सकते हैं परन्तु इसमें कुछ कमियाँ होती हैं। इन सभी सीमाओं के बाद हम इस साफ्टवेयर को उपयोग योग्य हार्डवेयर के साथ एक समूह बनाते हैं। वर्तमान प्रचलित सॉफ्टवेयर वेब पर आवाज से आवाज अनुप्रयोगो की मदद नहीं देता। यह किसी भी वेब अनुप्रयोग अधिक अनुकूलन बनाया जा सकता है। हमने इस कार्य के द्वारा आवाज पहचान की कुशलता में वृद्धि की है। इसके अलावा, वर्तमान काम में, हमने वेब व्याख्यान उपयोग करके आवाज से आवाज को मुद्रित किया हैं। भविष्य में इसमें प्रोग्रामिंग करके सभी वेब अनुप्रयोगों को आवाज की मदद से नियंत्रित किया जा सकता हैं। यह मुक्त स्रोत विचार का कार्यान्वन केवल स्थिर उपकरणों पर ही नहीं अपितु उपयोगकर्ता इन सेवाओं का उपभोग सक्रिय उपकरणों पर भी कर सकते हैं।

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विभिन्न तदर्थ रूटिंग प्रोटोकॉल पर टीसीपी की भीड़ नियंत्रण तंत्र का विश्लेषण

Analysis of Congestion Control Mechanisms of TCP Flavors over Different Ad-hoc Routing Protocols

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सारांश

हमारी परियोजना का मुख्य उद्देश्य की भीड़ नियंत्रण तंत्र के एक विश्लेषण करने के लिए है साथ प्रयोग किया जाए संचरण नियंत्रण टीसीपी तेहो तरह प्रोटोकॉल (टीसीपी) और रेनो के विभिन्न जायके तदर्थ मांग पर दूरी सदिश (AODV) कर रहे हैं जो तीन अलग–अलग मार्ग प्रोटोकॉल, गतिशील तदर्थ वायरलेस के लिए स्रोत रूटिंग (DSR) और गंतव्य अनुक्रम दूरी सदिश (DSDV) नेटवर्क। यहाँ हम सॉफ्टवेयर के रूप में एन एस–2.04 सिम्युलेटर का उपयोग कर रहे हैं। सभी काम पर किया गया है 9.04 Ubuntu ऑपरेटिंग सिस्टम। टीसीपी परिवहन परत में सबसे व्यापक रूप से इस्तेमाल नेटवर्क प्रोटोकॉल है इंटरनेट पर (जैसे HTTP, टेलनेट, और एसएमटीपी)। टीसीपी खंडों IP परत के लिए भेजा है। टीसीपी एक निभाता है समग्र नेटवर्क के प्रदर्शन को निर्धारित करने में अभिन्न भूमिका। टीसीपी तेहो स्वाद धीमी गति से शुरू प्रदान करते हैं और भीड़ को खिड़की के आकार ssthresh यानी दहलीज मूल्य बढ़ जाती है, जब इसे में प्रवेश करती है भीड़ को परिहार राज्य। भीड़ परिहार राज्य में, CWnd के आकार के एक एमएसएस के लिए कम है और शुरू होने से धीमा करने के लिए रीसेट। टीसीपी रेनो फास्ट तमजतंदेउपज और तेजी से वसूली जोड़कर तेहो को बेहतर बनाता है मॉड्यूल। नई रेनो, बोरी, वेगास की तरह इसी प्रकार अन्य टीसीपी जायके। Fack, आदि मौजूद है कुछ स्थितियों के तहत टीसीपी प्रदर्शन में सुधार।

ABSTRACT

The main objective of our project is to make an analysis of congestion control mechanism of different flavors of transmission control protocol (TCP) like TCP Tahoe and Reno when used with three different routing protocols, which are ad hoc On Demand Distance Vector (AODV), Dynamic Source Routing (DSR) and Destination-Sequenced Distance Vector (DSDV) for wireless Ad hoc networks. Here we are using the ns-2.04 simulator as the software. All the work has been done on Ubuntu 9.04 operating system. TCP is the most widely used network protocol in the transport layer on the Internet (e.g., HTTP, TELNET, and SMTP). TCP segments is sent to IP layer. TCP plays an integral role in determining overall network performance. TCP Tahoe flavour provide slow start and when the size of congestion window increases the ssthresh, i.e., threshold value, it enters into congestion avoidance state. In congestion avoidance state, size of cwnd is reduced to 1 MSS and reset to slow start. TCP Reno improves Tahoe by adding the Fast Retransmit and Fast Recovery modules. Similarly other TCP flavors like New Reno, Sack, Vegas. Fack, etc. exists which improves the TCP performance under some situations.

Keywords: TCP, AODV, DSR, DSDV, HTTP, TELNET, MSS, cwnd, ssthresh

1. STATEMENT OF THE PROBLEM

We have given the proposal for performing the TCP Congestion Control performance measurement in three different routing protocols AODV, DSR and DSDV in Ad hoc network. This TCP performance measurement can be done in the network simulator[2] (ns2) based on certain standard performance metrics such as throughput, connect time and goodput and collision. For simulation we will be using the available TCP options, i.e, TCP Tahoe and TCP Reno.

1.1 Objectives

We have performed the simulation of two flavours of TCP: TCP Tahoe and TCP Reno over three routing protocols AODV, DSR and DSDV. Our objective is to compare the performance based on the following performance metrics: Throughput, Collision, Connect time, Goodput. The maximum number of packets that the interface queue (IFQ) can hold is 50.The simulation time is 125s.

2. TCP CONGESTION CONTROL MECHANISM

TCP at Sender has two parameters to work upon congestion: Congestion Window (cwnd) and Slow Start Threshhold value(ssthresh). Hence TCP Congestion Control works in two modes: Slow Start(cwnd< ssthresh) and Congestion Avoidance (cwnd>= ssthresh).

2.1 Slow Start Phase

Initial value : Set cwnd = 1 segment. Here unit is Segment size. The receiver sends an ACK for each packet. Generally a TCP receiver sends sends an ACK for every other segment. Also, Each time an ACK is received by sender, the congestion window is increased by 1 segment i.e. cwnd = cwnd + 1; If ACK acknowledges two segments, cwnd is still increased by 1 segment. If ACK acknowledges a segment that is smaller than NSS, cwnd is still increased by 1. Instead of this, this congestion window grows very rapidly. It grows exponentially.

2.2 Congestion Avoidance Phase

As we have seen that the size of congestion window grows very rapidly. Congestion avoidance phase is started if cwnd>=ssthresh. If this state has reached, then each time ACK is received, the cwnd is increased as : cwnd= cwnd+1/[cwnd].

2.3 Time Out

If there is congestion in the network, then there will be packet loss. Now the question is How TCP detects that there is some packet loss? If it doesn't receive the acknowledgements back from receiver for a specific time period, then TCP assumes that packets has been dropped due to congestion. In this situation the value of ssthresh is set to cwnd/2 and drops the window size, i.e., cwnd to 1. It again enters into slow start phase. It starts the retransmission of packets. It is basically called as 'Time Out of Retransmission Timer'.

2.4 Triple Duplicate Acknowledgement and Fast Retransmit

TCP uses the duplicate acknowledgement for triggering the retransmission. If it receives acknowledgement for any particular segment more than twice, TCP assumes that the particular segment has been lost somewhere in the network due to congestion and it thus enters into Fast Retransmit phase to resend the particular missing segment again without waiting for Retransmission Timer to get timed out. It then enters into slow start phase. It then sets ssthresh = cwnd/2 and cwnd = 1.

2.5 Fast Recovery Phase

It avoids slow start after a fast retransmit. It assumes that Duplicate ACKs are a symbol of data getting through the network smoothly. After receiving three duplicate ACKs: It Retransmits the lost packet. It sets ssthresh= cwnd/2 and cwnd=cwnd + 3. It then enters the Congestion Avoidance phase. When new ACK acknowledges new data, cwnd = ssthresh. It then again enters into Congestion avoidance phase.

TCP actually works in the form of its various flavours: TCP Tahoe (1988, Free BSD 4.3 Tahoe): It uses slow start and Congestion Avoidance phase. It thenalso utilizes Fast Retransmit. TCP Reno (1990, Free BSD 4.3 Reno): TCP Reno improves upon TCP Tahoe when a single packet is dropped in a Round Trip Time. TCP Reno detects congestion in two forms:

(1) Duplicate ACKs :-It uses Fast Retransmit and then enter Fast Recovery phases.
(2) TimeOuts: It uses Fast Retransmit and then enters into slow start phase.

TCP Newreno (1996): It is used in Multiple dropping of Packets. TCP Sack: It uses the Selective Acknowledgements. Similarly various other flavours of TCP exists and these are: TCP Vegas, TCP CUBIC, TCP HYBLA, TCP BIC, TCP FAST, TCP VENO, TCP WESTWOOD, TCP WESTWOOD+, COMPOUND TCP exists and improves the performance of congestion controlling ability of TCP. In this paper we simulate and analyze the TCP Tahoe and TCP Reno in IEEE 8021.11 based MANETs.

3. RESULTS AND PERFORMANCE

The performance evaluation was based only on three scenarios-mobility, load on the network and the number of nodes.

We used the simulation time for 125 s., maximum number of packet is 50, and size of packet is 500 bytes. If the collision in the network is less, then It means that network is handling the congestion in absolute manner. More are the collisons, more is the

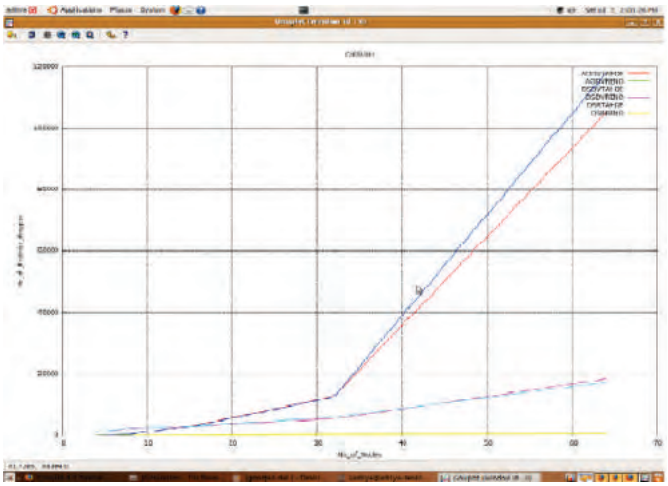

Figure 1. Performance evaluation.

congestion in the network. As shown in Fig.1. as no of node increases, the congestion will increase. Due to more congestion number of dropped packet increases. As the no. of nodes increases in the environment, there is a sharp rise in the frequency of collision in AODV Tahoe and DSDV Tahoe. The increase in DSR Tahoe is not sharp. In the large scenario, The performance of DSDV Reno is better than DSR Tahoe and DSR Reno performs very well in the increased no. Of nodes scenario. Most poorer TCP flavour in terms of packets dropped is Tahoe. When Tahoe is operated with DSDV Protocol, the performance is worst. It increases a little bit when Tahoe is operated with AODV protocol. When we are using the Reno flavour with DSR protocol, The no. of packets dropped are very very less and better than the Reno flavour used with DSDV. The collision in DSR Tahoe and DSDV Reno are almost same.

3.2 Analyzing Connect Time and Goodput

Figure 2 shows the connect time with increase in no. of nodes and Fig. 5 ahows Goodput.

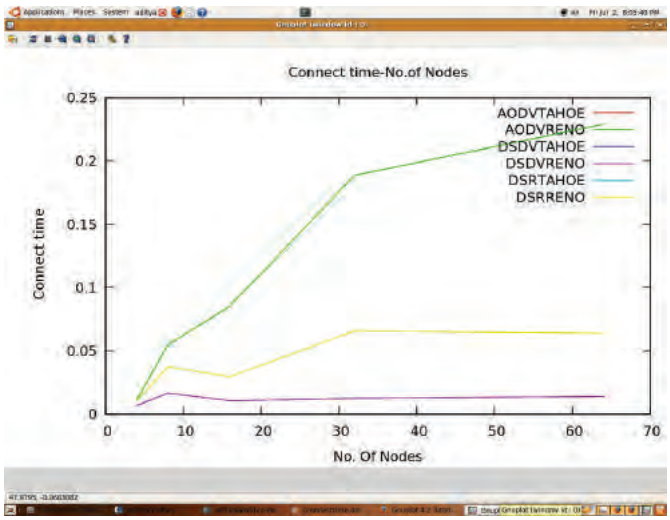

Figure 2. Connect time.

3.3 Throughput

We measure the throughput as the no. of bits Received Per second. But here we measure it as no. of packets received in particular amount of time. If throughput is less, It gives a clear indication that there exists congestion in the network due to which less packets are being received. Figure 4 and 5 shows the Throughput for the 4-node, 8 node and L6 node scenario, respectively.

As shown in the Figure 7, Throughput of 32 nodes scenario has been shown. The results are really intresting. As it was noted in the sceanrio of 16 nodes that AODV was performing better in heavy load networks. The AODV Protocol is performing better

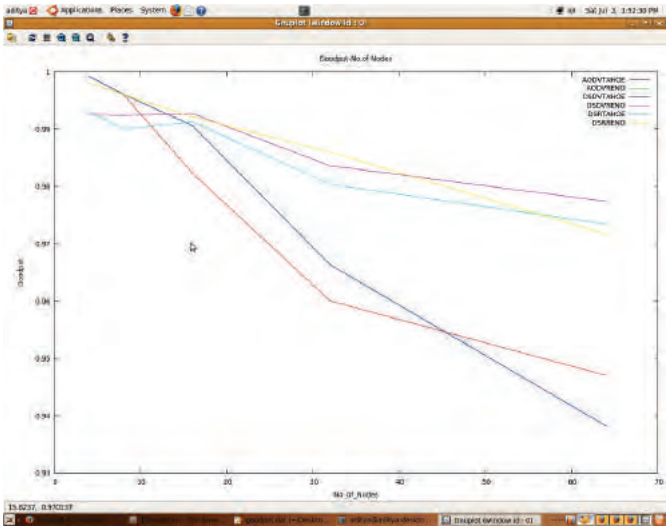

Figure 3.GoodPut.

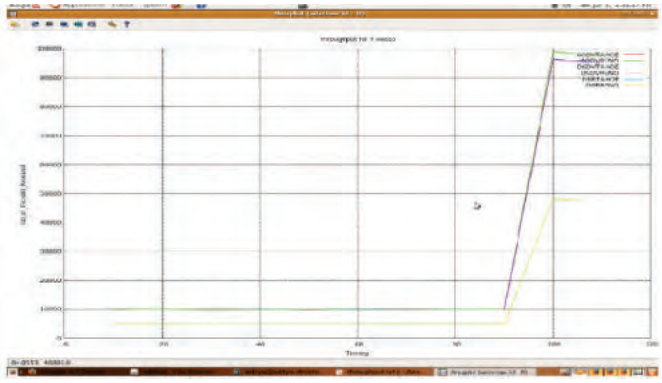

Figure 4. ThroughPut for 4-node scenario.

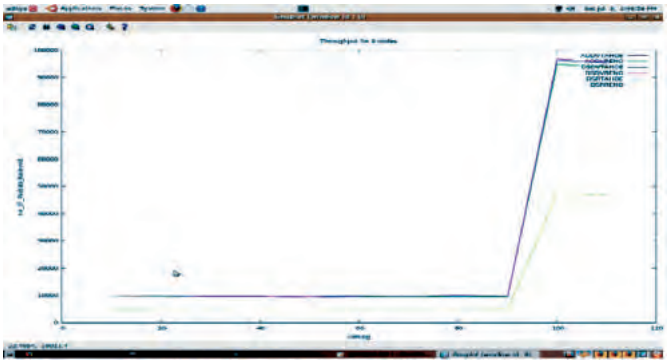

Figure 5. ThroughPut for 8. node scenario.

than the DSDV protocol. DSDV is in turn performing better than DSR. DSR protocol is having very less throughput. Here Flavour makes no difference. Till a certain time, the throughput of DSR remains same and after certain time period, We see a sharp increase in the throughput as every node starts to communicate and generates the data packets in a very large amount, but it also starts to fall down as the time proceeds. The comparitive performance of Reno flavour used with AODV is best. However, AODV with Tahoe gives it equal fight. Initially AODV with Tahoe and Reno

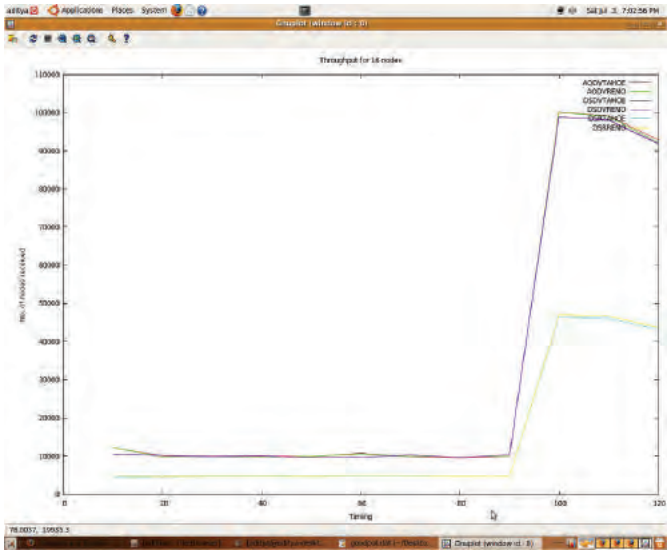

Figure 6. ThroughPut for 16-node scenario.

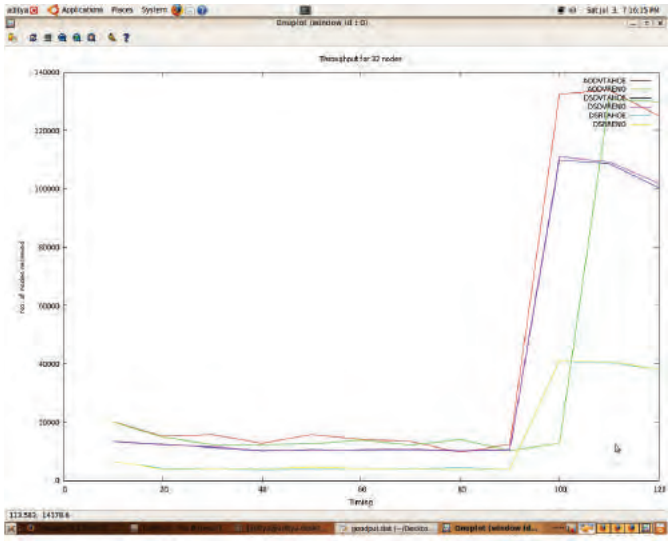

Figure 7. ThroughPut for 32-node scenario.

shows the same and best performance but as the time proceeds, Performance of AODV with Reno decreases slightly as compared to AODV with Tahoe. The rapid increase is also very more in Tahoe as compared to Reno. But after the hike, the performance of AODv with Tahoe decreases at a very alarming rate and AODV is possible to maintain its rate of throughput. Hence It is consistent.

3.3.1 64-Node Scenario

As shown in the Figure 6.h, Throughput of 64 nodes scenario has been shown. The results are really very intresting. As it was noted in the sceanrio of 32 nodes that AODV was performing better in heavy load networks. The AODV Protocol is still performing better than the DSDV protocol. DSDV is in turn performing better than DSR. It can be concluded that AODV is meant for heavy load Networks. DSR protocol is having very less throughput. Till a certain

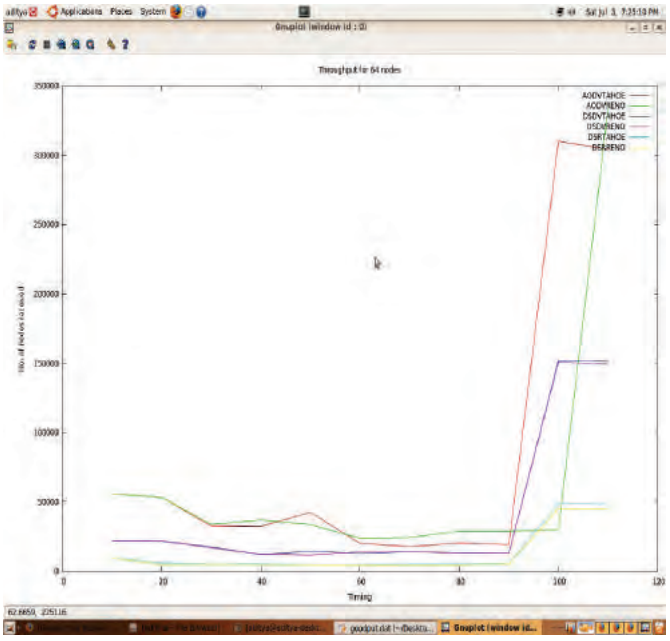

Figure 8. ThroughPut 64-node scenario.

time, the throughput of DSR remains same and after certain time period, We see a small increase in the throughput and after sometime it becomes constant. DSR with Tahoe is performing slightly better than DSR with Reno.

DSDV is again an intermediate player and Its performance shows a regular trend. There is a sharp hike in the throughput after certain time period, But this hike is less than the hike in AODV and higher than that of DSR. Tahoe version here also gives better results than the Reno flavour when used with DSDV. However, AODV with Tahoe is very much different than AODV with Reno.

Initially AODV with Tahoe and Reno shows the same and best performance but as the time proceeds, Performance of both decreases slightly. Then, the performance of TCP with Reno is better than TCP with Tahoe. As time increases further, Tahoe shows some improve but again it falls and Reno with AODV remains the best to deliver the maximum traffic and thus handles congestion in best possible manner. The rapid increase more in Reno as compared to Tahoe. But after the hike, the performance of AODV with Tahoe starts decreasing and AODV with Reno is possible to maintain its rate of throughput and it is still rising. Hence, it is consistent and better. AODV is proving to be the best solution in the loaded scenarios

4. SCOPE FOR FUTURE WORK

The performance evaluation was based on only on selected scenarios-mobility, load on the network and the number of nodes. The no. of nodes could be enahnced upto thousands and further the performance could be checked. Results could be obtained for different

scenarios as well using the NSG, i.e., (Network Scenario Generator). Network other parameter like radio network interface and realistic physical layers can be used. This would make the performance evaluation much better. More proactive and reactive routing protocols can be compared and their performance can be obtained in various cases. With the analysis of performance of MANETs, we can enhance the throughput of network as required. It will possible to do performance analysis of MANETs in noise network environment too.

5. CONCLUSIONS

Thus, we conclude from our simulation result that number of packets drop in DSR is very less compared to DSDV and AODV routing protocols. Drop Rate in Reno Flavour is less as compared to that in Tahoe Flavour. So Collision in DSR is very less than that in DSDV and AODV. Collision in DSR Reno is much less than that in DSR Tahoe. DSDV has less connect time than DSR and AODV. Goodput of DSR is high compared to DSDV and AODV. If we see overall from the perspective of Throughput, Reno Flavour performs better than that Tahoe Flavour. We also conclude that the DSR routing protocol performs well under the variety of conditions than that of the DSDV and AODV. In some of the scenarios DSDV protocol performance better than the DSR and AODV. There are various scenarios in which the performance of AODV with Reno is better than that of DSDV Reno and DSR Reno. AODV is good at higher loads scenario whereas for the scenarios of small loads, DSDV is a better approach.

निष्कर्ष

इस DSR बहुत है में इस प्रकार, हम हमारे सिमुलेशन परिणाम से पैकेट ड्रॉप की संख्या निष्कर्ष निकालना कम DSDV और AODV मार्ग प्रोटोकॉल की तुलना में। रेनो स्वाद में ड्रॉप दर के रूप में कम है तेहो स्वाद में उस की तुलना में। तो इस केत में टकराव क्वैक्ट और AODV में है कि अधिक से बहुत कम है। इस केत रेनो में टकराव की इस केत तेहो में है कि अधि ाक से बहुत कम है। क्वैक्ट इस केत से कम कनेक्ट समय है और AODVA इस DSR के Goodput DSDV और AODV की तुलना में अधिक है। हम थ्रू पुट के नजरिए से समग्र देखते हैं, रेनो स्वाद की तुलना में बेहतर प्रदर्शन कि तेहो स्वाद। हम भी इस केत मार्ग प्रोटोकॉल किस्म के तहत अच्छी तरह से करता है कि निष्कर्ष निकालना DSDV और AODV की तुलना में स्थितियों की। परिदृष्यों DSDV प्रोटोकॉल में से कुछ में इस केत और AODV की तुलना में बेहतर प्रदर्शन। विभिन्न परिदृश्यों हैं जो प्रदर्शन में रेनो के साथ AODV की DSDV रेनो और इस केत रेनो की तुलना में बेहतर है। AODV उच्चतर में अच्छा है छोटे भार के परिदृश्यों के लिए, जबकि भार परिदृश्य, DSDV एक बेहतर तरीका है)।

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वक्र फिटिंग का उपयोग करके मोबाइल तदर्थ नेटवर्क के लिए एक नवीन वितरित मूल प्रबंधन प्रणाली

A Novel distributed Key Management system for Mobile Adhoc Networks using Curve Fitting

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सारांश

वायरलैस माध्यम विभिन्न प्रकार के हमलों के लिए खुले और संवेदनशील है और घुसपैठिये अनायास ही नोड्स हैक कर सकते हैं। गोपनीयता और प्रमाणन सुरक्षा ढांचे के मूल तत्व हैं। वायरलैस नेटवर्क अक्सर सांस्थिति topology परिवर्तनों, सीमित आवेष्ट विशदता इंदकूपकजी और केन्द्रीय नियंत्रण के अभाव जैसे कई कारकों की वजह से अस्थिर और अविश्वसनीय हैं। एक मानक सुरक्षा ढांचे को लागू करने के लिए एक विश्वसनीय मूल प्रबंधन की आवश्यकता है। महत्त्वपूर्ण जानकारी को साझा करने, महत्त्वपूर्ण जानकारी को वितरित करने और निरसन मध्य हमलों में पुरुषों को रोकने जैसे प्रस्तावित कार्यों में वक्र फिटिंग के फायदों का लाभ उठाया जाता है।

ABSTRACT

The wireless medium is uncovered and vulnerable to different routing attacks and intruders can hack nodes effortlessly. The confidentiality and authentication are the main elements of security framework. The wireless networks are unstable and unreliable because of various factors; topology changes are frequent, limited bandwidth and acbsence of a centralized control.A reliable key management is required to implement a standard security framework. The proposed work leverages the advantages of curve fitting for key sharing; key distribution and revocation to prevent men in middle attacks

Keywords: Curve fitting, secret sharing, certificate, polynomial functions

1. INTRODUCTION

The "active attacks"[1,2] execute harmful functions such as packet discarding, corrupting payload and routing messages. The "passive attacks"[1,2] mainly read network functions and collect information about network. Furthermore, a malicious node[4,7] can take part in the network to disrupt the normal routing process. The malicious node is an unauthorized node that causes congestion, propagates incorrect routing messages, prevents services or shuts them down completely. These extortions exist because of intrinsically limited physical security of mobile ad hoc networks. Undeniably, it is easier to interrupt communications and infuse corrupted messages in the wireless communication medium than in an equivalent wired network. A dedicated server is constituted to manage certificates in normal scenario or assymetric keys are used. These traditional methods are not applicble to wireless networks.

2. SECURITY ISSUES

The spoofing is the main problem that destructs the entire network .The immediate dominance of spoofing attack[8,2] is the "over all" corruption of network information trailed by network loops and partitioning of network. The security frame work for MANET is made up of the following building blocks.

i) Distributed Key Management
ii) Security Association (SA)
iii) Curve fitting

2.1 Security Association

A certificate contains[3] (Px: public key, toc: time of creation and IPx: Ip address of a device). A dedicated server[3] is taking the responsibility of issuing and revoking certificates.But establishing a separate server is against to the nature of MANET. Therefore this work requires a hybrid approach with Security association

"Trust Model"[5], the security association (SA) is made up of set of trusted nodes.

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2.2 Key Distribution Concepts

In symmetric key cryptography[6], the prerequisite is exchanging the symmetric keys between source and destination before the encryption and decryption.

In public key cryptography, the key distribution is done through key servers. The keypair[6] contains public and private keys[6], the source retains private key and gives public key to receivers.

The basic idea behind key sharing is, 'N' secretes are distributed among M nodes so that any M<N of them can regenerate the original information, but no smaller group upto M-1 can do so. There are several mathematical approaches to solve this problem, such as the number of points needed to identify a polynomial of a certain degree (used in Shamir's scheme),[7] or the number of intersecting hyper planes needed to specify a point (used in Blakley's scheme).

When applying this type of secret sharing trust model, an entity is trusted[10] if any k trusted entities approve so. A locally trusted entity is globally accepted and a locally suspected entity is looked upon unreliable all over the network.

2.3 Secret Sharing

2.3.1 Curve Fitting

The process of finding the equation of the curve of best fit, which may be most suitable for predicting the unknown values, is known as curve fitting. The curve fitting defines an exact relationship between two variables by algebraic equations. Thefollowing methods are used for fitting a curve.

I. Graphic method
II. Method of group averages
III. Method of moments
IV. Principle of least square.

2.3.2. Principle of Least Squares

The principle of least squares provides a unique set of values to the constants and hence suggests a curve of best fit to the given data.

The difference of the observed and the expected value ,difference is called error ,clearly some of the error e1, e2, e3, ...ei....., en will be positive and other negative. To make all errors positive we square each of the errors (i.e) S= e1+ e2+ e3+ .....+ ei+ ..... en. The curve of best fit is that for which e's are as small as possible. An instance is given below.

Table 1. Curve fitting table

1	2	3	4	5	6
x	0.5	1.0	1.5	2.0	2.5
y	1.5	3.0	4.5	6.0	7.5

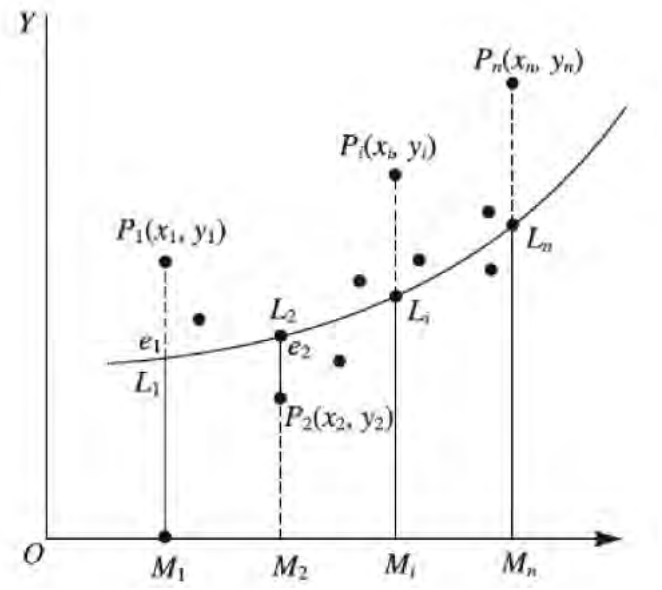

Figure 1. The method of least square.

n = 6 ∑xi = 7.5 ∑yi = 22.5 ∑xi2
= 13.75 ∑(xi,yi) = 41.25

$a\sum xi + b*n = \sum yi$ (1)

$a\sum xi2 + b\sum xi = \sum(xi,yi)$ (2)

The equations 1 & 2 are substituted in matrices and values of 'a' and 'b' are calculated usin Gaussian elimination method.

$$\begin{bmatrix} n & \sum x_i \\ \sum x_i & \sum x_i^2 \end{bmatrix} \begin{bmatrix} b \\ a \end{bmatrix} = \begin{bmatrix} \sum y_i \\ \sum (x_i y_i) \end{bmatrix} \quad (3)$$

$$\begin{bmatrix} b \\ a \end{bmatrix} = inv \begin{bmatrix} 6 & 7.5 \\ 7.5 & 13.75 \end{bmatrix} * \begin{bmatrix} 22.5 \\ 41.25 \end{bmatrix} \quad (4)$$

after applying Gaussian elimination

$$\begin{bmatrix} b \\ a \end{bmatrix} = \begin{bmatrix} 0 \\ 3 \end{bmatrix} \Longrightarrow f(x) = 3x + 0 \quad (5)$$

A linear function has been generated. This could be extended to any order of polynomial function.

The Figure 2 shows the graph that generates different curves and polynomials.

y = 1.2085e0.7824x

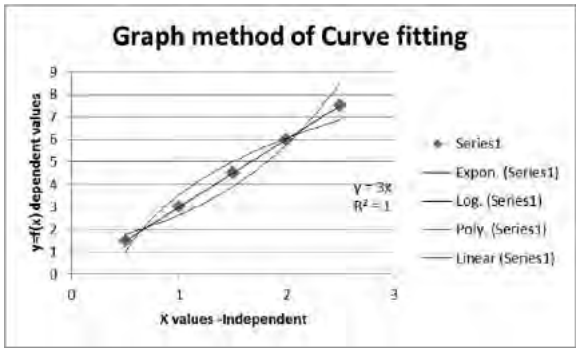

Figure 2. Curve fitting in graph display.

$R^2 = 0.9473$ (6)

$y = -2E\text{-}12x4 + 7E\text{-}12x3 - 1E\text{-}11x2 + 3x$

$R^2 = 1$ (7)

$y = 3.6324\ln(x) + 3.5398$

$R^2 = 0.9473$ (8)

$y = 3x$

$R^2 = 1$ (9)

The polynomial fits a curve through data points, of the form y=m0 + m1 * x + m2 * x2+ m3 * x3+...+ mn * xn .The more complex, the curvature of the data, the higher polynomial order required to fit it.

3. KEYMANAGEMENT

3.1 Initialization Crowd Sourcing

The SA (security association) [8][9]members are agreeing upon a common seed function to generate random numbers with boundary condition for min and max values.

Step 1: Security Association is formed with trusted nodes.

Step 2: A group head (Cluster Head) is elected from security association.

Step 3: All SA members generate one random number each.

Step 3: The cluster head collects all shares and fitting a higher order polynomial curve that interpolates all points.

Step 4: The CH calculates the f(x) values for x values

Step 5: The CH distributes key shares and order of the polynomial to all SA members.

Step 6: The SA members generate polynomial function using keyshares.

For instance,

Table 2. Crowed sourcing

1	2	3	4	5
305	167	467	304	412

Five members from SA have been selected to give their shares; The CH is generates different curves using these random shares. The curve should interpolate all points and R2=1 should be satisfied, if it is not possible then any higher order function is generated that interpolates almost all ponts .

3.2 Polynomial Interpolation

$y = 35.1x + 225.7$ $R^2 = 0.230$ (10)

$y = 2.071x2 + 22.67x + 240.2$ $R^2 = 0.232$ (11)

$y = -13.91x3 + 127.3x2 - 305.7x + 474$

$R^2 = 0.284$ (12)

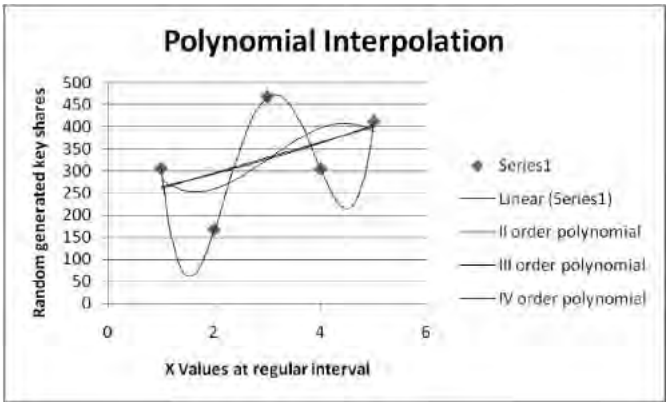

Figure 3. Polynomial interpolation.

$y = 68.12x4 - 831.4x3+3504.x2-5853.x + 3417$

$R^2 = 1$ (13)

The Eqn (13) is a fourth-order function that interpolates all points correctly.The generated polynomial is smoothened by taking the ceiling values of all constants for a better functioning.

So the Eqn (13) is rewriten as

$Y=69*X4 -832*X3+3505* X2-5854*X+3417$ (14)

3.3 Keyshare Generation

The second important step is to generate new key shares for this session. The CH generates different key shares and issues to all SA members. The key shares are generated by calculating f(x) for x=1..n.

4 KEY ISSUES

4.1 Key share request

The primary role of SA is to issue or reject a key share to a new node after authentication[10].There is a policy file that stores all requlations to validate a new node for testing its trustworthiness[12]. The policy file pattern is left to the end users and they can customize. A SA member issues the key share based on policyfile. And a node table is maintained to store issued keyshares

The Table 4 structure has three major elements that are Node number, the key share and time of issue.

4.2 Curve fitting

A new node collects k our of n shares,and gives it to any nearby SA member to fit a polynomial on

Table 4. Keyshare issue table

Node no	Key share	Time of issue
1	(2,177)	11.00.11
2	(4,497)	12.12.12

Table 3. Keyshare table

x	1	2	3	4	5	6	7	8	9	10
f(x)	305	177	525	497	897	4185	14477	37545	80817	53377

received values .The existing polynomial is compared with newly generated one,if both are equal then symmetric key is issued or node is rejected.And that new node is identified as intruder.

Theorem 1:

The keyshares that are generated from a polynomial are correctly interpolated by same right order polynomial function.

Proof :

Here five shares are taken from table 3 to reconstruct the polynomial.

Table 5. Keyshare collection table

1	2	3	4	5
305	177	525	497	897

The order of the polynomial function is 4 here. The SA member interpolates with different order of polynomials.

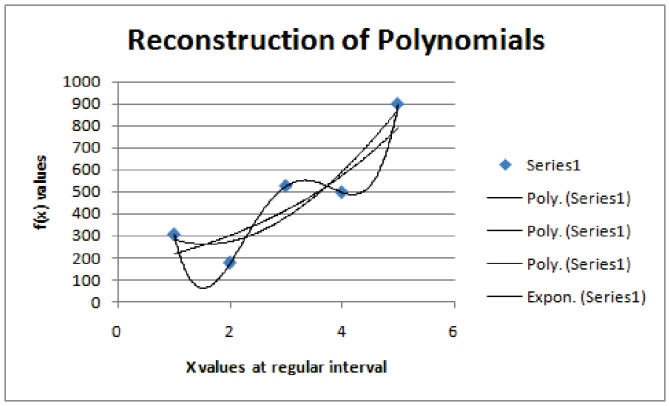

Figure 4. Reconstruction of polynomials.

$$y = 69x4-832x3+3505x2-5854x+3417 \quad (15)$$

$$R^2 = 1$$

$$y = -4x3 + 84.57x2 - 235.4x + 436.2 \quad (16)$$

$$R^2 = 0.868$$

$$y = 160.2e0.319x \quad (17)$$

$$R^2 = 0.677$$

The trendline fixation shows that eqn. 15 has the correct key (3417).

Theorem 2:

The keyshares that are collected at irregular intervals are interpolated with a correct polynomial function after sorting the shares.

Proof :

Here five f(x) values have been collected from table 3 in random order

x	2	3	7	9	10
f(x)	177	497	14477	80817	153377

The following graph shows the correct regeneration of a polynomial function with random shares.

$y = 69x4 -832x3+3505x2-5854x+3417$ $R^2 = 1$

Theorem 3:

The incorrect number of shares cannot generate

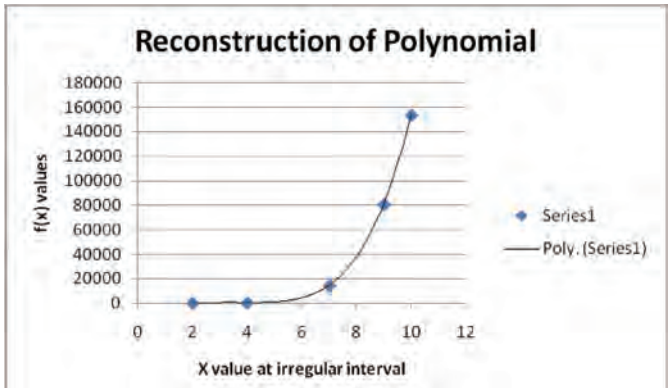

Figure 5. Correct function generation.

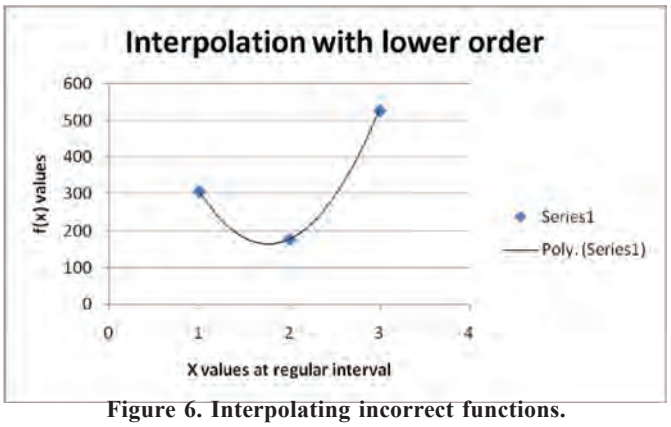

Figure 6. Interpolating incorrect functions.

the correct polynomial function.

Proof:

Three 3 insufficient shares have been taken to regenerate polynomial. The graph shows the incorrect version of polynomial function.

$$y = 238x2 - 842x + 909 \quad (18)$$

$$R^2 = 1$$

Theorem 4

The incorrect shares are not tolerated in curvefitting to regenerate originating polynomials.

Table 6. Incorrect share collection

2	3	7	9	10
177	497	14477	567856	153377

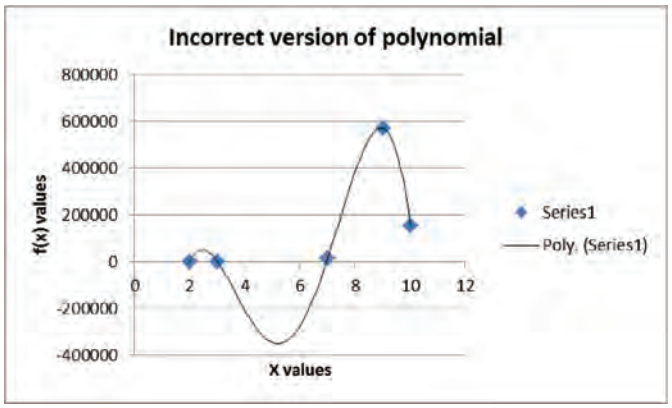

Figure 7. Incorrect polynomial interpolation.

Proof:

The Table 6 shows that an incorrect value for 9 is taken to generate the polynomial.

$$y=-5728.9x4+126721x3-929941x2+3E+06x-2E+06 \quad (19)$$

$R^2 = 1$

The Eqn (17) is an incorrect one. So even a single incorrect share cannot generated correct polynomial.

A new legitimate node is issued a symmetric key after all four conditions satisfied on keyshares that are collected from SA members.Moreover the new node have symmetric key but not a polynomial function.So it cannot generate its own shares to issue to hackers.

4.3 Certificate Exchange-secured Way

The PSK(polynomial secret key) , is the symmetric key found by a new node, this is used for encrypting all routing messages and beacons to avoid all men in middle attacks. The forward ant[13][14] that is used for route discovery is encrypted by PSK and it carries a certificate to destination node.

4.3.1 Forward ant Generation

Input : f_{ant}:forward ant and cerificate

Output: $f_{ant}S$: secured forward ant

//IPx- Ip addres, Px-Public key,toc-time of creation, exp-expiry time

C_{node}=[IP_x,P_x,toc,exp]

$f_{ant}S$=[$f_{an}t$,C_{node}]psk+

Routediscovery (fanSt,nlist);

end

The forward ant and certificate of node X are joined together and encrypted by the PSK.

4.4 Route Discovery

4.4.1 Routediscovery (fantS,nlist)

Input :fant :forward Ant, nlist :neighbor list

Output: Route discovery and table updating

//Decrypt the received forward ant with the help of PSK

fant=[fantS]psk-

if isNew(fant.aid) then

//if hop count does not cross Maxhopcount then accept

if fant.ahc<=fant.amhc then

// if it reaches destination then create backward ant and stop route discovery. The certificate of source node is extracted for future communications.

if fant.adst == currentNodeID

Cdst=[IPdst,Pdst,toc,exp]

Backwardant(fant,Cdst)

Break

// If it is not destination then continue route discovery

elseif fant.adst!=currentNodeID and

Routediscovery(fantS,nlist)

else

discard(fant)

end

The route discovery is fully encrypted and the nodes that are having valid PSK only can participate routing. The unauthorized nodes cannot snoop routing packets and non repudiation and denial of service are completely avoided.

4.4.2 Path Updating

The path updating is done by backward ant

The intended source node decrypts backward ant to extract certificate of destination node and stores in to node table.

Algorithm : BackwardAnt (bant¬S)

Input : bantS : backward ant

Output: m:updated path

// Decrypt backward ant by psk

bant=[bantS]psk-

//Checks hop count limit

if bant.ahc<bant.amhc then

//if it reaches source node then collect keys of destination node

if bant.adst==currentNodeIP then

KeyCollect(Uant,Cdst)

// else travel further to reach source

else if bant.adst!=currentNodeIP then

pickup next node from bant.apath and

bant.ahc=bant.ahc+1

bantS=[bant]psk+

unicast(bantS)

else

discard(bant)

end

5. KEY REVOCATION

A same key for a longer duration is not a good idea and periodical change of key is required.

5.1 Key Revocation algorithm

Step 1: The key shares expired and symmetric key becomes obsolete.

Step 2: The SA members elect a new CH

Step 3: The SA members are filtered based on their trustworthiness. A misbehaving SA would be eliminated from further operations.

Step 4: The CH collects random numbers from all SA members and generates a new polynomial

Step 5: It generates key shares based on the new polynomial.

Step 6: The SA members collect new shares

Step 7: The other nodes need to collect shares from SA

5.2 Key Revocation Methods-alternatives

Method I:

The same sets of random shares from table 2 are interpolated by different order of polynomial.

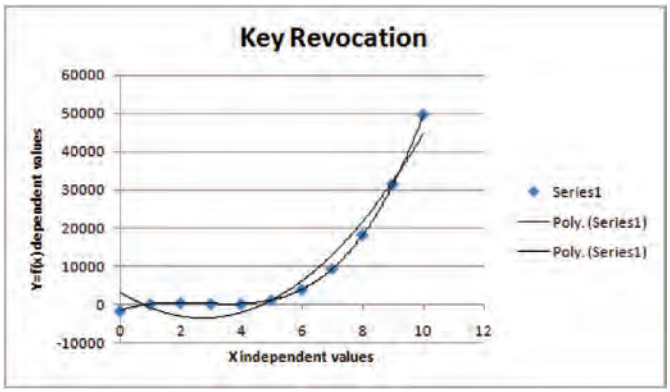

Figure 8. Key revocation.

$y = 911x2 - 4962.x + 3273$

$R^2 = 0.959$ (20)

$y = 134x3 - 1098.3x2 + 2702x - 1551$

$R^2 = 0.9666$ (21)

The 3rd-order polynomial is taken as next session symmetric key value is 1551.

Method II:

The originating function is updated with new key value. This is a simple method of changing Xo term.

$y = 69x4 - 832x3 + 3505x2 - 5854x + 3417$

this is overwritten as

$y = 69x4 - 832x3 + 3505x2 - 5854x + 12345$ Eqn.20

and from Eqn.20 the new keyshares are generated.

x	0	1	2	3	4	5
f(x)	12345	9233	9105	9453	9425	9825

linear shares

$y = 69x4 - 832x3 + 3505x2 - 5854x + 12345$

$R^2 = 1$ Eqn.20

$y = 69x4 - 832x3 + 3505x2 - 5854x + 12345$

$R^2 = 1$ Eqn (21)

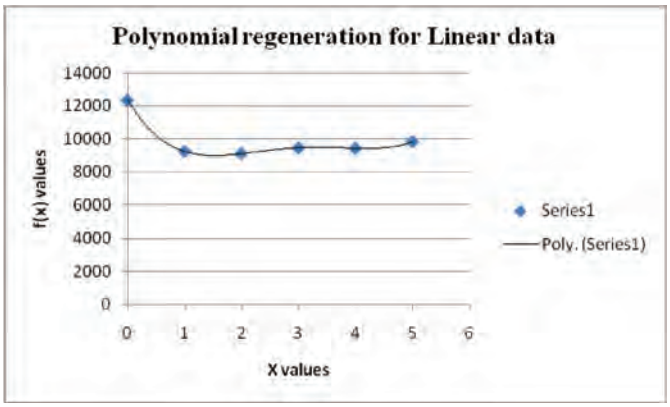

Figure 9. Keyregeneration.

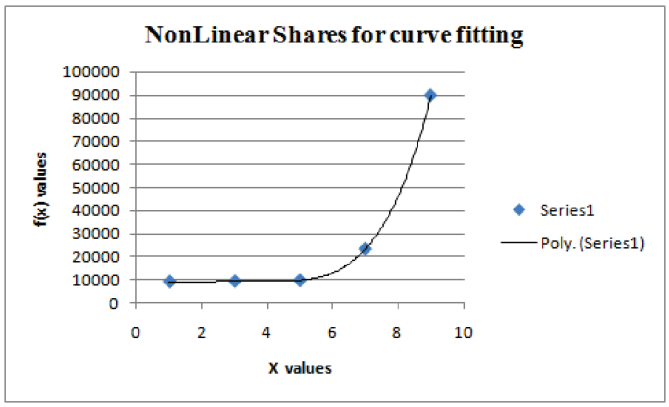

Figure 10. Regeneration of polynomial-non.

6. CONCLUSIONS AND FUTUREWORK

The above graphs show the complete life cycle of a key management system. The key generation, polynomial interpoloation ,key share generation ,key distribution and key revocation all things are implmented in curvefitting tool and all things are proved that this framework is more suitable for MANET. The other polynomial interpolation like Lagrange and Berkley methods are more complex in term of computational efforts.

The future work would be the following things. The policy file need to be standardized. This policyfile is purely based upon the MANET type and some heuristic method would be suggested for automative policy file establishment.

निष्कर्ष

ऊपर दिये गये ग्राफ में प्रमुख प्रबंधन प्रणाली के पूरी जीवन चक्र को दिखाया गया है। महत्त्वपूर्ण उत्पत्ति, पॉलीनोमिया इंटरपोलोएशन, मूलशेयर उत्पत्ति, मूल वितरण और मूल निरसन जैसी सभी बातें वक्र फिटिंग उपकरणों में लागू की जा रही हैं और सभी चीजों ने साबित कर दिया है कि यह फ्रेमवर्क मोबाइल तदर्थ नेटवर्क मेनेट के लिए अधिक उपयुक्त है।

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वायरलेस सेंसर नेटवर्क में घुसपैठ का पता लगाने वाली प्रणाली पर वर्तमान सर्वेक्षण
A Current Survey on Intrusion Detection Systems for Wireless Sensor Networks

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सारांश

वायरलेस सेंसर नेटवर्किंग आगामी तकनीक है जिसके चिकित्सा सेवाओं में शारीरिक संवेदको से लेकर जटिल सैन्य और रक्षा सेवाओं में मानवरहित यातायात नियन्त्रण तक के विविध अनुप्रयोग हैं। वारलैस सेंसर नेटवर्क के कई आकर्षक गुणों जैसे न्यूनतम संस्थापन लागत, निगरानी से मुक्त नेटवर्क कार्यन्वन आदि के बावजूद ये सुरक्षा उल्लंघनों में प्रभावित हो सकते हैं जो विषेष रूप रक्षा की कमी के कारण होते हैं। वायरलेस सेंसर नेटवर्क में वायर्ड नेटवर्क की तरह सूचना को किसी गेटवे या स्विचो और हबो द्वारा नियंत्रित नहीं किया जाता। यह जटिल अनुप्रयोग जिसमें गोपनीयता की माँगा हैं जैसे सैन्य संचार, संगठन संचार आदि हेतु इनकी उपयोगिता को कम करता हैं। जब हमलावरों द्वारा वास्तविक नुक्सान से पहले किसी घुसपैठ का किसी वायरलेस सेंसर नेटवर्क या संवेदक या मूल स्टेशन से पता लगता हैं तो वायरलेस सेंसर नेटवर्क की उपयोगिता को बढा सकते हैं। यह आलेख वायरलेस सेंसर नेटवर्क के लिए नवीनम तकनीक से पूर्ण घुसपैठ जाँच प्रणाली के प्रस्तावित करता हैं। वायरलेस सेंसर नेटवर्क में घुसपैठ जाँच प्रणाली की विभिन्न दृष्टिकोणों जैसे हमलावर की उपस्थिति/ताकत, डाटा कैसे प्रसंस्करण कैसे, डिवाइस की क्षमता, और प्रोटोकॉल स्टैक की जाँच को दर्शाया जाता हैं। इसके अलावा, यह आलेख विश्लेषण, संरचना, प्रतिक्रिया इत्यादि के आधार पर वारलैस सेंसर नेटवर्क–घुसपैठ जाँच प्रणाली का वर्गीकरण करता हैं। आगे हम लाभों और हानि के साथ प्रत्येक प्रणाली की विस्तृत तुलना और विश्लेषण करेगें। अंत में डब्लूएसएन–आईडीएस के लिए संभावित रूप से लागू सर्वोत्तम तरीके संक्षेप में वर्णित हैं। यह सर्वेक्षण इस क्षेत्र में कुछ मुक्त अनुसंधान मुद्दों पर है।

ABSTRACT

Wireless Sensor Networking is an upcoming technology which has diverse applications ranging from body sensors for medical applications to unmanned-vehicle to traffic control to critical military and defense. Inspite of the many fascinating features of Wireless Sensor Networks (WSNs) like minimal installation cost, monitor-free network operation etc., they are susceptible for security breaches especially due to lack of a physical line of defense. The information flows in the WSN are not controlled by any gateways or switches or hubs, as done in any wired networks. This minimizes their utilization choice for critical applications which demand confidentiality eg., military communications, corporate communications etc. However, when any type of intrusions is detected prior to the real harm caused by the attackers either to the WSN or to the sensor nodes or to the base station, the chance of WSN's utilization is enhanced. This article presents a survey of the state-of-the-art in Intrusion Detection Systems (IDSs) that are proposed for WSNs. An investigation of the IDS in WSN from various perspectives like presence/strength of attacker, how the data are processed, device capability, and protocol stack etc., is provided. Furthermore, the paper categorizes WSN-IDS based on type of analysis, structure, response type etc. A comprehensive analysis and comparison of each system along with their advantages and limitations is presented next. Best practices potentially applicable to WSN-IDS are summarized finally. The survey is concluded by emphasizing few open research issues in this field.

Keywords: Intrusion detection systems, wireless sensor networks, security threats

1. INTRODUCTION

The advancements in computer technology from wired to wireless have transformed the lifestyle of our day-to-day activities. Figure 1 shows the wide range of WSN applications. A survey by Microsoft tag showed that in 2012 there are more than 4 billion mobile phone users around who do not include laptops and desktops in use [1]. Therefore, providing security to this vast wireless network plays a key role as these networks are prone to many security attacks since it quite possible to access the internet from public areas like railway station, coffee shop etc. Among the various wireless networks, Wireless Sensor Network (WSN) [2] has developed immense interest among industrialists and researchers. These networks are mostly deployed where a wired network doesn't work i.e., in areas where

human accessibility is limited. WSN consists of a set of nodes called sensors that are spatially distributed and resource constrained; they sense significant data related to environment like temperature, pressure, etc., and transmit these information to a base station or sink node that serves either as a gateway to another network or as an access point for human interface. The inherent and appealing characteristics of WSN like low energy, less memory, less computational power, self-organizing nature, communication via multi-hop, dependent on other nodes and distributed operations using open wireless medium make it vulnerable to various security breaches. Unfortunately, these characteristics also suppress the possibility of implementing complex security mechanism in these networks. Therefore, a simple, energy-efficient resource constraint security mechanism is required for WSN for protecting from attackers.

WSN is susceptible to both inside and outside attackers. Therefore, the first level of security like encryption, authentication, access control, key exchange and firewall can provide security to some extent. Hence, a second level of security mechanism like Intrusion Detection System (IDS) is essential to protect the network from both inside and outside users. An intrusion is any anomalous activity in the network that harms or denies sensor nodes/base station. An IDS is a hardware or software which monitors and detects such anomalous activity.

1.1 Overview of Security Threats in WSN

WSN are vulnerable to various security threats due to their nature of communication and the place where they are deployed. Table 1 shows the various security attacks in WSN and their definition.

Different attacks are plausible at the layers. Some of them which are specific to each layer are discussed here. The main function of the physical layer is radio and signal management. Jamming is a kind of DoS attack in physical layer in which adversary disrupts the operation of WSN by broadcasting high energy signal. Exhaustion in data link layer is a type of attack in which attacker is continuously requesting or transmitting over the channel. Similarly, network layer is also prone to various kinds of attacks and one common attack is Hello Flood attack. In this attack, the adversary exploits the HELLO packets (which are used to broadcast nodes to their neighbors) to all

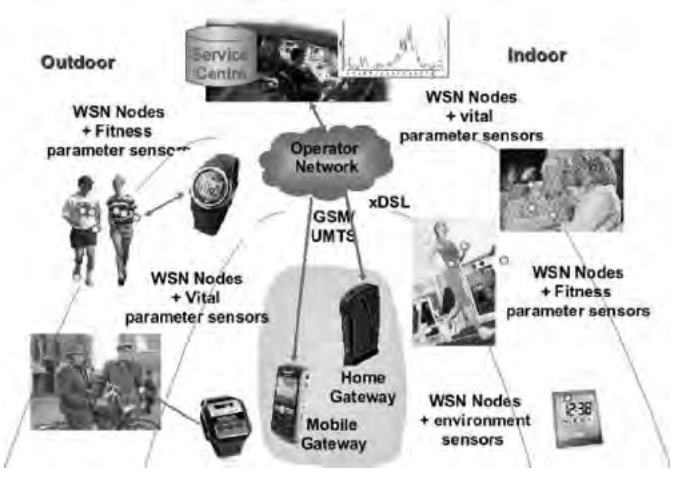

Figure 1. Example for WSN (Ref:http://esd.sci.univr.it/images/wsn-example.png).

Table 1. Taxonomy of attacks

Taxonomy of attacks	Attack types	Definition/Types
Based on the presence of attacker	Outsider Attack	Attack occurs from node outside of WSN network
	Insider Attack	Legitimate node in WSN is malicious
Based on how the data are processed	Passive Attack	Monitoring or eavesdropping packets transferred within WSN
	Active Attack	Creation, deletion or modification of data stream
Based on Device Capability	Mote Class Attack	Attacker has few sensor nodes compromised for attack
	Laptop Class Attack	Attacker has more energy, powerful processor and sensitive antenna for attack
Attack based on Protocol Stack	Physical Layer Attack	Jamming , Tampering and Radio interference
	Link Layer Attack	Exhaustion, Interrogation, Sybil attack, Collision and Unfairness
	Network Layer or Routing Attack	Sink hole, Hello flood, Traffic analysis, Node Capture, Misdirection and Selective forwarding/ Black holes/Neglect and greed, Sybil attack, Worm hole attack, Spoofed/ Altered/Replayed routing Information, Acknowledgement spoofing, Misdirection, Internet smurf attack, Homing
	Transport Layer Attack	Flooding and Desynchronization attacks
	Application Layer Attack	Overwhelm attack, Path based DoS attack and Deluge / Reprogram attack

sensor nodes in the network. The nodes receiving this kind of packets assume that the compromised node is in its radio range and it is its neighbor. This causes most of the nodes in the network sending packets to this compromised neighbor. Flooding attack in transport layer makes new connection continuously until the resources required by each connection gets drained. In overwhelm attack the intruder with the help of sensor stimuli overwhelms the nodes in the network causing the nodes to transmit large number of packets to base station. Thus WSN is prone to various attacks in each and every layer and therefore protecting sensor networks demands a higher level of defense mechanism like IDS to protect it from intelligent intruders. For more information readers may refer to[3].

2. FRAMEWORK FOR IDS IN WSN

An IDS monitors all activities in the network and detects any vulnerabilities caused by intruder in the network. There are three essential components in IDS for WSN

1. Traffic Monitoring: This component monitors the traffic patterns that are exchanged between the nodes in sensor network.
2. Analysis and Detection: This component analyses the traffic patterns and classify the pattern as normal and malicious.
3. Alert to system Administrator: This component alerts the system administrator if it finds any malicious patterns.

3. TAXONOMY OF WIRELESS SENSOR BASED INTRUSION DETECTION SYSTEM

IDS can be generally classified into two broad categories as active and passive. Active IDS also called as intrusion prevention system which not only monitors the attack activities but take corrective actions by blocking suspected attacks. Whereas passive IDS monitors and analyzes network traffic activities and alerts the system administrator if it finds any suspicious activity.

IDS works on the assumption that there is a significant difference between normal and anomalous traffic patterns. According to this assumption, IDS

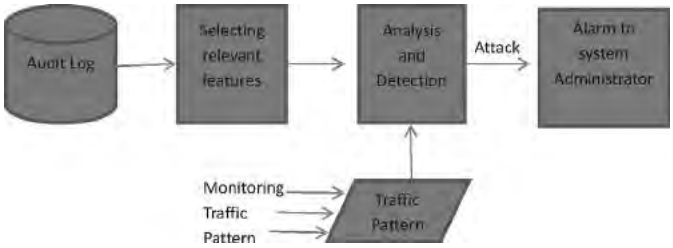

Figure 2. Outlines the general framework of WSN-IDS.

are classified into three types depending on how the traffic patterns are processed as (i) Anomaly, (ii) Rule-Based and (iii) Hybrid. Anomaly detection [4,5,6] techniques detect an intrusion when the observed activities in computer systems show a large deviation from the normal profile created on long-term normal activities. is that it can detect unseen attacks. Misuse IDS also known as signature recognition techniques store patterns of anomalous signatures and relate those patterns with the observed activities for a match to detect an intrusion. Rules are formed based on previous different patterns of attacks and the normal profile. Any incoming new pattern is matched against this rule set and treated accordingly. If it doesn't match these rules, then to play safely, such traffic is considered as anomaly. The drawback with this approach is that it cannot detect novel attacks and it can detect only the attack patterns that are stored in the rule-base. False positive, i.e., identifying a slight normalcy variant as an anomalous one, is high in this type of IDS. Hybrid IDS is the ensemble of anomaly and rule-based and it combines the strengths of the two. It has capability of detecting known and unknown attacks. Also some defines hybrid IDS as the intrusion detection system which detects and prevents attack. The limiting factor is high computational overhead.

Based on the structure and how the data records are processed WSN IDS can be classified into centralized and distributed. In centralized IDS data are processed in a centralized location (eg. base station) whereas in distributed IDS data are distributed across the network and are processed by multiple nodes.

A malicious traffic pattern is suspected when it enters the sensor region and is detected by a single sensor or multiple sensors. If detected by a single sensor it is called single sensing intrusion detection and if multiple sensors are involved the detection mechanism is called as multiple sensing detection mechanism.

Based on how the detection system monitors the intrusive activities they are classified as continuous or periodic. The continuous IDS has real time continuous monitoring capabilities whereas periodic IDS monitors in a predefined time interval.

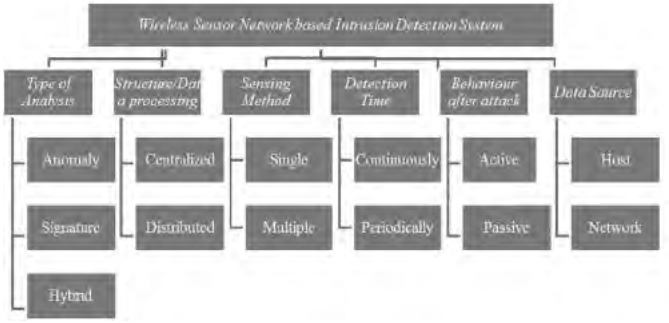

Figure 3. Taxonomy on classification of IDS in WSN.

Also, based on the location of data source, IDS is classified as host based and network based IDSs. The host based IDS uses log files of single host for processing whereas in network based IDS uses network traffic patterns for processing and analysis.

Table 2 lists the survey of various intrusion detection schemes in WSN based on various perspectives. Among the various classification perspectives the most common type of classification is '*type of analysis*'.

The following section explains some major works that fall under these categories.

3.1 Anomaly Detection Techniques in WSN

There are many research works in anomaly intrusion detection system in wireless sensor networks. Most researchers prefer anomaly than misuse and hybrid IDS due to the resource constraints such as poor memory, weak computational capability in WSN. Misuse IDS requires more memory to store the predefined rules whereas the computational overhead is high in hybrid IDS.

Clustering is one of the data mining approaches used for IDS. Clustering is the process of selecting groups of similar objects, such that each group of objects is well separated by a distance. Sutharshan Rajasegarar, *et al.*, proposed a clustering based anomaly detection technique[7] in which clusters are formed based on the fixed-width clustering. Each data vector is the Euclidean distance between the centroid of the current clusters and this dissimilarity measure is computed to add or form a new cluster. The approach followed is distributed and therefore each sensor node executes the clustering operation on its own local data. It then sends the sufficient statistics to its immediate parent and the parent node combines the clusters from its immediate children. It again then forms a combined set of clusters and sends the sufficient statistics of the merged clusters to its immediate parent. This process proceeds continuously up to the gateway node. At gateway anomalous cluster is detected using average inter-cluster distance of the K nearest neighbor (KNN) clusters. Inter cluster distance is computed using Euclidean distance measure between centroids of the number of clusters in the cluster set. Between the set of inter-cluster distances the shortest K distances are chosen and using those, the average inter-cluster distance is computed. A cluster is identified as anomalous if its average inter-cluster distance is greater than one standard deviation of the inter-cluster distance from the mean inter-cluster distance.

Evaluation: Simulation based on the sensor data gathered from the Great Duck Island project.

Advantage: The sensor node should be in active mode for longer time duration than in sleep mode if large volume of raw data is transmitted over the network. The sensor nodes send only the merged clusters rather than raw data and therefore this reduces the communication overhead which in turn improves the life time of WSN.

Disadvantage: In the centralised case, the gateway node has complete information about the data in the network, whereas in the distributed case, the gateway node only has the merged cluster information of the nodes. Therefore, there is a slight reduction in the detection accuracy in the distributed case compared to the centralised case.

Outcome: Proved that distributed approach achieves comparable performance with the centralized case, while achieving a significant reduction in communication overhead.

Heshan Kumarage[8], *et al.*, proposed anomaly detection mechanism that aims to detect anomalies using distributed in-network processing in a hierarchical framework. Unsupervised data partitioning is performed distributively adapting fuzzy c-means clustering in an incremental model. Non-parametric and non-probabilistic anomaly detection is performed through fuzzy membership evaluations and thresholds on observed inter-cluster distances. Robust thresholds are determined adaptively using second order statistical knowledge at each evaluation stage.

Evaluation: Two types of dynamic heterogeneous data set called Intel sensor data set and ISSNIP data set.

Advantage: Load balancing is achieved here by distributing the clustering process between all the nodes. If not, there will be greater communication overhead in the nodes that are in close proximity to the gateway node, which in turn reduces the life time of the network.

Disadvantage: Slight reduction in accuracy when compared to centralized approach.

Outcome: Results show that the their framework achieves high detection accuracy compared to existing data clustering approaches with more than 96% less communication overheads opposed to a centralized approach.

Loo[9], *et al.*, proposed an anomaly detection technique which uses fixed-width clustering. This algorithm constructs a set of clusters, such that each cluster has a fixed radius in the problem space. In the training phase of the fixed-width clustering technique, a threshold value is chosen as the maximum radius of a cluster. The first data point in the dataset forms the centroid of a new cluster. If the distance of each successive point to its closest cluster is less than threshold value, then the point is assigned to the cluster, and the centroid of the cluster is recalculated. Otherwise, the new data point forms the centroid of a new cluster. At the end of training phase, the clusters that contain less

Table 2. Comparison of various IDS in WSN based on classification perspectives

	Technique	Author	Year	Analysis Type			Structure / Data Processing and Collection		Sensing Method		Detection Time		Behavior after attack		Data Source	
				A	S	H	Centralized	Distributed	Single	Multiple	Continuous	Periodic	Active	Passive	Host	N/W
1	Key Mgt Protocol [21]	David et. al	2000	Cryptographic approach: Key Mgt for Confidentiality and Group level Authentication												
2	SPINS [22]	Perrig et.al	2001	Cryptographic approach: Authentication, Confidentiality and Authenticated Broadcast												
3	Protocol behavior of TCP [23]	Haining et. al	2002	√			√ Leaf Router		√		√ SYNKill		√			√
4	Deviation Detection [24]	Palpanas et al	2003	√				√		√	√			√	Stream data by a sensor	
5	Directional Antennas [25]	Hu et al	2004	Protocol based				√		√	√		√		Direction info based on received signal	
6	Malicious node detection by signal strength [26]	PiresWaldir Ribeiro et al	2004				√			√		√	√			
7	Decentralized IDS [27]	Silva et al	2005				√			√	√			√		
8	Prevention and Detection in Clustering based [28]	Su et al	2005					√	√ Cluster Head			√	√		√	
9	Distributed anomaly [29]	Rajasegarar et al	2006	√						√		√		√		
10	Intrusion Detection for Routing attacks [9]	Loo et al	2006	√					√		√		√(Simulation)			
11	Distributed Intrusion Detection [14]	Ioannis et al	2007				√			√		√	√(Simulation)		√	
12	SVM Intrusion Detection [12]	Sophia et al	2007	√					√		√			√(simulation)		
13	Machine Learning based IDS [31]	Yu et al	2008				√		√		√		√ (Simulation)		√	
14	Cooperative IDS [15]	I. Krontiris et al	2009	√						√		√		√ (In real situation)		
15	Light Weight Intrusion Detection [17]	Hai et al	2010					√		√		√		√	√	
16	Hyperellipsoidal clustering algorithm [29]	Moshtaghi et al	2011	√						√		√	√			
17	Cross layer intrusion detection [11i]	Djallel et al	2012	√						√	√			√		
18	Dissimilarity of sensor observation [32]	Rasam et al	2013	√						√		√	√ (Simulation)			

than a threshold value of the total set of points are labeled as anomalous. Remaining clusters are labeled as normal. The testing phase operates by calculating the distance between a new point and each cluster centroid. If the distance from the test point to the centroid of its nearest cluster is less than threshold, then the new point is given the label of the nearest cluster, i.e., normal or anomalous. If the distance from new point to the nearest cluster is greater than threshold, then newpoint lies in a sparse region of the feature space, and is labeled as anomalous.

Evaluation: Simulation is based on a sensor network simulation library from the Naval Research Laboratory. Four types of simulation scenarios were implemented which includes normal traffic, periodic route error attacks, active sinkhole attacks, and passive sinkhole attacks.

Advantage: This approach requires no communication between sensor node, which is a significant factor required in power-constrained sensor networks in minimizing the energy. Also, a general set of features that can be used to characterize the routing behaviour in a network for intrusion detection, and are potentially applicable to a wide range of routing protocols has been identified.

Disadvantage: This approach has the capability to identify only three different types of attack. Also, it uses AODV (Ad hoc On-Demand Distance Vector) protocol which not more suitable for WSN.

Outcome: Periodic route error attack, achieved a 95% detection rate for a 5% false positive rate For passive sinkhole attack, the detection rate was 70% for a 5% false positive rate. For active sinkhole attack, detection rate was 100% and false positive rate was 5%.

Bhuse and Gupta[10] used the DSDV and DSR protocols instead of AODV protocol used by Loo, *et al*.. Intrusion detection uses specific characteristics of these protocols like number of route requests received, number of route requests sent, number of data requests received etc. However, to our familiarity, these routing protocols are not attractive for sensor networks.

Djallel[11], *et al*. proposed an intrusion detection system based on a cross layer architecture that exploits communication and collaboration of three adjacent layers -- network, MAC and physical layers. The basic idea of this approach is to detect malicious users when they attempt to communicate with the network nodes. After receiving Request To Send (RTS) packets of the intruder's node by the targeted node, their detection system checks if it is one of the neighbors in the routing path (by consulting the routing table at the network layer). In addition the authenticity of the intruder node will be checked by measuring the Received Signal Strength Indicator (RSSI) of the received packet (at the physical layer). By using the routing information at the MAC layer, each sensor node can previously know the source of packets that will be received. Thus, any node trying to communicate (receive RTS or Clear To Send (CTS) packets) with the sensor nodes is immediately detected as an intruder if it is not included in the routing path. A hierarchical cluster-based network topology is proposed. This topology divides the network into several clusters, and selects a cluster head (CH) node which has the greatest energy reserves in the cluster. The base station is responsible of the formation of clusters, the election of CHs and the establishment of chains of node based on routing information (identifier, geographical position and energy reserve) sent by all nodes in the network. All the network nodes will transmit collected data to their CH through the chain of neighboring nodes. Then CHs take the responsibility of transmitting received data directly to the base station (BS), or indirectly through the neighboring CHs.

Evaluation: IDS performance analysis is carried out using the network simulator NS2 with a model built on 100 nodes distributed randomly on a square surface of 100×100 m^2

Advantage: The implementation of detection system for each layer can greatly increase the load (processing power, energy consumption etc.) on sensor nodes. Therefore, in their approach instead of proposing IDS for each layer, a single intrusion detection system is constructed that can detect different types of attacks across several layers of the OSI model.

Disadvantage: Could not detect all types of security attacks. Outcome: Prevents major attacks that affect data routing in network layer.

SVM has been used by many researchers for classification of network traffic patterns in wired networks. The drawback with SVM is its long training time and complexity overhead. There are only very few research works in applying SVM for intrusion detection in WSN.

Sophia Kaplantzis, *et al.*, proposed a centralized intrusion detection scheme based on Support Vector Machines (SVMs) and sliding windows[12]. They focused on adapting a classification based IDS to detect a malicious DoS attacks, namely the Selective Forwarding Attack, that may be launched against a WSN. This IDS used routing information local to the base station of the network and raises alarms based on the 2D feature vector (bandwidth, hop count). Classification of the data patterns is performed using a one-class SVM classifier. By centralized, here it means that the intrusion detection task (feature selection, data processing, anomaly detection) is carried out entirely by the base station, without further loading the sensor

nodes or unreasonably reducing the lifetime of the network.

Evaluation: A field size of 100 x 100 m^2, where 50 nodes have been deployed randomly. There is a single base station located on the far left end of the network. Each node has maximum signal strength of 30m. The detection range of each sensor is 10m. Sensors are activated in 1 sec intervals. The simulated packet size is 26 bytes. All network simulations were carried out using OMNeT++

Advantage: The proposed IDS is placed at the base station and therefore the nodes do not need to spend energy or memory collecting and communicating features amongst themselves.

Disadvantage: This approach handles only selective forwarding attack and black hole attack and has low detection rate for selective forwarding attack. Secondly, the base station cannot manage when large numbers of packets are sent by the nodes which subsequently cannot be evaluated by the SVM.

Outcome: This SVM based IDS detects black hole attacks with 100% accuracy and selective forwarding attacks.

3.2 Misuse Detection Techniques in WSN

Misuse detection also called as signature based detection technique analyzes the traffic profile it gathers and compares it to large databases of attack signatures. Misuse detection techniques are good in detecting insider attacks and known attacks.

Misuse detection technique also called as rule based approach employs the concept of watchdog [13] in which traffic monitoring take place at several specific nodes in the network. The approach uses the broadcast nature of wireless network. The packets forwarded by the sender are not only received by the receiver but also by other nodes which are placed in the radio range of sender. Normally, the neighbor nodes ignore the received packet but in case of IDS this can be used as a valuable audit data. Therefore, a node can activate its IDS agent and monitor its neighbor node packets by overhearing them. In the figure 5, Node X transmit packet to Node Y. Node A, B and C act as watchdog for X and Y since they are in the radio range of X and Y. The limitation of this watchdog mechanism is that it does not provide good result if the anomalous node is present in multi hop distance in the network. In addition, all nodes are involved in monitoring their neighbors and passing information about their behavior which increases the communication overhead. Therefore, many researchers have proposed extended watchdog approach to overcome these limitations. Ioannis Krontiris [14], *et al.,* proposed a misuse IDS based on watchdog which uses predefined set of rules. Rules are formed to detect selective forwarding attack and black hole attack. One such rule is "If more than 50% of neighbor node generates alert then the corresponding node is malicious". This alert message is sent to base station to take further action. Another rule is each watchdog node increments the counter if packet is dropped and generates alert if threshold is reached.

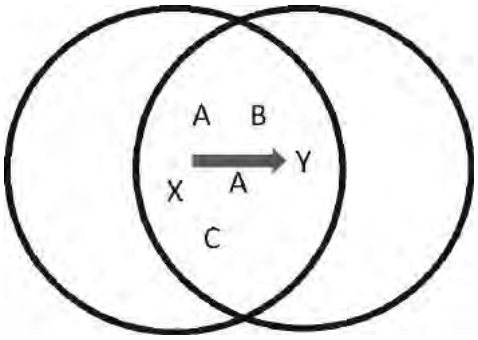

Figure 5. Illustration for watchdog approach.

Evaluation: Simulated a sensor network of 1000 nodes distributed randomly in uniform order with 8 neighbors for each node.

Advantage: Better accuracy

Disadvantage: Communication overhead and no clear details about experimental settings and results (e.g. Which simulator used?).

Outcome: This rule based IDS detect black hole attacks and selective forwarding attacks with very low false positive and false negative rates.

Ioannis Krontiris, *et al.,*[15] extended the above work by developing a generic algorithm and implemented in real time environment. Soumya Banerjee, *et al.,* proposed an ant colony based misuse intrusion detection mechanism to keep track of the intruder trials [16]. Rules are formed for possible types of attacks based on the advice from network administrator. One such rule is "If a network connection, where all the micro sensors are deployed, with source IP address 1.0.0.1 – 255.0.0.0, destination IP address 2.**.?.?, source port number 75, destination port 80, duration time 30 seconds ends with the state 11 (the connection terminated by the originators) uses protocol type 2 (TCP) and the originator sends 43.2 MB/Sec data the responder sends 36.5 MB /sec data, then this is a suspicious behavior and can be identified as probable intrusion." Their

Figure 4. Flow diagram for misuse detection in WSN.

work is based the use of multi ant agents driven by parallel search to deploy pheromone value on each node. At a given iteration each ant travels from the current node of sensor network to neighboring node and changes the color of each visited node according to a local norm. They introduced the concept of tabu list, where for each session the list stores the pheromone trace or path that is prone to attack. If there is any imbalance in the pheromone values, an alert is raised and system administrator is informed.

Evaluation: No clear details about how they are simulated:

Advantage: Self organizing nature.

Disadvantage: The sender node broadcasts packets to all nodes through all possible paths which result in congestion and high energy consumption. In addition, the proposed algorithm requires more memory to store the pheromone trace or path.

Outcome: No clear results

3.3 Hybrid Detection Techniques in WSN

Hybrid detection techniques are fusion of anomaly detection and misuse detection in order to combine the advantages of these two techniques. The hybridization of these learning and adaptation techniques overcome the limitations of individual intrusion detection techniques and achieves synergetic effects for intrusion detection. There are some existing works on hybrid intrusion detection systems for WSN such as [17], [18] and [19]. In Hai[17], *et al.*, proposed a cluster based and hybrid approach for intrusion detection in WSN. In their work, IDS agents are placed in every node. There are two types of agents - local IDS agent and global IDS agent. Due to the resource constraint characteristics of WSN, global agents are active only at a subset of nodes. The global IDS agent monitors the communication of its neighbors by means of predefined rules with two-hop neighbor knowledge. It then sends alarm to cluster head (CH) if they detect any malicious nodes. Each node has an internal database, which contains a list of known signatures, attack patterns, which are computed and generated in the CH. They attempt to minimize the number of nodes where the global agents are positioned by evaluating their trustworthy based on trust priority. In order to reduce the collisions and usage of resources, they proposed an over-hearing mechanism that reduces the sending message alerts.

Evaluation: A field size of 100×100 m^2, where 200 nodes have been deployed randomly. All network simulations were carried out using Castalia, a WSN simulator in OMNeT++

Advantage: High detection rate even under burst of attacks.

Disadvantage: False positive rate is high when rule based-approach of intrusion detection is used. Secondly, it requires manual rule updating by experts and specialists in the area of wireless security.

Outcome: When the rate of collision and the number of anomalous node is not very high the proposed approach can detect the routing attacks such as selective forwarding, sinkhole, hello flood and wormhole attacks with a better energy saving.

Yan[18], *et al.*, proposed a clustering approach in WSN and embedded hybrid IDS in CH. This developed model has three modules: misuse detection module, anomaly detection module and decision making module. In the misuse detection module, rules formed are used to analyze incoming packets and categorize the packet as normal or anomalous. For building anomaly detection model, the supervised learning algorithm Back Propagation Network (BPN) is adopted. The abnormal packets, which are detected by misuse detection model is used as input vectors of BPN. Initially, the network is trained with training dataset containing four types of attacks and normal patterns, when the process of training is over; the model is integrated with the misuse detection module in order to classify the new data. Finally, the output of both anomaly detection and misuse detection models is used as an input for the decision making module. The decision making module reports the results to the base station if there is any intrusion.

Evaluation: KDD dataset with 24 features and 4 types of attack patterns and one normal pattern are used.

Advantage: Accuracy is increased.

Disadvantage: The major drawback of the proposed scheme is that IDS monitor runs in a fixed cluster heads. Therefore it's an attractive node for the intruder that uses all its capacity to attack this node. Another drawback is the number of features which is very important (twenty four features are used). Thus the cluster head consumes much more energy, which minimizes the life time of the node.

Outcome: The simulation results show a higher rate of detection and a lower false positive rate.

Hichem Sedjelmaci [19], *et al.*, proposed an intrusion framework that uses a combination between the anomaly detection based on support vector machine (SVM) and the misuse detection. The anomaly detection uses a distributed learning algorithm for the training of a SVM to solve the two-class problem (distinguish between normal and anomalous activities). In addition, the author used a hierarchical topology that divide the sensor network into clusters, each one having a cluster head (CH). The objective of this framework is to save the energy that allows the network life time prolongation. Each node has the possibility to activate its IDS. Minimization of number of nodes to run intrusion detection is required since it reduces energy. The average number of IDS nodes (N) for

each individual link is expressed by the following equation $N=1.6r^2d$ where d is network density and r is the communication range. Each IDS monitors the neighbor nodes with no trust between each pair of agents. Sensor nodes are stationary and cluster head has more energy compared to the other ones. Training model with less feature and high accuracy is chosen and embedded into hybrid intrusion detection module in order to obtain a lightweight and accurate detection system.

Evaluation: KDD Cup '99 dataset with selected features.

Advantage: Achieves high detection rate with low false positive rate.

Disadvantage: Communication in WSN consumes high energy. Training time is long and therefore it requires high computational power.

Outcome: Accuracy rate over 98%.

The analysis and comparison of various wireless sensor based IDS based on its characteristics are given in Table 3.

Table 3. Comparison of various IDS in WSN based on its characteristics

S. No.	Technique	Author/Year	Attacks detected	Detection accuracy	Energy consumption	Computational speed	Memory consumption	Comm. bandwidth/ overhead
1	Key Mgt Protocol [21]	David, et al., 2000	Secret Key based Protocol		Low	High	Medium	High
2	SPINS [22]	Perrig, et al., 2001	Authenticated comm.unication		Low	Medium	High	Low
3	Protocol behavior of TCP [23]	Haining, et al., 2002	SYN Flooding	High	Low	Low	Low	Medium
4	Deviation Detection [24]	Palpanas, et al., 2003	Outlier detection	NA	Low	Low	Low	Low
5	Directional Antennas [25]	Hu, et al., 2004	Worm Hole	NA	Low	Low	Low	High
6	Malicious node detection by signal strength [26]	Pires Waldir Ribeiro, et al., 2004	HELLO flood and Worm Hole	Near 90%	High	High	Low	High
7	Decentralized IDS [27]	Silva, et al., 2005	Message delay, Repetition, Worm Hole, Jamming Data alteration Msg negligence, Black Hole and Selective Forwarding	Greater than 80%	Medium	Medium	Medium	Low
8	Prevention and Detection in Clustering based [28]	Su, et al., 2005	Packet –Dropping Duplicating and Jamming	High	High	Medium	Medium	High
9	Distributed anomaly [29]	Rajasegarar, et al., 2006	Normal/ anornal	Slightly low compared to centralized	Medium	O(mNc) m-no. of measurements during a time window	O(Nc) Nc-No. of clusters	Low
10	Intrusion Detection for Routing attacks [9]	Loo et al 2006	Periodic Route Error, Active and Passive Sink Hole Error	95% 70% 100% respectively	High	Low	High	High
11	Distributed Intrusion Detection [14]	Ioannis, et al., 2007	Black Hole and Selective Forwarding Attack	Lower false +ve and false –ve rate (>5% false alarm rate)	Low	O(n) n-No. of nodes in the monitoring area	O(nw) w- width of sliding window	Low
12	SVM Intrusion Detection [12]	Sophia, et al., 2007	Black Hole and Selective Forwarding Attack	100% and 85% respectively	High	Low	0(n) n-no. of data records	High

13	Machine Learning based IDS [31]	Yu, et al., 2008	Not limited to particular attacks	Medium	Medium	High	Medium	Medium
14	Cooperative IDS [15]	I. Krontiris, et al., 2009	Random Attacker	Medium	Medium	Publish Key phase takes more time	depends on the maximal number of node's neighbors which is configurable	High
15	Light Weight Intrusion Detection [17]	Hai, et al., 2010	Worm Hole, Sink Hole, Selective Forwarding, Hello floods	High	Medium	Medium	Medium	Medium
16	Hyperellipsoidal clustering algorithm [29]	Moshtaghi, et al., 2011	Clusters of normal and anomaly patterns	High	Medium	Computational Cost O(N) where N- No. of data points		Medium
17	Cross layer intrusion detection [11]	Djallel, et al., 2012	Link Layer and Network Layer Attack	Depends on No.of attacked nodes and probability of missed detection	2 J(Energy of a node)	Low	High	20kpbs
18	Dissimilarity of sensor observation [32]	Rasam, et al., 2013	Normal/Abnormal	96%	Medium	CC-O(N) N-No. of Observed variable	O(c .d .p) c-Observations, d- no. of variables, p-fitting parameter	O(K) K-No. of nodes in each cluster

From the above-tabulated data based on the characteristics of WSN the following conclusions are obtained. In sensor networks, detection systems should be powerful in addressing a wider range of security breaches with a comparable cost; therefore, detection generality should be added to the new performance metrics. Second, energy cost must be taken into account.

- Most of the IDS techniques detect specific or very few types of attack [9][12][14][23] [25][26][27]. Therefore developing a new IDS for each and every attack is not possible and is resource consuming. So in future generic IDS has to be developed in order to detect and prevent all types of attack in sensor networks.
- Machine learning or soft computing [12][31] based IDS produces better results in terms of detection capability but the computational complexity and the memory requirement are high in these kinds of techniques.
- Normally, distributed IDS in WSN are implemented using the hierarchical structure and is mostly a choice for sensor networks. Since centralized IDS involves high communication overhead in communicating the data records for detecting the intruders to the centralized point like base station. Therefore most of the energy is utilized in transmission rather than computation which makes distributed approach preferable compared to centralized approach.
- When compared to anomaly based schemes, misuse or signature based detection schemes use less memory and high detection speed. Also the computational complexity of signature based detection schemes is less when compared to anomaly in most cases. However the detection rate is low when compared to anomaly in detecting new types of attacks.
- Machine learning approaches like SVM [30], NN [18] [19] are computationally complex and therefore consumes more sensors energy. Also, automatically tuning dynamic intrusion detection systems involves more computational cost resulting in drainage of energy.
- Also, some approaches like computational intelligence techniques use more number of attributes in detecting intrusions, which involve high computational complexity and reduced speed. So attribute reduction is required to choose optimal features and to increase the speed of detection. Energy consumption by sensor nodes will also be high if more features are involved.

4. COMPARISON AND DISCUSSIONS

The major problem of security in sensor networks lies in the balance between minimizing resource consumption and maximizing security. The resource in this perspective comprises energy as well as computational resource like CPU, memory, and network bandwidth. Therefore, any security mechanisms for sensor networks should consider the following five major resource constraints: (1) limited energy, (2) limited memory, (3) limited computing power, (4) limited communication bandwidth, (5) limited communication range [20]. Intrusion detection systems are classified into anomaly, misuse and hybrid based on the detection mechanism. These types of intrusion detection system can be centralized or distributed based on the control strategy. The distributed IDS can be fully distributed or partially distributed. Control Strategy defines how the elements of an IDS is controlled, and moreover, how the input and output of the IDS are managed. In centralized IDS, monitoring and detection of traffic pattern is controlled directly from the base station/ gateway node. In partially distributed IDS, monitoring and detection of attack patterns is controlled from a local sensor node, with hierarchical reporting to one or more cluster head. In fully distributed, monitoring and detection of traffic patterns is done using an agent-based approach, where response decisions are made at the point of analysis. Centralized IDS in WSN allow for easy expansion of network. The drawback here is that there is a single point of failure if compromised. If the centralized analyzer flops, the entire network is now without the protection of wireless IDS. In distributed IDS, each IDS sensor agent keeps in touch with the other sensors to transfer information and alerts in order to function as a comprehensible structure. The advantage here is that the system does not face any single point failure. The drawbacks include 1. Expansion of network results in redesigning all sensors 2. Overall cost increases etc. Centralized SVM training method allows an improved separation of the classes with the error rate negligible. However, there is high communication overhead, and it is not appropriate for resource-constrained WSN. Therefore many researchers suggest that the distributed SVM training is appropriate for the constraint of sensor nodes in terms of energy, computation, memory and provide nearer classification as centralized approach. Also, from the papers discussed above in the earlier sections we came across some limitations which can be considered as open-research issues that could be addressed while developing better IDS for WSN.

1. Developing a real time IDs for WSN and investigating its applicability in fading atmospheres and also with networks of moving sensors with different radio ranges.
2. Developing generic IDS, which detects almost all attack types.
3. Developing lightweight IDS using soft computing approaches as these techniques utilize more resources. Also these machine learning approaches have been successfully applied in many fields including wired IDS and adhoc IDS and therefore applying these techniques improve the detection capability.
4. Developing computationally intelligent optimization technique for placing IDS agents in sensor nodes.
5. To our knowledge, there is no labeled dataset specifically for WSN IDS. Collecting and designing such dataset would be useful for the research community.

5. CONCLUSION

This survey paper introduces IDSs for WSN along with their design specifications, requirements and classifications based on various strategies. Further, different types of attacks happening in a WSN and respective plausible detection mechanism adapted is also mentioned. Also, significant IDSs adapted for WSNs are discussed and their salient features are highlighted in a comparable chart, followed by the critics about IDSs that would be suitable to WSNs are provided. Finally, as a measure to help out the researchers over the selection of appropriate IDS for WSNs, a few unhandled research issues are pointed out along with future scope for this research.

निष्कर्ष

यह सर्वेक्षण आलेख वायरलैस सेंसर नेटवर्क के आईडीएस के साथ उनके डिजाइन विनिर्देशों, आवश्यकताओं और विभिन्न रणनीतियों पर आधारित वर्गीकरण का परिचय देता हैं। इसके अलावा वायरलैस सेंसर नेटवर्क में विभिन्न प्रकार के हमलें और इसके लिए अपनाई गई विश्वसनीय खोज प्रक्रिया का उल्लेख हैं वायरलैस सेंसर नेटवर्क के लिए अपनाई गई घुसपैठ जाँच प्रणाली और तुलनात्मक चार्ट में मुख्य गुण प्रकाशित किये गये हैं। उसके बाद आईडीएस जो कि वायरलैस सेंसर नेटवर्क के लिए अनुकूल है उनकी आलोचना प्रस्तुत की गई हैं। अंत में, उचित आईडीएस का चयन में शोधकर्ताओं की मदद के लिए, कुछ अप्रबंधित अनुसंधान मुद्दों के साथ–साथ इस अनुसंधान के भविष्य की संभावना को दर्शाया गया हैं।

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मोबाइल ऐडहोक नेटवर्क के लिए एक नोवल ट्रस्ट आधारित रूटिंग एल्गोरिथम
A Novel Trust based Routing Algorithm for Mobile Ad-hoc Networks

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सार

इस आलेख में मोबाइल ऐडहोक नेटवर्क के लिए रूटिंग तकनीक को प्रस्तावित किया गया हैं सुरक्षा पर आधार पर रूटिंग रास्ते में होने वाले नोड़ का चयन होगा। नोड का विश्वसनीय मूल्य की गणना नेबर नोड की संख्या, नोड का पूर्व विश्वसनीय मूल्य, नोड द्वारा अग्रेषित और उत्पन्न किए गए पैकेट और नोड द्वारा अग्रेषण में होने वाली देरी पर निर्भर करेगा। सिमुलेशन के माध्यम से प्रदर्षन मूल्यांकन से पता चलता हैं कि प्रस्तावित ट्रस्ट आधारित एल्गोरिथम मौजूदा योजनाओं से दुर्भावनापूर्ण नोड्स की पहचान करने और नेटवर्क के थ्रोपुट बढ़ाने के संदर्भ में उत्तम कार्यक्षमता प्रदान करती हैं। इसके अलावा सिमुलेशन विभिन्न वातावर्णीय परिस्थिति जैसे दुर्भावनापूर्ण नोड्स की संख्या और और नोड गतिशीलता को ध्यान में रखकर किया जाता हैं।

ABSTRACT

In this paper a routing technique is proposed for Mobile Ad-hoc Networks (MANETs) and the nodes in the routing path are selected based on security. The trust value of the nodes are calculated using the number of neighbourhood nodes, previous trust value of nodes, forwarded and generated packets sent by nodes and forwarding delay of nodes. The performance evaluation via simulation reveals that the proposed trust-based routing achieves better performance than the existing schemes in terms of identifying the malicious nodes and increasing the throughput of the network. Also the simulation is done over a range of environmental conditions such as number of malicious nodes and node mobility.

Keywords: MANETs, malicious nodes, routing, security

1. INTRODUCTION

Mobile Ad-hoc Networks (MANET) are a collection of mobile nodes which communicate with each other via multi-hop wireless links. Each node in MANETS acts as host and router at the same time. Due to openness of MANETS, nodes moving in any direction can join or leave the network at any time and can be publicly accessed without restriction. Mobile nodes are characterized with less memory, power and light weight features. The reliability, efficiency, stability and capacity of wireless links are often inferior when compared with wired links. This shows the fluctuating link bandwidth of wireless links and spontaneous behaviour which demands minimum human intervention to configure the network. All nodes have identical features with similar responsibilities and capabilities. Hence, it forms a completely symmetric environment. Another important challenge is high user density and large level of user mobility and nodal connectivity is intermittent.

MANETs routing protocols are classified into two major categories, like table-driven (Proactive) and on demand (Reactive). AODV (Ad hoc on demand Distance vector) offers low network utilization and uses destination sequence number to ensure loop freedom. The DSDV (Destination Sequence Distance Vector) protocol requires each mobile station to advertise to each of its current neighbours, its own routing table. At all instances, the DSDV protocol guarantees loop-free paths to each destination. DSR (Destination Sequence Distance Vector) computes the routes when necessary and then maintains them. DSR uses no periodic routing messages like AODV, thereby reduces network bandwidth overhead, conserves battery power and avoids large routing updates. MANETS is the suitable network for such type of application areas. All the existing MANETS protocols simply trust their neighbours and make a route through the neighbours. This kind of neighbour based routing is disturbed by intruders and internal attackers or malicious nodes. Threat to the nodes may be due to malicious nodes that generally harm the network with the manipulation

of routing. Many routing protocols that have already been proposed are unable to identify such behaviour. There are several existing problems in Ad hoc network, but there are fewer solutions. Generally, the existing systems provide either authentication level of security or a monitoring system[1]. But these do not meet the challenges and security threats of MANETS. Various mathematical models have been used for calculating trust value. Based on the level of trust value the nodes will communicate with its one hop neighbours. In this proposed model, trust plays a major role in providing security which is being evaluated from Trust Based Routing (TBR) Algorithm. The idea of estimating trust rate among neighbours in a MANETS is probably a fast and effective way. But when the number of constraints increases, robust and accurate techniques are necessary, as it might affect the accuracy of the result. And hence a trust based computation model is proposed. The chapter discuss about the background details of the proposed system.

2. BACKGROUND INFORMATION

In the ad hoc networks, routing protocol should be robust against topology update and any kinds of attacks. Unlike fixed networks, routing information in an ad hoc network could become a target for adversaries to bring down the network. The need for mobility in wireless networks necessitated the formation of the MANETS working group for developing consistent IP routing protocols for both static and dynamic topologies. The different types of routing protocols explore several deterministic and random process models. Simply, a trust evaluation based method is needed along with these protocols.

2.1 AODV (Ad-hoc on Demand Distance Vector)

It is a reactive protocol implying that it requests a route when needed. It does not maintain routes for those nodes that do not actively participate in a communication. An important feature of AODV is that it uses a destination sequence number, which corresponds to a destination node that was requested by a routing sender node. The destination itself provides the number along with the route it has to take to reach from the sender node up to the destination. In this method security is a major constraint since the intruders can easily attack the nodes. Sometimes, malicious node can also involve in communication. Trust based secure routing AODV has been proposed but with a modified AODV with the trust value and leads to insecure and greater time complexity.

2.2 DSDV (Destination Sequence Distance Vector)

It is a proactive routing protocol and is based on the distance vector algorithm. In proactive or table--driven routing protocols, each node continuously maintains up-to-date routes to every other node in the network. Routing information is periodically transmitted throughout the network in order to maintain routing table consistency. In case of failure of a route to the next node, the node immediately updates the sequence number and broadcasts the information to its neighbours. The packet delivery ratio of this protocol compared to the other routing protocol is a low fraction value which shows the performance of the MANETs. When a node receives routing information then it checks in its routing table. In case, if the node finds that it has already entry into its routing table then it compares the sequence number of the received information with the routing table entry and updates the information. In DSDV, malicious node arbitrarily tampers the update messages to disrupt the routing algorithm. Thus, trust in the routing protocols is necessary in order to defend against hostile attacks.

2.3 DSR (Dynamic Source Routing)

DSR is a reactive protocol. This protocol is one of the example of an on-demand routing protocol that is based on the concept of source routing. It is designed for use in multi hop ad hoc networks of mobile nodes. It allows the network to be completely self-organizing and self-configuring and does not need any existing network infrastructure. The DSR routing protocol discovers routes and maintains information regarding the routes from one node to other by using two main mechanisms: (i) Route discovery – Finds the route between a source and destination and (ii) Route maintenance –In case of route failure, it invokes another route to the destination.

3. PREVIOUS WORK

Wang et. al.[2] present a secure destination-sequenced distance-vector routing protocol (SDSDV) for ad hoc mobile wireless networks. The proposed protocol is based on the regular DSDV protocol. Within SDSDV, each node maintains two one-way hash chains about each node in the network. Two additional fields, which is AL (alteration) field and AC (accumulation) field, are added to each entry of the update packets to carry the hash values. With proper use of the elements of the hash chains, the sequence number and the metric values on a route can be protected from being arbitrarily tampered. In comparison with the Secure Efficient Distance vector (SEAD) protocol previously proposed in the literature provides only lower bound protection on the metrics, SDSDV can provide complete protection. To evaluate the performance of SDSDV modified form of DSDV routing protocol that implemented in NS 2. Specifically, the increased the

size of each routing update package to accommodate the authentication hash values in each table entry required in SDSDV. This focuses on the evaluation of computation complexity between symmetric cryptograph and asymmetric cryptograph solutions in different scales of ad hoc networks.

The trust enhanced dynamic source routing protocol[3] is based on relationship among the nodes which makes them to cooperate in an Ad hoc environment. The trust unit is used to calculate the trust values of each node in the network. The calculated trust values are being used by the relationship estimator to determine the relationship status of nodes. Trust Enhanced DSR protocol increases the level of security routing and also encourages the nodes to cooperate in the ad hoc structure. It identifies the malicious nodes and isolates them from the active data forwarding and routing.

The routing misbehaviour is mitigated by including components like watchdog and pathrater in the scheme proposed by Marti, Guiti, Lai and Baker[4]. Every node has a Watchdog process that monitors the direct neighbors by promiscuously listening to their transmission. No penalty for the malicious nodes is awarded. The CONFIDANT protocol works as an extension to reactive source routing protocols like DSR[5]. The basic idea of the protocol is that nodes that does not forward packets as they are supposed to, will be identified and expelled by the other nodes. Thereby, a disadvantage is combined with practicing malicious behavior.

The paper Bayesian-based Confidence Model for Trust Inference in MANET is based on service-based scheme for computation of trust which takes into consideration the security requirement of a node as criteria for choosing the appropriate trust computation scheme. It can either choose to use direct trust, indirect trust or to form a trust network. It also proposes a modified Bayesian based confidence model[6] that gives an explicit probabilistic interpretation of trust for ad hoc networks and describe trust inference algorithm that uses probabilistic sampling to infer the trust of a node based on the highest confidence estimation. It takes into account the security requirement for the application concerned and decides the scheme of trust computation.

Trusted AODV[7] is a secure routing protocol, this protocol extends the widely used AODV routing protocol and employs the idea of a trust model in subjective logic to protect routing behaviours in the network layer of MANET. TAODV assumes that the system is equipped with some monitor mechanisms or intrusion detection units either in the network layer or the application layer so that one node can observe the behaviours of its one-hop neighbours[8]. In the TAODV, trust among nodes is represented by opinion, which is an item derived from subjective logic. The opinions are dynamic and updated frequently. Following TOADV specifications, if one node performs normal communications, its opinion from other nodes' points of view can be increased; otherwise, if one node performs some malicious behaviors, it will be ultimately denied by the whole network. A trust recommendation mechanism is also designed to exchange trust information among nodes.

Dependable DSR without a Trusted Third Party[9] is a technique of discovering and maintaining dependable routes in MANET even in the presence of malicious nodes. Each node in the network monitors its surrounding neighbours and maintains a direct trust value for them. These values are propagated through the network along with the data traffic. This permits evaluation of the global trust knowledge by each network node without the need of a trusted third party. These trust values are then associated with the nodes present in the DSR link cache scheme. This permits nodes to retrieve dependable routes from the cache instead of standard shortest paths.

The distributed trust model makes use of a protocol that exchanges, revokes and refreshes recommendations about other entities. By using a recommendation protocol each entity maintains its own trust database. This ensures that the trust computed is neither absolute nor transitive. The model uses a decentralized approach to trust management and uses trust categories and values for computing different levels of trust. The integral trust values vary from –1 to 4 signifying discrete levels of trust from complete distrust (-1) to complete trust (4).

Each entity executes the recommendation protocol either as a recommender or a requestor and the trust levels are computed using the recommended trust value of the target and its recommenders. The model has provision for multiple recommendations for a single target and adopts an averaging mechanism to yield a single recommendation value. The model is most suitable for less formal, provisional and temporary trust relationships and does not specifically target MANET. Moreover, as it requires that recommendations about other entities be passed, the handling of false or malicious recommendations was ignored in their work. In this paper, a theoretical framework is proposed for trust modeling and evaluation. Here trust is a software entity. From this understanding of trust, an Algorithm is developed that address the basic rules for trust in a network.

4. PROPOSED WORK

4.1 Trust Based Routing Algorithm

The main contribution of this paper is to provide a secure model based on trust computation. For this a trust based routing algorithm is proposed with the

idea of managing the decentralized network effectively. It includes the Neighbour set table that contains the neighbour id of the source node. For each source their one hop neighbours will be listed. Neighbour set table also contains a self entity known as trust for each of the available neighbours. Based on the level of trust from the neighbour set table the node is assigned as TH, TA, TL and NT (Refer Table 1). The priority is given only for the TH and TA neighbour range. This paper also provides the second level authentication of password checking for the neighbours in the higher priority level. After this, the Source node will send RREQ Packet to the trusted node. Similarly, the routes

Table 1. Trust entity

S. No	Entity	Full Form	TBR Value
1	TH	Trust High	0.76 to 1
2	TA	Trust Average	0.51 to 0.75
3	TL	Trust Low	0.26 to 0.5
4	NT	No Trust	0 to 0.25

are established on demand. The key framework of this paper is to check the level of trust with the neighbours available in the table. So, this provides a higher model of trust computation with simple mathematical equation.

Step 1: The source node will broadcasts HELLO packets to all its one hop neighbors in its transmission range. If an acknowledgement is received, then those nodes will be included in Neighbor Set Table (NST).

Step 2: In order determine the trust level of the neighbors', check whether the destination node is in source nodes NST. If it is true then calculate its trust value according to the step 4.

Step 3: If the destination is not in the NST, then find the trust value of all of its neighbors in the NST.

Step 4: Compute the good level of trust TBR(y) among all the available neighbors. TBR(y) = sin(x) to calculate the trust value (y) based on a node's direct experience. Here the computation value is restricted between 0 and 1. The function for calculating the trust value is

$$TBR(y) = \sin (c1 * Prev_{trust} + c2 * No_{neigh} + c3 * Pac_{sent} + c4 \quad Delay_{Forward}) \qquad (1)$$

where c1, c2, c3 and c4 are constants whose sum is equal to 1. Those values are determined during simulation. $Prev_{trust}$ is the previous trust value of node x. No_{neigh} represents the number of neighbor nodes of y. Pac_{sent} represents the packets forwarded and generated by x. $Delay_{Forward}$ represents the forwarding delay of node x.

Step 5: After calculating the trust value of all neighbors, they are categorized according to trust value ie. Trust High -TH (TBR value between 0.76 and 1), Trust Average – TA (TBR value between 0.51 and 0.75), Trust Low - TL (TBR value between 0.26 and 0.5) and No Trust - NT (TBR value between 0 and 0.25).

Step 6: The neighboring nodes which fall under the category of NT will not be considered for routing. Rest of the three categories TH, TA and TL goes for the next level of security verification.

Step 7: The neighboring nodes with trust value TH will go for low level of encryption. Likewise nodes with trust values TA and TL will go for medium and higher level of encryption respectively. The encryption levels are classified based on the size of the key. 32 bit, 64 bit and 128 bit keys for TH, TA and TL respectively.

Step 8: With these levels of security checks the source node establishes a route to its neighbor and the process proceeds still one hop neighbor is the destination.

4.2 Procedure for Evaluating Trust

The nodes in the neighbor table are evaluated for trust based on the Eqn (1) mentioned in step 4 of the TBR algorithm. In this equation four important parameters are considered for calculating the TBR value. The $Prev_{trust}$ parameter specifies the previous trust value of the node. It represents the past activity of the node. The parameter Pac_{sent} is considered for determining the trust value in order to accommodate the severity of the traffic. Trust is an array that holds neighbor id for each trust entity. TMNODE is used to temporarily hold the neighbors.

```
for (each node I in neighbour table)
{
    if ( 0.76 < TBR value < 1.0)
    {
      assign_trust[i] = TH;
      save TMNODE[j] = i;
      j++;
    }
    else if (0.51 < TBR value < 0.75)
    {
      assign_trust[i] = TA;
      save TMNODE[k]=i;
      k++;
    }
    else if ( 0.26 < TBR value < 0.5)
    {
      trust[i] =TL;
    }
    else
    {
      trust[i]=NT;
      Generate a warning message;
    }
}
```

4.3 Flow Chart

The flow chart in Fig. 1 explains the procedural steps of the proposed algorithm. The network is deployed first for a particular transmission range. Then the nodes within that range are identified by broadcasting Hello packets. Applying the TBR algorithm for establishing neighbour adjacency and then evaluates the trust. And as a second level different levels of encryption technique are done with the trusted neighbours.

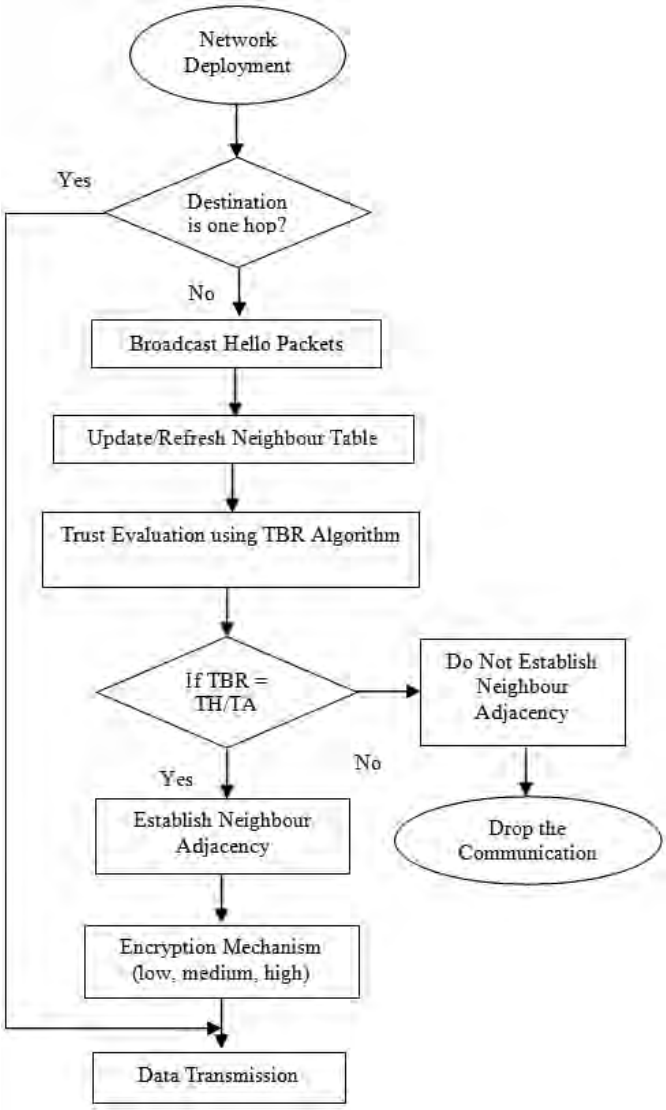

Figure 1. Flow chart for TBR algorithm.

5. PERFORMANCE EVALUATION

Consider a MANET with all type of nodes, which may be selfish or malicious as well as trusted node. Here in the illustrated example, (Fig. 2) there are eight nodes. The node 1 acts as source want to send data to destination node 8. When a node is ready for data transmission, first it should be aware of the neighbours. After getting information about its one hop neighbours, the source now has to compare the level of trust among all of them from neighbour set table.

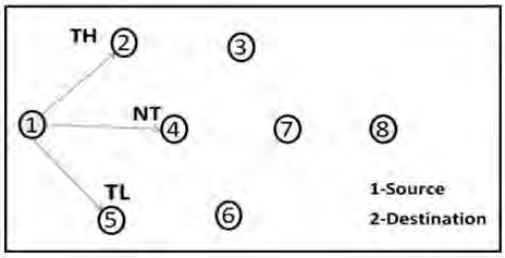

Figure 2. Trust evaluation using TBR.

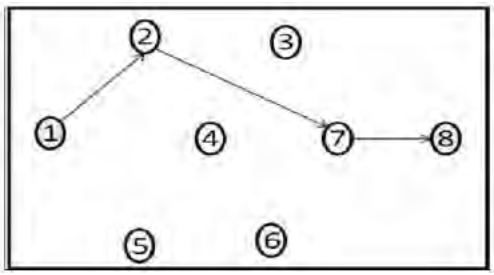

Figure 3. Path establishment from source to destination.

For instance, (Fig. 3) node 1 has 2, 4, and 5 as its one hop neighbours. The neighbour set information is updated in the neighbour table. Applying TBR Algorithm, the source node will decide the trusted node and data packets are sent to that node. For node 2, the neighbor table contains 3, 7, and 6 as neighbors. Among these, node 7 has the highest trust. Now, node 7 will broadcasts Hello Packets to choose its neighbors. The node 7 has node 8 as its one hop which is the destination. This process continues until the exact path or the route to the destination is reached.

Table 2. Neighbour trust table

Neighbour Id	Trust Value
2	TH
4	NT
5	TL

To analyze the performance of the proposed protocol, it was simulated in a 1000m X 1000m region. The transmission range was set to 25 m. The nodes were set to move at a speed to 10 to 20 meter/sec with a pause time of 30 seconds. CBR traffic was generated with the data payload size of 512 bytes. To calculate the value of TBR for each neighbor node the constants c1 to c4 are assumed as 0.25. The parameters like time to first byte, throughput and percentage of attacks detected were measured.

The parameters time taken to receive first byte (TTFB) after the connection has been setup was measured in each round of simulation and it seems to be consistent throughout the simulation as shown in Fig. 4. TBR algorithm is a reactive routing protocol which will collect routing information only on demand. The advantage of this algorithm is that it creates no

extra traffic for communication along existing links and the connection setup delay is lower.

The throughput of the nodes in the network seems to drop down with the increase in number of nodes in the network and this behaviour is shown clearly in Figs. 5 and 6 which show a decreasing trend in the percentage of attacks detected in each rounds of simulation with increasing number of adversaries.

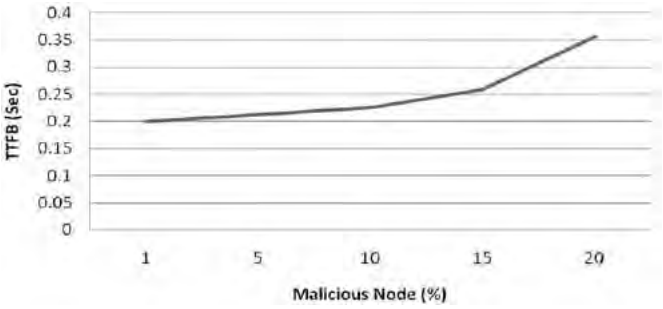

Figure 4. Time to first byte vs malicious nodes

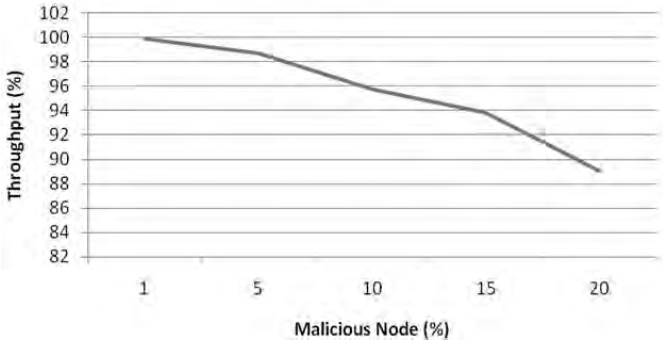

Figure 5. Throughput vs malicious nodes

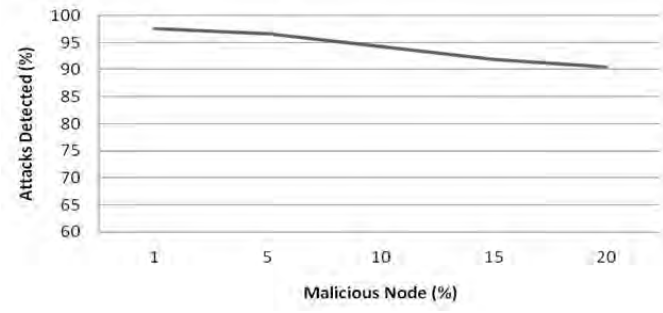

Figure 6. Attacks detected vs malicious nodes.

6. CONCLUSION

This paper proposes a novel routing algorithm that relies on the trust of the neighbours to select a path in routing the protocols to the destination. A TBR algorithm is proposed which calculates the trust worthiness of the neighbors in the network and prioritizes a path based on the calculated trust value.

निष्कर्ष

यह आलेख एक नोवल रूटिंग एल्गोरिथम को प्रस्तावित करता हैं जो गंतव्य तक पहुँचने के रास्ते का चयन करने के लिए नेबर नोड पर भरोसा करता हैं। एक टीबीआर एल्गोरिथम प्रस्तावित किया जाता हैं जो नेबरस की विश्वास पात्रता की गणना करता हैं और इस गणिक संख्या के आधार पर रास्ते को प्राथमिकता देता हैं।

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राष्ट्रीय ज्ञान नेटवर्क के माध्यम से ज्ञान का सहज एकीकरण
Seamless Integration of Knowledge through National knowledge network

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सारांश

सूचना और संचार प्रौद्योगिकी (आई सी टी) के विकास ने पुस्तकालयों को वास्तविक समय ज्ञान प्रदान के लिए सक्षम बना दिया है। दिनोंदिन ज्ञान प्रदान और साझा करने के लिए अधिक से अधिक नई तरीको की माँग बढ़ रही है। इस बढ़ती जरूरत को महसूस करते हुए भारत सरकार तीव्र गति का डाटा संचार नेटवर्क स्थापित किया हैं उदाहरणतः राष्ट्रीय ज्ञान नेटवर्क (एन के एन) ने अनुसंधान संस्थानों, प्रयोगशालाओं, विश्वविद्यालयों को जोड़कर उनके ज्ञान और सहयोगात्मक अनुसंधान (कोलाबोरेटिव रिसर्च) को साझा किया हैं। इस वीडियो केंद्रित दुनिया में, सामाजिक नेटवर्किंग साइटों के पास ज्ञान को साझा करने के लिए में खुद के वीडियो उपलब्ध हैं। स्नातक, स्नातकोत्तर और पीएचडी छात्रों को आई आई टी, आई आई एस ई आर और आइ आई एस सी से नियमित आभासी (वर्चवल) कक्षाएं राष्ट्रीय ज्ञान नेटवर्क के माध्यम से उपलब्ध हैं। संगोष्ठियाँ, सम्मेलन आदि आभासी मोड में आयोजित की जा रही हैं जिससे ज्ञान प्रबंधन के क्षेत्र में एक क्रांतिकारी परिवर्तन आया हैं। इस शोधपत्र में लेखकों ने एन के एन सुविधा के माध्यम से नौ–सेना भौतिकी तथा समुद्र विज्ञान प्रयोगशाला में ज्ञान अर्जन और साझा करने के तरीके की व्याख्या करने का प्रयास किया है।

ABSTRACT

The developments in Information and Communication Technology (ICT) have enabled libraries to provide real-time knowledge access. Day by day the demand for more and more innovative methods of accessing and sharing knowledge is increasing. Realizing this growing need, Government of India established the high speed data communication network i.e. the National Knowledge Network (NKN), connecting research institutes, laboratories, universities, etc. to share their knowledge and collaborative research. In a video centric world, social networking sites have their own video options to share the knowledge. Regular classes for undergraduate, post graduate and PhD students are available from IITs, IISER and IISc through NKN as virtual classes. Seminars, Conferences, etc. are also conducted in virtual mode making a revolutionary change in the field of knowledge management. In this paper, the authors attempt to explain the ways of knowledge acquisition and sharing through NKN facility in Naval Physical and Oceanographic Laboratory (NPOL).

Keywords: Firewall, National knowledge network, video conference, virtual classrooms, knowledge shharing

1. INTRODUCTION

The libraries and information centres of any research organization in the digital world have to adopt Information Communication Technologies (ICT) to collect organize and disseminate information. In NPOL library viz. Technical Information Resource Centre (TIRC) Internet service was started way back in 1997 with dial-up connection from Videsh Sanchar Nigam Limited (VSNL). Subsequently, a series of internet plans such as Direct Internet Access Service (DIAS), Integrated Service Digital Network (ISDN), etc were provided to users for internet access. TIRC professional also utilized this service for providing literature search service to scientists on project related topics. TIRC established BSNL broadband connection in 2006 which made the e-journal access faster. In 2012, NPOL became a member of India's prestigious National Knowledge Network (NKN) and established its connection in TIRC and technical groups.

1.1 National Knowledge Network

National Knowledge Network (NKN) project is aimed at establishing a strong and robust internal Indian network which will be capable of providing secure and reliable connectivity. NKN is intended to connect all the knowledge and research institutions in the country using high bandwidth / low latency network. National Informatics Centre is the project execution agency for NKN in India and the project was approved in 2010. National Knowledge Network (NKN) is multi-gigabit

pan-India network providing high speed connectivity to all knowledge related institutions in the country and thus making a revolutionary step in the field of knowledge management. The purpose of such knowledge network is to build quality institutions with research facilities and create highly trained professionals. At present 934 institutions are connected through NKN and in future it aims to connect about1500 knowledge related institutions like universities, R&D institutions, libraries, across the country so as to share information for advancing human development. The NKN bandwidth is created by multiple bandwidth providers and the end user connectivity is provided by any service provider and the participating institutions get high speed internet connection[1]. Defence Research and Development Organisation (DRDO) is also an organization connected to NKN. At present forty four DRDO laboratories are connected to this high speed network[2].

An institution to become a member of NKN following are the criteria[3]:

- The institution must be a knowledge creator
- There should have enough space to keep the equipment supplied by NKN and should keep the instruments under safe custody
- Cabling within the institution should be done to connect to the NKN router.
- Minimum bandwidth interface should be 100 Mbps
- Should follow the policies of NKN regarding IP usage, and how to maintain the local area network, security related matters, messaging gateway, etc.
- There should be a Nodal Officer within the institution to manage the connectivity.

1.2 Setting up of NKN connection in NPOL

NKN connection in TIRC was established in 2013. The existing BSNL broadband internet connection is having 8Mbps speed and it is insufficient to meet the information requirements of the users. Power Grid Corporation of India Ltd. (PGCIL) is the service provider for NPOL. PGCIL is India`s biggest power transmission company. Power Grid has been entrusted to use its robust and widespread infrastructure to provide high speed connectivity through fiber optic network[4]. The Fiber optic cable is routed through outdoor Fibre Optic Terminal Box and then in the Fibre Optic Ethernet switch and Router. Then it is connected to the Firewall and from there it is connected to a Switch and distributed to Transducer group, Information Technology group, Ocean Data Centre and TIRC. The switch, router and firewall are mounted in a rack. The connection is again distributed within the divisions. Bandwidth usage policies have been set up in the firewall so as to get the maximum utility of the service. The NKN connection drawn from the main point is distributed in TIRC through a 28-port switch which is having fiber ports. The bandwidth available for the connection is 100 Mbps. This can be upgraded according to the requirements[5].

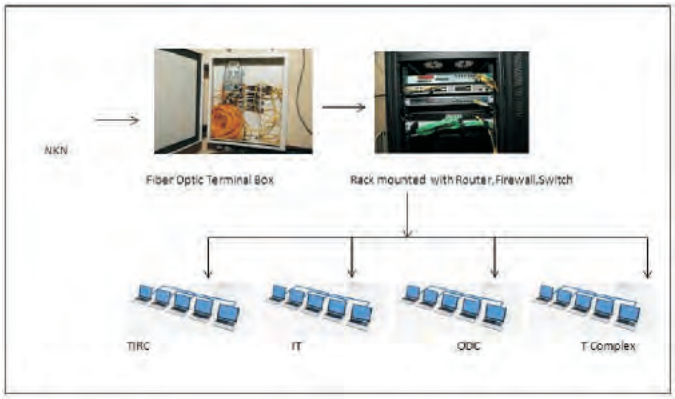

Figure 1. NKN infrastructure @ NPOL.

1.3 Setting up of Videoconferencing facility

For Desktop videoconference/ virtual class rooms, the devices required are as follows[6]

- PC with Windows XP/Windows Vista/ windows 7 /Linux with video conferencing software
- Webcam
- Microphone
- Speakers
- Projector

1.4 Configuring VidyoDesktop

Initially the windows based video conferencing was done. At present the Linux Mint 17 Cinnamon 32 bit permits easier way of configuring the hardware and software for accessing videoconference. There is a number of videoconferencing software such as Adobe Connect, Citrix Gotomeeting, VidyoDesktop, Skype, TeamViewer, etc. Some of them are free and some are proprietary. Vidyo Desktop™ extends high-quality video conferencing to Windows, Mac and Linux computers. The Vidyo system has two components. One is the Vidyo Portal and the other is the Vidyo desktop. User can download the client Vidyo Desktop

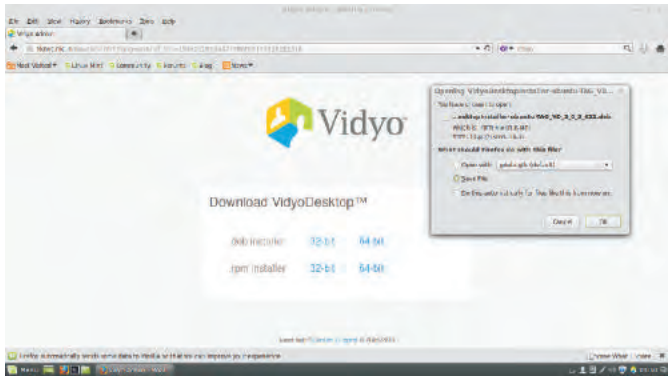

Figure 2. Installing Vidyo desktop.

from the Vidyo Portal.[7]

To install the software some dependency problem had to be resolved by issuing command # apt-get install-f.

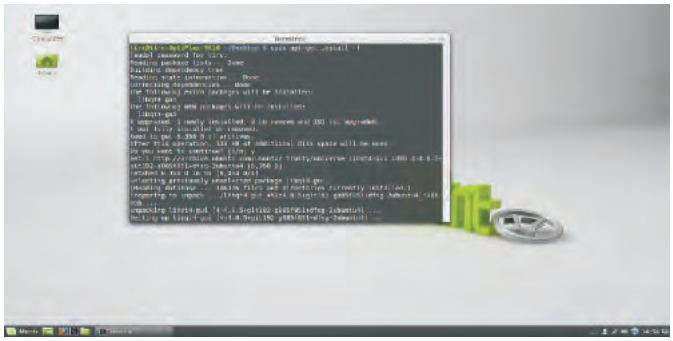

Figure 3. Installing VidyoDesktop.

After installation, a window will appear asking to fill the Portal address, username and password. Different category of users such as NIC official, NKN (educational Institutions under NKN), Judiciary, Financial Services, etc., have accounts on different portal. NPOL belongs to the NKN category.

We may also install the same software using the terminal also. For this, go to the directory where the package is downloaded and install it typing

sudo dpkg -i <package name>.

Figure 4. Installing VidyoDesktop.

After submitting the username, password details, a window with a list of contacts appear (Fig.5). Camera, Microphone and speaker are connected and configured (Fig.6). Testing of the devices can be done by "Join My Room" (Fig.7)

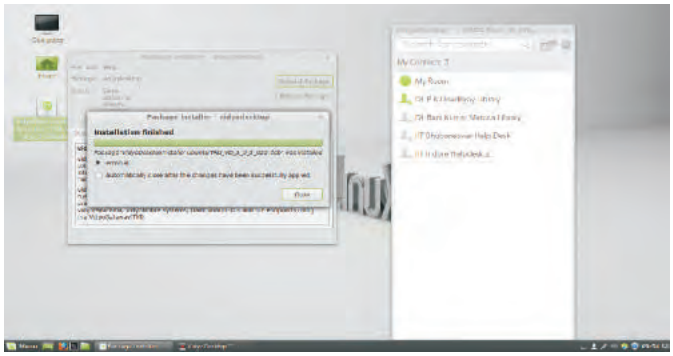

Figure 5. Installing VidyoDesktop.

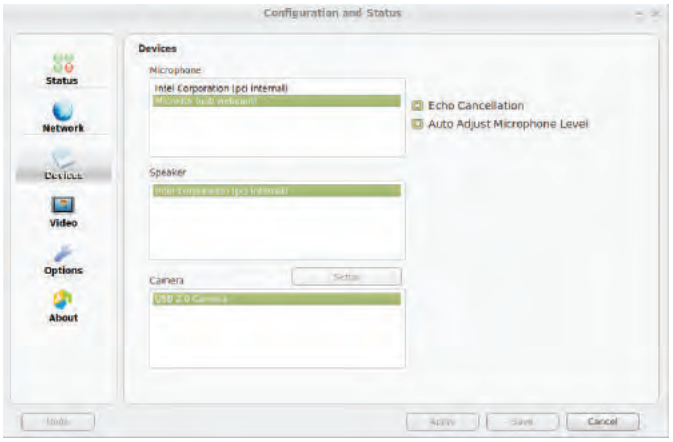

Figure 6. Setting up speaker, camera and microphone.

Figure 7. Joining Room.

1.5 VidyoDesktop Conference Toolbar

Before entering in to the video conference, we should be thorough with the icons in the VidyoDesktop Conference Toolbar.

Before calling room status is also to be taken into account.

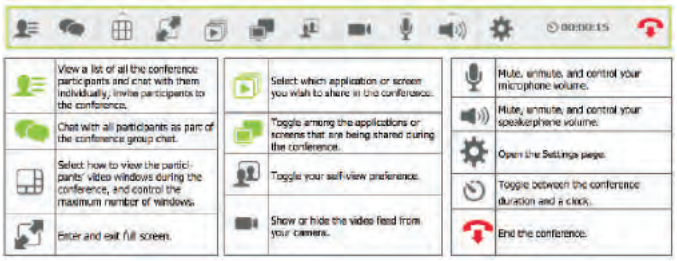

Figure 8. The conference toolbar icons meaning[8].

Room Status

Icon	Description
	The room is available and empty, so you can enter the room.
	The room is available and PIN-protected. If you attempt to join the room, you will be asked to enter a PIN.
	The room is occupied but available to enter.
	The room is locked, so you cannot enter it.
	The room is full, so you cannot enter it.

Figure 9. Room status[8].

Search can be done by name (first/last/initials) or extension. By typing asterick(*), an alphabetical list is displayed. Select the user. Now there will be option such as for Calling. We can make Pont to point or Multi Point call from our system.

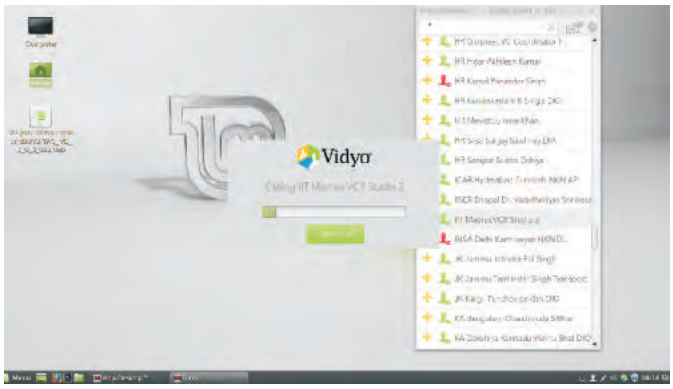

Figure 10. Searching user and connecting firewall setting up.

For monitoring and managing the NKN access properly, NPOL is having a firewall. The device having the following features such as web based applications, support secured communication, support scanning for SMTP, POP3, IMAP, FTP, HTTP, HTTPS, FTP over HTTP protocols, able to filter unwanted sites, Web based reporting, Individual or group wise access control[9].

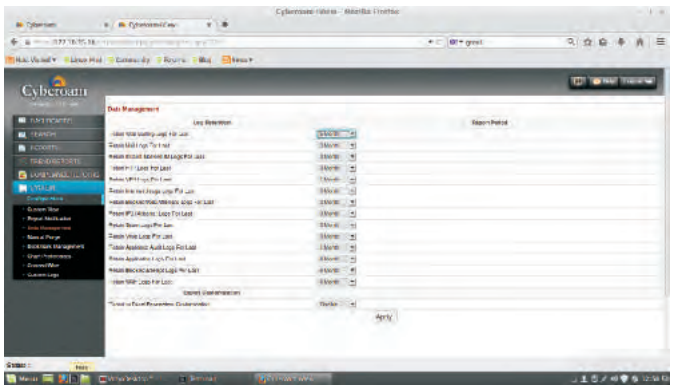

Figure 11. NKN firewall set up.

1.6 Applications of NKN in NPOL

The main services offered through NKN for the researchers in TIRC and use of NKN by ocean data centre are the main advantages of NKN in NPOL.

2. NKN AND NPOL LIBRARY-TIRC

The main services offered by TIRC through NKN for the researchers in NPOL are as follows:-

2.1 Web Based Learning (WBL) Facility

TIRC established virtual class room and videoconferencing facility for its users through NKN. Web based learning is often called online learning or e-learning because it includes online course content. Discussion forums via email, videoconferencing, and live lectures (videostreaming) are all possible through the web. One of the values of using the web to access course materials is that web pages may contain hyperlinks to other parts of the web, thus enabling access to a vast amount of web based information.[10]

Figure 12. NKN virtual class room.

Videoconferencing and virtual class room set up was established in TIRC. The main subjects of NPOL are Digital Signal Processing, Signal processing Algorithms, Transducers, Oceanography, Material science, etc. Scientists want to update their knowledge through the virtual class offered through NKN connection. We can record the class and replay it whenever required. So along with flexibility in physical location, WBL offers flexibility in timing of participation. In contrast to lectures given at a fixed time, learners can access recorded classes as and when required and when they are free from their busy schedule of projects.Accessing virtual class rooms of IITs, which creates an advanced learning facility with interactive sessions. The person sitting in the remote location feels as if he/she were sitting in the same class room. Participants can ask questions and interact with the teacher as if he is in the local classroom.[11]

The time schedule for each topic has been published well in advance, so that scientific community in the organization can access and record the classes. The library professionals are selecting the relevant classes in consultation with scientists and regularly displaying

Figure 13. NKN virtual class room time table.

the time of the lecture in TIRC portal which can be accessible by all through intranet. Users make their demands from this list and library professional arrange the classes for them. For this, prior permission is sought from the competent authority. The facility like head set, microphone and webcam have been provided to the users to access virtual class rooms and video conferencing facility at NPOL.

IIT class rooms can also be accessed through National Programme on Technology Enhanced Learning (NPTEL). This facility is used by many scientists of NPOL and through NKN the speedy access to video class rooms enables them to save time.

2.2 Video Conferencing for the Project Activities

Videoconferencing is meeting of two or more persons sitting in different locations in the world. They can share their knowledge virtually. This facility helps to save money and time. Decisions can be taken quickly. Videoconferencing can be conducted between DRDO laboratories, between NPOL and DRDO Head Quarters or between NPOL and academic institutions. This facility eliminates travel by scientists.

2.3 Knowledge Sharing Through Collaboration

Already NKN is having 934 members from various organizations like CSIR, DRDO, ISRO, DST, DAE, deemed universities, engineering colleges, ICAR, ICMR, IIMs, IISER, IITs, etc. Out of the 46 CSIR labs a minimum of 7 labs dealing with subjects of NPOL, all the IITs are of relevant to NPOL. Through NKN scientists can interact with experts from all the member institutions through chatting or videoconferencing and vice versa.

3. ACCESSING DRDO-E-JOURNAL SERVICE

NKN provides high speed access to e-journals. At present most of the journals acquired by TIRC as e-journals. Scientists find it more convenient to browse their journals and search keywords through this high speed network.

4. INFORMATION DISSEMINATION

As a research library, one of the most important services carried out by librarians is information dissemination. Due to NKN facility in TIRC library professionals are doing this service through social networking tools and e-mail. When library professionals are browsing e-journals and when they see an article of interest, they are disseminating the same to scientists concerned then and there. Literature search service is also carried out on subject of interest and provides consolidated information to various technical groups. NKN facilitate doing this service in limited time.

5. NKN USE IN OCEAN DATA CENTRE

Ocean data collection is carried out by Ocean data centre for creating databases of different parameters. NPOL has an Ocean Data Centre for augmenting all available and future oceanographic and acoustic data on a single platform. NKN which is having its connectivity in ODC enables the scientists a speedy retrieval of ocean data from different sources. It is an essential infrastructure facility to support design, development, testing, evaluation and deployment of underwater sonar systems/sensors, naval operations and simulation of tactical warfare scenarios. NPOL acquires data from various platforms like ships and submarines and all these data are being augmented to the oceanographic database of ODC for future use. The centre is having Storage Area Network (SAN) and Network Attached Storage Server (NAS) with 20 TB and 16 TB memory respectively.[5]

6. CONCLUSION

Setting up of National Knowledge Network at NPOL and facilities established like virtual class room and videoconferencing facility enable scientists to acquire information and knowledge at a faster rate. Videoconferencing facility of NKN is highly cost effective to the research institutions like NPOL since it avoids frequent travel by scientists to collaborate with experts of other DRDO and CSIR laboratories and academic institutions. By providing connection to its library, facilitates information and knowledge acquisition and sharing through collaborative technologies. In the area of information retrieval, e-journals subscribed under DRDO e-Journals consortia are being effectively exploited in TIRC due to this high speed NKN connectivity. Since all the IEEE journals may be accessed quickly from IEEE/IEL database through NKN TIRC stopped subscribing print version of these journals and a big amount of foreign currency was saved. It is pertinent to mention that due to optimum use of NKN in the laboratory more internet terminals are being made available for the users in all other technical groups also in future. Efforts are also being made to augment the bandwidth in the near future and encourage scientists to use virtual class room facility and convert NPOL to a full-fledged learning organization.

निष्कर्ष

नौ–सेना भौतिकी तथा समुद्र विज्ञान प्रयोगशाला (एन पी ओ एल) में राष्ट्रीय ज्ञान नेटवर्क की स्थापना और आभासी कक्षा कमरा (वर्चवल क्लास रूम) और वीडियो कांफ्रेंसिंग सुविधा जैसी सुविधाओं की स्थापना ने वैज्ञानिकों को तेज गति से सूचना और ज्ञान प्राप्त करने में सक्षम बना दिया है। एन

के एन की वीडियोकांफ्रेंसिंग नौ–सेना भौतिकी तथा समुद्र विज्ञान प्रयोगशाला एक किफायती सुविधा है क्योंकि इसने वैज्ञानिकों को अन्य डीआरडीओ, सीएसआईआर प्रयोगशालाओं और शैक्षणिक संस्थानों के विद्वानों के साथ सहयोग हेतु बार–बार यात्रा को बचाया है। इसने पुस्तकालय से कनेक्शन प्रदान करके, सहयोगी प्रौद्योगिकियों के द्वारा सूचना और ज्ञान प्राप्ति को साझा किया है। सूचना प्राप्ति के क्षेत्र में ई–जनरलस जो कि डी आर डी ओ कंसोर्सियम के तहत हैं उसका एन के एन के माध्यम से टी आइ आर सी में बेहतरीन उपयोग हुआ है। क्योंकि सभी आई ई ई ई जरनल एन के एन के माध्यम से आई ई ई ई/आईल डेटाबेस से तीव्र गति से प्राप्त किए जा सकते हैं इससे टी आइ आर सी ने छपे हुए जरनल को खरीदने के इंकार करके विदेशी मुद्रा की एक बड़ी राशि को बचाया है। यह बताना जरूरी है प्रयोगशाला में एन के एन के उत्तम उपयोग से भविष्य में इंटरनेट टर्मिनल अन्य तकनीकी समूह के उपयोगकर्ताओं के लिए उपलब्ध कराए जा सकते हैं। निकट भविष्य में बैंडविड्थ बढ़ाने और वैज्ञानिकों द्वारा आभासी कक्षाओं की सुविधा का उपयोग करने में प्रोत्साहित करके एनपीओएल को एक पूर्ण विकसित अध्ययन संगठन में बदला जा सकता हैं।

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एयर गैप वाइड एरीया नेटवर्क में त्रुटियों और क्षमताओं का प्रबन्धन : चुनौतियां और मोबाइल एजेंट पद्धति

Fault and Performance Management in Air-gap Wide Area Organizational Networks: Challenges and Mobile Agent Approach

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सारांश

नेटवर्क के अतिवृहित बढते आकार और जटिलता के कारण आज एक सरल, मापनिय और संसाधना सहायक नेटवर्क प्रबन्धन प्रणाली की आवश्यकता हैं। त्रुटियों और क्षमताओं का प्रबन्धन बहुत महत्वपूर्ण क्षेत्र हैं। यह आलेख एयर गैप वाइड एरिया नेटवर्क के प्रबंधन में होने वाली चुनौतियों और मुद्दो को प्रस्तुत करता है। इस अध्ययन के आवृति नेटवर्क को एक समर्पित नेटवर्क संचालन केन्द्र की मदद से जाँचा जाता हैं। एक निर्धारित अवधि में नेटवर्क की उपलब्धता, पैकेटो की क्षति और और पैटर्न का अवलोकन किया गया। यह अवलोकन परंपरागत एस एन एम पी आधारित नेटवर्क प्रबन्धन प्रणाली के उपयोग से किया गया। इसके बाद हमने मोबाइल एजेंट पद्धति पर आधारित त्रुटियों और क्षमता प्रबंधन के लिए एक मॉडल का प्रस्ताव किया है। मोबाइल एजेंटों ने केंद्रीकृत स्टेटिक एजेंट आधारित प्रबंधन मॉडल की कुछ कमियों को दूर किया है। प्रबंधन स्टेशन द्वारा उत्पन्न एजेंट एक बार सारा नेटवर्क का भ्रमण करता है, जरूरी सूचना एकत्रित करता है और मूल स्टेशन को भेज देता है। प्रबंधन स्टेशन के द्वारा एक पूर्व–निर्धारित नीति से एजेंट की यात्रा को संचालित किया जाता है। किसी भी स्थानीय प्रसंस्करण को उसी नोड पर निष्पादित किया जाता है जिससे मध्यवर्ती परिणाम प्रेषण की आवश्यकता नही रहती। यह प्रबंधन सूचना के लिए होने वाली बैंडविड्थ खपत को कम कर देता है। उपरोक्त प्रणाली परंपरागत पद्वति के संप्रेक्ष में संप्रेषण प्रसुप्ति की तुलना में बेहतर प्रदर्शन करती है।

ABSTRACT

With tremendous growth in the size and complexity of networks, the need for a light weight, scalable and resource friendly network management has further increased. Fault and performance management have been the most crucial areas.The paper discussed the challenges and issues faced during the management of an air-gap wide area network. The network under study was monitored at a dedicated network operations centre. Network availability and packet loss were observed over a stipulated period and patterns observed. The observations were made using a conventional SNMP-based network management system. Thereafter, we propose a model for fault and performance management based on the mobile agent approach. Mobile agents have been used to overcome some limitations imposed by the centralised static agent based management model. The agent once generated by the management station traverses the network, collecting the required information and returns to the base. The agent itinerary is governed by a predefined policy at the managing station. Any local processing is performed at the nodes itself, thereby, eliminating the need to transmit intermediate results. This reduces bandwidth consumption by management information. The system also performs better than the conventional system in terms of reduced latency.

Keywords: Router, mobile agent, fault management, performance management, availability, packet loss, SNMP, CMIP, polling, latency, bandwidth, core router, leaf node, routing aggregation point, wide area network

1. INTRODUCTION

Fault management is one of the most critical functional areas of network management. Effective fault management can contribute towards increased network availability and timely resolution. Performance management improves resource utilisation and improves efficiency. Traditional network management approaches based on the client server model exhibit performance issues as network expand. Heterogeneity of components and convergence of voice as well as data further aggravate the problem. A distributed approach to network management is therefore the logical step to help decentralize management control. Mobile agents, which are mobile code snippets, capable of traversing

the network and executing the code locally have been used in this paper to propose a simplistic yet robust model for fault and performance management in large scale organizational networks.

Wang et al.[1] proposed a framework for modelling and evaluation of mobile agents in fault management. They discussed two models combining SNMP and MA approach and compared their superiority in terms of performance to the traditional approach. Srivastava et al.[2] proposed a multi-agent approach with elliptical curve cryptography to enhance security. Kim et al. [3] suggested a proactive and adaptive management system for device control based on mobile agent technology. Experimental evaluation results establishing the system viability were also presented. Cao et al.[4] covered all aspects of network fault management using mobile agents. They also discussed the architecture and strategy of the agent.

2. NETWORK DESIGN

The network used for this study is illustrated in Fig. 1. The nodes are divided into clusters and connected in a hybrid topology consisting of an extended star architecture with partial mesh between the main centres. All links are point to point leased lines of varying bandwidths. Leaf nodes (LN) are congregated into clusters according to geographical proximity. One node in each cluster is designated as a routing aggregation point (RAP). The RAPs of each cluster are connected to a core router (CR) at base centre which acts as a central monitoring point of the network. The network has redundancy built in between CR and RAPs through another ISP.

3. AIR GAP AS NETWORK SECURITY MEASURE

An air gap network, which may be loosely defined as a network physically separate from the internet, is considered as a possible strategy to secure against threats. It ensured that sensitive data on the connected devices was not pilfered due to system compromise. Conventionally military, nuclear and avionics networks were designed as air gap networks. A challenge related to such networks is the need for a secure mechanism to transfer files back and forth from the internet. Any such transaction also opens a way for a potential attack. Some practices followed to keep such a network secure are:

- Installation of minimalistic software
- Disabling unwanted OS services
- Disabling wireless connectivity
- Disabling auto runs
- Using only trusted removable media
- Maintaining network baseline snapshots and monitoring for variations

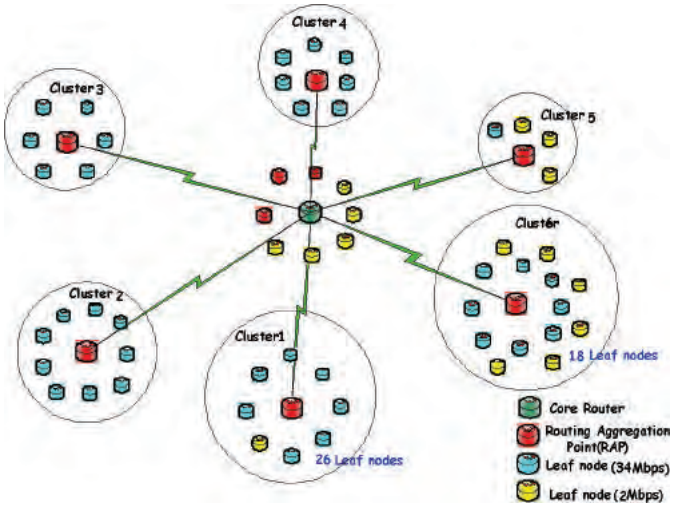

Figure 1. Network design.

4. MOTIVATION

Efficient and timely management of wide area network has been a challenging task for network administrators. Timely detection of faults is imperative to ensure network uptime and avoid disruption of services. A robust fault and performance management system is also essential to guarantee the desired quality of service and meet the service level agreements (SLA). The conventional static agent based management architecture has latency and bandwidth limitations when applied to large scale network. The air-gap nature of the network further compounded the problem as any processing had to be offline. Mobile agents, though a lesser explored technology, have shown significant potential in distributed control application. The need for a low latency, bandwidth friendly framework was the motivation behind this paper.

5. PRESENT MANAGEMENT MODEL

Fig. 2 shows the present model used for fault and performance management in the network. The model is based on the conventional client-server model and uses Ssimple network management protocol (SNMP) as the communication protocol. Alternatively common management information protocol (CMIP) may be used[5]. A management application hosted on the server, also called the 'manager' collects management information

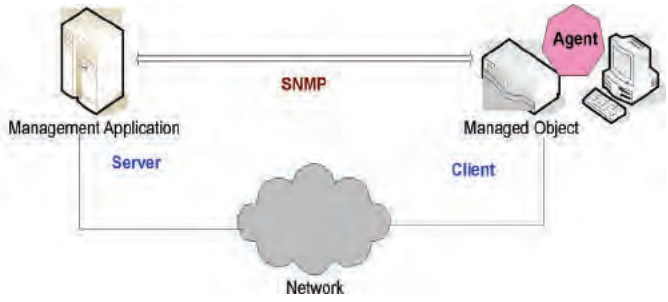

Figure 2. Centralised client server based network management architecture.

from the managed devices. The devices host a daemon called the 'agent' which sends the required information to the manager.

However this approach has limitations when applied to large scale converged networks. Regular polling of the managed entities by the management application introduces latency. Frequent transmission of the requested information by the agents also consumes a part of the bandwidth. These problems were the motivation for a new model for management.

6. EXPERIMENT AND OBSERVATIONS

The network in consideration was monitored at a network operations center (NOC) regularly. The observations recorded during this study are over a period of one year. Other experimental parameters are listed in Table 1.

Table 1. Experimental parameters and values

S. N.	Parameter	Value
1	Number of leaf nodes	102
2	Routing aggregation points (RAP)	7
3	Polling interval	60 secs
4	Warning interval	2 mins
5	Downtime alarm interval	5 mins
6	Core router (CR)	1
7	Ping parameters monitored	Availability/Packet Loss/Response Time
8	Monitoring software used	IPswitch'sWhatsup Gold Ver 16[6]
9	SNMP version	SNMP v2

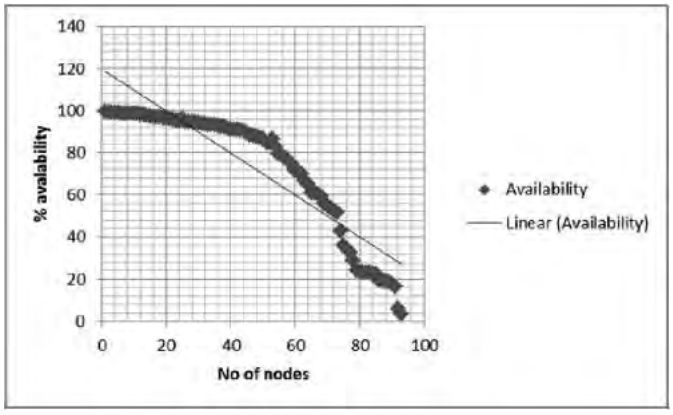

Figure 3. Scatter plot of availability against number of nodes.

Fig. 3 shows the scatter plot of percentage availability of the nodes. The RAPs with redundant connectivity to the core router have high overall availabilities as indicated by the availability plots in Fig 6-9. Availabilities for other leaf nodes lie between 80 to 65%, depending on the link fluctuations, infrastructure support, operating hours, etc. Few nodes remain in power saving state for most of the duration and are turned on only on requirement. This explains the low

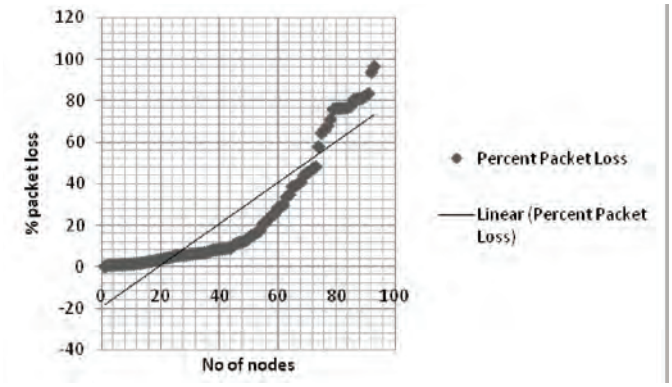

Figure 4. Scatter plot of packet loss against number of nodes.

points in the scatter plots for some of the nodes. The packet loss plot in Fig. 4 is inversely proportional to the availability. The system measures the packets sent and received from the core router to the managed router. A count of the inbound and outbound packets is maintained which is used to calculate the percentage packet loss. A ratio of the packets lost over total packets sent gives the percentage availability. This can be mathematically represented as[7]:

$$\text{Availability} = \frac{\{1-(\text{Total downtime of all outages})\}}{\text{Total obsevation time}}$$

Two related network statistical parameters linked to availability are mean time between failure (MTBF) and mean time to repair (MTTR). MTBF gives the average time between failures of a particular device. MTTR on the other hand is a measure of the time between a device failure and resumption of service. The correlation between these parameters is given by[7] :

$$Availability = MTBF/(MTBF+MTTR)$$

7. PROPOSED MODEL: MOBILE AGENT APPROACH

We propose mobile agent (MA) based architecture that for network fault and performance management. Though mobile agent technology has been used for all functional areas of the FCAPS model (including fault, configuration, accounting, performance & security),

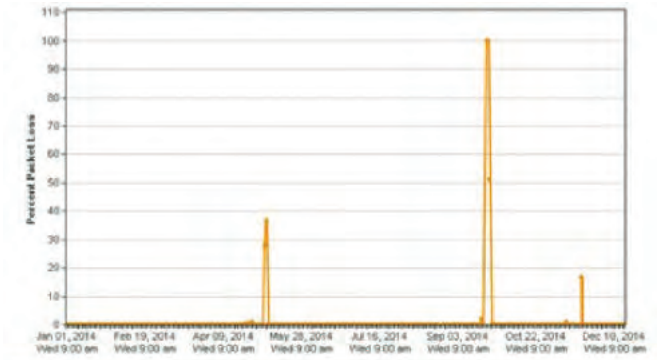

Figure 5. Availability plot for core router.

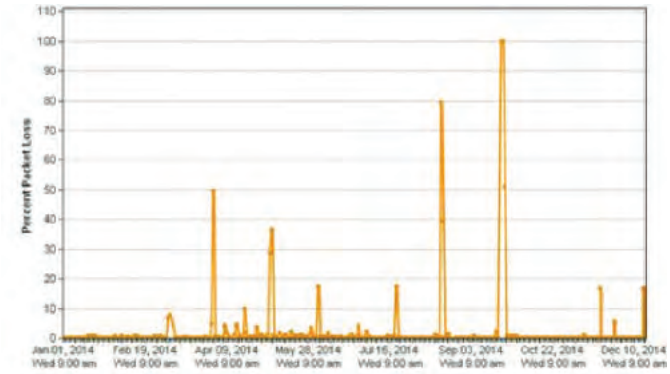

Figure 6. Availability plot for RAP-1.

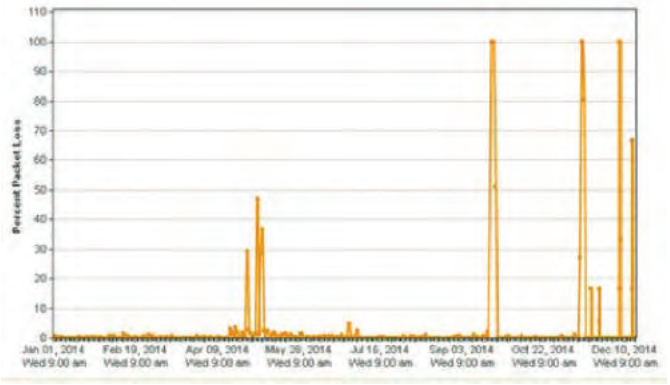

Figure 7. Availability plot for RAP-2.

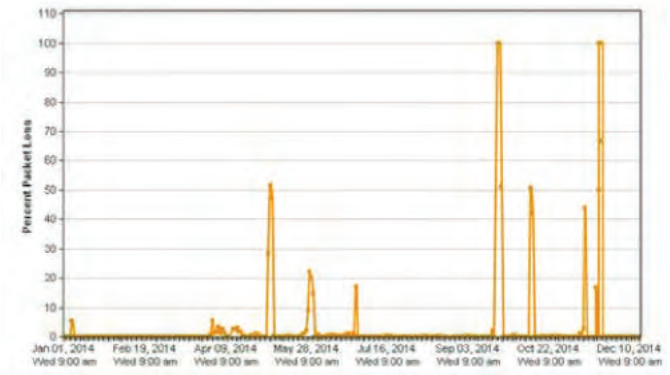

Figure 8. Availability plot for RAP-3.

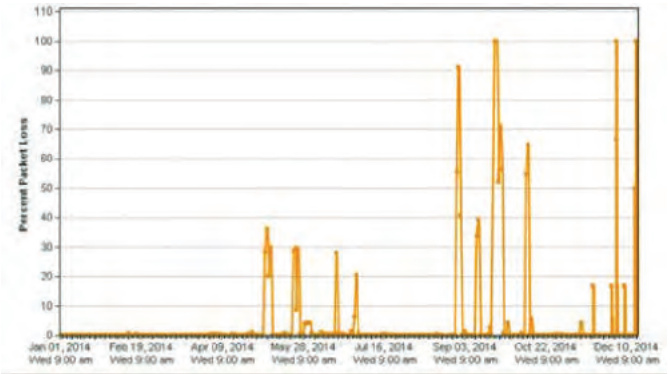

Figure 9. Availability plot for RAP-4.

our focus in this paper is on fault and performance monitoring. A mobile agent is a small software program that performs a predefined computational task on behalf of a user[8]. The agent traverses autonomously from one node to the other in a network. The technology is a widely accepted design paradigm in applications requiring distributed control. The proposed MA based fault and performance management reduces the network bandwidth requirements as well as the latency as the computation code now moves closer to nodes. The approach is a step ahead of the traditional client server.

Figure 10 represents a high level representation of a mobile agent.The agent comprises of the following parts[8]:

- Code comprises of the instructions defining the functions, behaviour and intelligence of the agent.
- Data encompasses the global variables characterizing the behaviour of the agent.
- Execution state is one of the several stages in the agent life cycle.

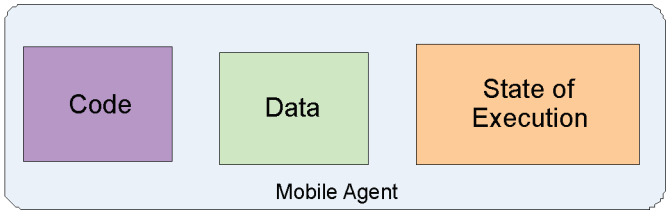

Figure 10. Mobile Agent representation.

8. ARCHITECTURE AND FRAMEWORK

Figure 11 shows the proposed fault and performance model based on Mobile Agents (MA). The managing station at the NOC has a mobile agent generator (MAG), which generates a mobile agent (MA). The MA, with an encapsulated task, is dispatched to the remote site. The code migrates across the network according to predefined policies[5]. The agent executes the code and performs the designated task on reaching the network

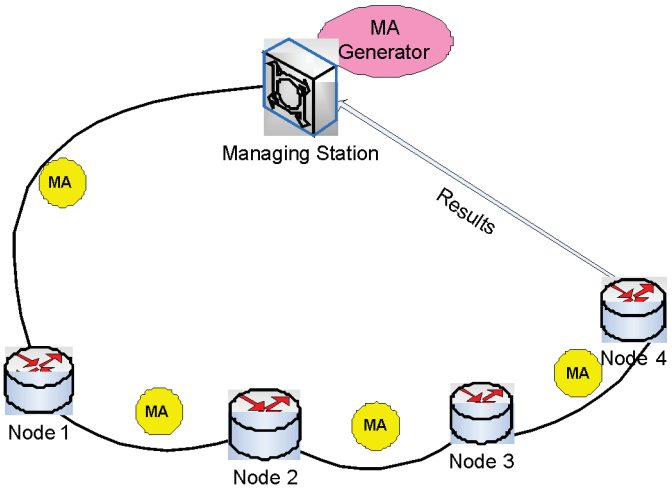

Figure 11. Proposed MA based model.

element. Management information is collected, locally processed and result transmitted to base station. It can thereafter return to the originating site or it may

send the results in a message. Since the computation is now performed in a parallel fashion, the time required to performthe task reduces.

The mobile agents require an agent communication network (ACN) to communicate with each other. The network consists of a host station which is a node that houses an agent. A group of agents having a common goal form a society. A query station is an interface for a user to specify a task, which is further fragmented into smaller goals. A species is a society of agents that has a common goal of same priority.

9. CONCLUSIONS

Future work in this direction includes testing the proposed model through simulation to establish it's supremacy over the conventional approach. The effect of various parameters in the proposed model on the system performance will also be done.

निष्कर्ष

इस दिशा में भावी कार्य, प्रस्तावित मॉडल का परीक्षण इसक अनुरुपण पर करके, उस पद्वति के प्रभुत्व को परंपरागत पद्धति पर स्थापित किया जा सके। प्रस्तावित मॉडल में विभिन्न मापदंडों पर असर का प्रणाली की क्षमता पर अध्ययन किया जाएगा।

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वायरलैस सेन्सर नेटवर्क के डेटा संग्रह के डिजाइन मुद्दे और तकनीकः एक सर्वेक्षण
Design Issues and Techniques on Data Collection in WSNs: A Survey

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सारांश

हाल के वर्षों में, वायरलेस सेंसर नेटवर्क बहुत सारे अनुप्रयोगों के प्रभावी समाधान प्रदान करता है। इस नेटवर्क का प्रमुख कार्य पर्यावरण को अनुभव और प्रासंगिक डाटा का संग्रह करना है। डाटा संग्रह अनुभूतित डाटा को इकट्ठा करके प्रसंस्करण हेतु प्रेषक सेंसर से अंतिम सेंसर तक भेजने की प्रक्रिया को कहते हैं। डाटा संग्रह सीधे अंतिम सेंसर तक या बहुत सारे सेंसर से बने हुए मार्ग द्वारा भेजा जाता है। इस आलेख में, वायरलैस सेन्सर नेटवर्क के लिए विभिन्न डेटा संग्रह राऊटिंग प्रोटोकॉल का वर्गीकरण प्रस्तुत किया गया है। राऊटिंग प्रोटोकॉल का वर्गीकरण इन डिजाइन मुद्दों पर आधारित है ये मुद्दे हैं ऊर्जा, उम्र, विलंबता और दोष सहने की क्षमता। प्रभावी डेटा संग्रह के लिए विभिन्न तकनीकें जैसे क्लस्टरिंग, एगरीगेशन, नेटवर्क कोडिंग, ड्यूटी साईकिलिंग, डारेक्शनल एंटेना, सिंक मोबिलिटी और क्रास लेयर समाधानो की पहचान की गई हैं। इस आलेख में इन तकनीकों की कमियां की भी चर्चा की गई हैं।

ABSTRACT

In recent years, Wireless Sensor Networks have become the effective solutions for a broad range of applications. The major task of this network is sensing the environment and collection of relevant data. Data collection is the process of collecting and forwarding the sensed data from the source sensor nodes to the sink for further processing. Data collection is done either directly or through multi-hop based routing. In this paper, classification of different data collection routing protocols for WSNs is presented. Classification of routing protocols is done based on design issues such as energy, lifetime, latency, and fault tolerance. To accomplish effective data collection, various techniques, using clustering, aggregation, network coding, duty cycling, directional antennas, sink mobility, and cross layer solutions have been identified. The drawbacks of these techniques are discussed in this paper.

Keywords: Routing protocols, Wireless sensor networks, data collection, energy efficiency, network lifetime, low latency, fault tolerance

1. INTRODUCTION

Wireless sensor networks (WSNs)[1] are wide spread networks containing a huge number of tiny and lightweight wireless sensor nodes. These networks are used to sense the environment by measuring the essential parameters such as sound, movements, vibration, pressure, temperature, humidity, etc. The sensor nodes in WSN are self organized and connected through wireless communication to the base station (BS) or sink, which collects the information from the sensor nodes. These sensor nodes work with resource constraints such as limited battery, computational communication capabilities. WSNs are widely used in many applications[1,2,3] such as medical applications, structural monitoring, habitat monitoring, intrusion detection, tracking for military purpose, home applications, etc. In major WSN applications, data collection is the most important functionality. In this, the source nodes sense the data from the sensing field and forwards to the BS either directly or through multi-hop for further processing.

The routing protocols used in ad hoc and cellular networks are not suitable to WSNs due to its design challenges such as node deployment, limited resource constraints (battery, processing power, and communication capabilities), and node mobility[4]. WSNs are application specific networks deployed with large number of nodes for data gathering. Because of huge number of nodes global addressing is not achievable. The nodes located in the same area may generate redundant data and transmit the same. This leads to network traffic, bandwidth wastage, and more energy consumption. Finite battery power is the main resource constraint of a sensor node because battery replacement or recharge is not possible in WSN. Energy depletion in a sensor node leads to node failures. This has an impact on network lifetime and quality of data collected. Communication medium in WSN is wireless medium; this increases

the collisions when sensor nodes are communicating with each other which have an impact on network performance. These design issues are to be considered for designing new data collection routing protocol and achieving its requirements such as coverage area, data accuracy, and low latency[5].

Data collection in WSNs can be done in a regular fashion or non-regular fashion. During regular data collection, data has to be collected continuously from sensor nodes. The data have to be collected at some periodic intervals from sensor nodes in non-regular data collection. In Table 1 different applications of WSNs are listed together with the design metrics such as Energy Efficiency (EE), Lifetime (LT), Low Latency (LL), Fault-Tolerance (FT), Security(S), QoS(Q), and Reliability(R). Table I also provides the mapping of the design metric consideration level (Low (-), Medium (+), and High (*)) for each application. The main objective of this paper is to get a better understanding of the different data collection routing protocols for WSNs with respect to energy conservation, lifetime, low latency, and fault tolerance and easy understanding of some existing techniques such as clustering, aggregation, network coding, duty cycling, directional antennas, sink mobility, and cross layer solutions for achieving these parameters.

2. DATA COLLECTION

Based on applications, sensor nodes are installed at a specific location for sensing the data from the environment and forwarding to the BS. The essential requirement of data collection is how accurately sensing and forwarding the data to base stations is done without any delay and information loss.

The process of sensing and forwarding data is done in two stages: stage one is Data dissemination or Data Diffusion and stage two is Data Gathering or Data Delivery[6]. Propagation of data/queries (Network setup/management and /or control collection commands) throughout the network is done in data dissemination stage. Disseminating data/queries with low latency is the main issues for dissemination.

Data Gathering or Data Delivery[7] is the second stage of data collection in WSN, forwarding sensed data to the BS. The most important goal of data gathering is to maximize the number of rounds of communication before node dies in the network. Also, there is a need to conserve minimum energy and minimum delay for each transmission. In data gathering, the communications happens between source sensor node and a BS either by single- hop (direct) or multi-hop. In multi-hop[8] the sensed data is relay to the BS in multi-hop fashion, where intermediate sensor nodes act as relay nodes between source sensor node and BS. Route discovery, energy conservation, low latency, and QoS are the major issues in multi-hop routing.

In single-hop, mobility is introduced with sink nodes, called Mobile Sinks or Mobile Collectors[9]. These nodes move along a trajectory path in entire network such a way that these nodes access the data from all source sensor nodes in a single-hop fashion. The trajectory path to cover all the nodes throughout the network, mobility, and energy conservation are the major issues in mobility based single-hop data transmission.

3.RELATED WORK

Extensive research work has been carried out on routing or data collection protocols with different classifications[4,10-14]. Fig.1 shows the taxonomy of data collection routing protocols.

Table 1. WSN applications based on data collection

Data Collection	Applications		EE	LT	LL	FT	S	Q	R
Regular Data Collection	Health Care	Patient monitoring	+	+	*	*	*	*	*
	Military	Battlefield surveillance	*	*	*	*	*	*	*
	Public/industrial safety	Structural monitoring	*	*	*	*	+	+	*
		Factory monitoring	+	+	*	+	+	+	*
		Machine monitoring	+	+	*	+	-	+	*
		Chemical monitoring	+	+	*	+	+	+	*
	Environmental	Disaster monitoring	*	*	*	*	-	+	+
		Traffic control and monitoring	+	+	*	*	+	*	+
Non-Regular Data Collection	Agriculture	Precision agriculture	*	*	-	+	-	-	*
	Industrial/home	Environment control in buildings	+	+	+	-	-	-	+
		Managing inventory control	+	+	+	-	-	-	+
		Smart home automation	+	+	-	-	-	-	+
	Environmental	Animal monitoring	*	*	-	-	-	-	+
		Vehicle tracking and detection	*	*	-	-	-	+	+
		Disaster damage assessment	+	+	-	-	-	+	+

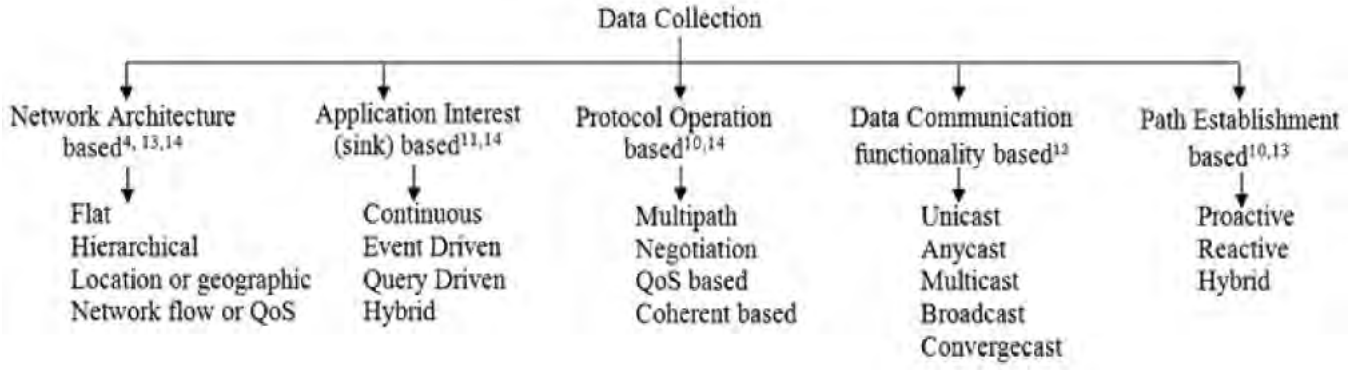

Figure 1. Taxonomy of data collection routing protocols.

Akkaya[4], *et al.* in 2005 classified routing protocols based on network architecture as follows: data centric, hierarchical, and location based protocols. In data centric protocols, sink requests the data by disseminating the queries to the nodes in the network. In hierarchical or cluster based routing protocols, Network is divided into clusters and each cluster is headed by cluster head (CH). Cluster Members (CM) in the cluster are sending the data to the respective CH, which then forward to BS. While forwarding, CH can use aggregation or some data reduction techniques for energy conservation. In location based or geographic based protocols, the position information of sensor nodes are considered for routing.

Tilak[11], *et al.* in 2002 classified data delivery protocols into continuous, event-driven, observer-initiated, and hybrid based on application interest. In continuous model, continuously the sensor nodes communicate their data at pre-specified rate to base station. In event-driven data model the sensor nodes forward information, only when an event occurs. In observer initiated model, the sensor nodes respond with the results to an explicit request from the observer. Finally, hybrid protocols contains the combination of the above three approaches.

Karaki[10], *et al.* in 2004 classified the routing protocols based on protocol operations into multi-path, query-based, negotiation-based, QoS-based, and coherent based protocols. Multi-path routing is using various paths through a network for achieving fault-tolerance, increased bandwidth, and reliability. In query-based routing destination (sink) requests the data by disseminating the queries to the nodes in the network. All nodes maintain interest cache, which stores interest of nodes. If any data received or sensed by a node is matched with the received queries then it forwards the data to the destination. Negotiation-based protocols are reduces the redundant data relays by using data descriptors. QoS-based protocols mainly consider QoS metrics such as bandwidth, delay, and throughput, etc., when routing the data to the BS. The sensed data is forwarded directly to the aggregate node in coherent routing. Where as in non-coherent routing, nodes locally process the data and then forwarded to neighbour nodes. In addition, routing protocols are classified as proactive, reactive, and hybrid protocols depending on path establishment between source and destination.

Han[12], *et al.* in 2013 classified the routing protocols into unicast, anycast, broadcast, multicast, and converge-cast based on the data communication functionalities in WSNs. Unicast routing uses a one-to-one association between sensor nodes. It is used to select one neighbouring node as a relay node for forwarding data. Anycast routing nodes forwards the data to a single member of a group of potential receivers. This is a one-to-nearest association, in which each node maintains a relaying set as its next-hop relaying nodes and its enough to forward data to any node in the relaying set. In multicast routing, sensor node forwards the data to multiple selected neighbour nodes simultaneously in a single transmission. Broadcast routing uses a one-to-many association; sensor nodes forward the data to their neighbour nodes simultaneously in a single transmission. In convergecast, the data is aggregated at relay nodes and forward towards the base station. Unicast/anycast is used for information exchanges within pairs of sensor nodes, broadcast/multicast is needed for disseminating commands or codes to sensor nodes, and convergecast serves mainly for data collection from sensor nodes.

Zungeru[13], *et al.* classified the routing protocols as classical and swarm intelligence based protocol. Further, each protocol is classified into data-centric, hierarchical, location based, network flow, and quality of service (QoS) awareness. In addition, this paper includes proactive, reactive, and hybrid protocols depending on path establishment between source and destination.

Pantazis1[4], *et al.* classified the energy efficient routing protocols into Network Structure, Communication Model, Topology Based, and Reliable Routing. Flat and hierarchical protocols come under the kind of network structure routing protocols. Coherent or Query-based

and Negotiation-based or non- coherent-based protocols come under the category of Communication Model routing protocols. Topology based routing protocols are Location-based. Reliable Routing protocols are classified as Multipath-based or QoS-based.

4. DESIGN ISSUES AND TECHNIQUES FOR DATA COLLECTION

The techniques such as clustering, aggregation, network coding, duty cycling, directional antennas, sink mobility, and cross layer solutions are used to achieve efficient data collection routing protocols were presented.

4.1 Design Issues in Data Collection

Energy and Lifetime: Effective usage of energy is the main issue in WSN because it is the tight constraint of the sensor node. Energy conservation improves the network lifetime. Sensor node consumes most of the energy in two major operations: environment sensing and forwarding data to BS. In Sensing, only the sampling rate influences the energy consumption as a result the energy consumption is stable. However, data forwarding process depends on these factors. Hence, energy saving is possible with this data forwarding process. Network lifetime[15] is the duration from the beginning to the time when any or a given percentage of sensor nodes die. Hence, the main aim of the data collection protocol collects the data with maximum rounds within the lifetime of the network. The data-gathering is the important factor that considers energy saving as well as lifetime. In literature[2,16], the authors have given energy efficient consumption techniques. Anastasi[16], *et al.* in 2009 discussed directions to energy conservation in WSNs and presented the taxonomy of energy conservation techniques such as duty cycling, data driven, and mobility based routing. Rault et al.[2] has discussed the energy conservation techniques and its classification such as radio optimization, data reduction, sleep/wakeup schemes, energy efficient routing, and battery repletion.

Latency is the difference in time between data generation at sensor node and data reception at the base station. It is one of the major considerations for time critical applications such as military and health monitoring. Achieving low latency is a critical issue as of the following reasons: First, sensor nodes are subject to failures due to its limited constraints. Second, the broadcast nature of radio channel increases the collisions and network traffic. Third, different sensor nodes may generate the same data from the same location and this redundant data forwarded to the base station, may increase network traffic and waste bandwidth. There is a need for a low latency data collection protocol to deal with the above issues. Srivathsan and Iyengar[17] have given a survey of some key mechanisms to minimize latency in single-hop and multi-hop wireless sensor networks, which includes sampling time, processing time, propagation time, scheduling, MAC protocols, use of directional antennas, predictions, sleep/wakeup cycles, use of dual-frequency radios and more. Bagyalakshmi[18], *et al.* in 2010 presented a survey on low latency, energy efficient and time critical routing protocols for WSNs without overshadowing the other design factors.

Fault Tolerance[19] assures that usage availability of the system without any interruption in the existence of faults; as a consequence fault tolerance improves the reliability, availability, and dependability of the system. Fault tolerance is one of the critical issues in WSN because sensor nodes are subject to failure due to various reasons including energy depletions, communication link errors, de-synchronization, etc., caused due to software and hardware failures, environmental conditions, etc. For these reasons in WSN fault management must be dealt with carefully. Early survey work can be found on fault tolerance routing in literature[15,19–22]. Yu[20], *et al.* explains the fault management issues in WSN. Three phases are explained for managing faults: fault detection, fault diagnosis, and fault recovery. In fault detection phase, an unexpected failure should be identified by the system. Various fault detection techniques are discussed in literature[20–22]. In fault diagnosis stage, model to distinguish various faults in WSNs is identified. This model is capable in selecting precise fault diagnosis[15] or recovery action. In the fault recovery phase, the sensor network is reconfigured or restructured from failures or fault nodes to improve network performance. Fault recovery techniques are discussed by Alwan[19], *et al.*

4.2 Techniques Used for Data Collection Design Issues

In this Section, existing techniques used for achieving energy saving, long lifetime, low latency and fault-tolerance in WSNs is discussed.

Cluster Architecture is network architecture based effective energy conservation mechanism. In this architecture, network is organized in clusters, where the cluster head (CH) manages each cluster. The member in the cluster forwards the sensed data to their respective CH, which then forwards to BS. This reduces flooding, multiple routes, and routing loops. Hence, network traffic is reduced and low latency is achieved. The main use of cluster architecture is that it requires less transmission power because of small communication ranges within the cluster. The CH uses the fusion mechanism, to reduce the size of the transmission data. CH selection is a rotation process,

which balances the energy saving in the network and improves the network lifetime. However, in cluster based routing protocols cluster head selection plays a critical role. BS location is not considering in these algorithms, which causes the hot spot problem in multi-hop WSNs.

Data Aggregation in WSNs is one of the important methods used to aggregate the raw data originated from multiple sources. In data aggregation schemes, nodes receive the data, minimized the amount of data by applying data aggregation techniques and then forwarded towards the base station. Average or minimum received data are only forwarded by the received node. Hence, it reduces the traffic in the network, with this low latency is achieved. However, the base station (sink) cannot be ensuring the accuracy of the aggregated data that has been received by it and also cannot recover the data.

Network Coding is a technique same as aggregation scheme, where the nodes of a network collects data from neighbours and combines them together for transmission. Network Coding improves the network throughput, efficiency, reliability and scalability, as well as resilience to attacks and eavesdropping. Network traffic in broadcast scenarios can be reduced by sending several packets as a single packet instead of sending individual packets at a time.

Duty Cycling has been considered one of the key energy conservation techniques in WSNs. The radio transceiver of node is switching between sleep and active modes. In duty cycling, radio transceiver of node is move to sleep mode whenever it is not communicating to other nodes. This requires cooperative coordination between nodes when the nodes are working in duty cycling. In this, for communication to occur a node must wait until its neighbor nodes are awake. This increases sleep latency. With duty cycling multi-hop broadcasting is complex because all the neighbouring nodes are not active at the same time.

Directional antennas are used to send or receive signals with greater power in one or more directions at a time, allowing for improving performance in terms of throughput, increase in the transmission range and reduce interference from unwanted sources. Reusing of bandwidth is also possible through these directional antennas. However, there is over head in the optimal antenna pattern selection and transmission power calculations. There is a need to consider hidden and exposed terminal problems.

Sink mobility is the energy efficient technique, where mobility is introduced with sink nodes. The mobile sinks travels across the network and collects the information from nodes with single-hop and then forward the same to BS. Sink mobility scheme increases the network lifetime by minimizing the workload of nodes which are nearer to the BS. It improves scalability of the network by connecting the sparse network. In sink mobility scheme mobile data collector collects the data in single-hop fashion, this also improves reliability. However, the mobile node needs to maintain the trajectory path while moving. It requires synchronization between mobile collector and nodes. Mobility of mobile collector may cause packet loss while data gathering.

Cross layered approach in WSN is energy efficient when compared to layered approach. In the cross-layered approach, the protocol stack is considered as a single system instead of separate layers. Protocol state information is shared among the all layers for interaction across the protocol layers. Implementations of these protocols significantly affect the performance metrics such as energy consumption, latency, and system efficiency

5. EXISTING SOLUTIONS

Existing solutions for achieving energy efficiency, longer lifetime, Low latency, and fault-tolerance have been briefly explained in this Section. Most of these solutions are based on techniques such as clustering, aggregation, network coding, duty cycling, directional antennas, sink mobility, and cross layer solutions.

Peng[23], *et al.* proposed flow partitioned unequal clustering algorithm (FPUC) to achieve longer network lifetime and coverage lifetime. FPUC consist of two phases: clustering and flow partition routing. In the clustering phase, cluster head is elected based on the sensor nodes that have more residual energy and larger overlapping degree. In the flow partition routing, cluster head gathers the data from each cluster node and aggregates this data as a packet and then forwards to the sink through gateway nodes depending on residual energy. The flow-partitioned routing algorithm consists two phases: data flow partitioning phase and relaying phase. In the data flow partitioning phase, the cluster head partitions data flow into several smaller packets and then distributes these packets to its gateway nodes. In relaying phase, every gateway node transmits received information to the next hop with minimum cost.

Wu[24], *et al.* proposed ant colony algorithm for data aggregation (DAACA). This algorithm consists of three phases: initialization, packets transmissions, and operations on pheromones. In the transmission phase, dynamically select the next hop by estimating the residual energy and the amount of pheromones of neighbour nodes. Pheromones adjustments are performed after certain rounds of transmissions. In addition, four different pheromones adjustment strategies such as Basic-DAACA, elitist strategy based DAACA (ES-DAACA), Maximum & Minimum based DAACA

(MM-DAACA), and Ant Colony System based DAACA (ACS-DAACA) are used to prolong the network lifetime. However, in an initialization phase duplication packets are transmitted from sink nodes to initialize the network which leads to energy wastage in the network. Miao[25], *et al.* discussed network coding to solve the problems in the Gradient-Based Routing (GBR) scheme such as:

(i) Broadcasting of interest messages by sink node leads to duplication of packets, which causes more energy wastage in network and

(ii) Due to the unstable network environment in WSNs, point to point message delivery leads to data retransmissions in the network.

Network coding for GBR (GBR-NC) is proposed for the energy efficient broadcasting algorithm, which is used to reduce network traffic. GBR-C and auto-adaptable GBR-C are two competing algorithms proposed to reduce the retransmission attempts.

Chandanala[26], *et al.* proposed mechanism to save energy in flood-based WSNs using two techniques called network coding and duty-cycling. First, they proposed a cross layer technique called DutyCode, in which a Random Low Power Listening MAC protocol that implements packet streaming was designed. The authors have used elastic intervals for randomizing sleep

Table 2. Comparison of existing solutions

Author	Proposed Algorithm	Techniques Used	Metrics	Drawbacks
Peng[23], *et al.*	FPUC	Clustering, Data aggregation, and Multi-hop	Energy, network lifetime, and coverage lifetime	Cluster Head selection overhead
Wu[24], *et al.*	DAACA	Clustering, Data aggregation using ant colony optimization, and multi-hop	Energy, network lifetime	Bottle neck problem nearer to sink node, Overhead in pheromones calculation at each round
Miao[25], *et al.*	GBR-NC, GBR-C, and auto-adaptable GBR-C	Network coding and Multi-hop	Network lifetime, Energy, and network traffic	Transmission delays in competing algorithm
Chandanala[26], *et al.*	DutyCode and ECS	Network coding, duty-cycling, and multi-hop	Energy	Transition between active and sleep states Overhead
Rout[27], *et al.*	ADANC	Clustering, network coding, duty-cycling, and multi-hop	Energy, low latency, and lifetime	Cluster maintenance overhead
Qiu[28], *et al.*	IHR	Clustering and multi-hop	Fault tolerance and Energy	Node unable to find CH leads reliability problems
Assi[29]	MSTP	Data aggregation using compressive sensing, random projection, and multi-hop	Energy, Network lifetime	Computational overhead in MST calculations causes delay and wastage of energy
Ma[30], *et al.*	SHDGP	Mobile collectors and Single-hop	Energy, low latency, scalability, and throughput	High control overhead to maintain the trajectory path, Packet loss due to speed of data collector
Rout[31], *et al.*	ETD-DA	Directional Antennas, network coding, and Multi-hop	Energy, throughput, and low latency	Overhead in optimal antenna pattern selection and transmission power calculations
Boukerche[3], *et al.*	PEQ and CPEQ	Clustering, aggregation, and publish/subscribe mechanism	Fault tolerance, low-latency, and Energy	Traffic overhead

cycles. To eliminate redundant packet transmissions an Enhanced Coding Scheme was proposed, which selects suitable network coding techniques for nodes.

Rout[27], *et al.* intended an energy efficient adaptive data aggregation strategy using network coding (ADANC) to improve the energy efficiency in a cluster based duty-cycled WSN. Network coding reduces the traffic inside a cluster, and duty cycle is used in the cluster network to improve energy efficiency and network lifetime.

Qiu[28], *et al.* put forward a novel energy-aware cluster based fault tolerance mechanism, called the Informer Homed Routing (IHR). IHR is the advanced version of Dual Homed Routing (DHR) in which, each sensor node associated with two cluster heads called primary cluster head (PCH) and backup cluster head (BCH). Sensor node forwards the data to PCH instead of forwarding to both PCH and BCH at the same time. In each round BCH checks the liveness of the PCH using beacon message. If BCH not received beacon message from PCH within three rounds then BCH will announces to sensor nodes that the PCH has failed and transmit data to BCH. Hence, IHR provides an energy efficient fault tolerance mechanism to enhance the network lifetime. However, there is an overhead in cluster head selection process.

Assi[29] proposed a data gathering method using the techniques Compressive Sensing (CS) and random projection to improve the lifetime of large WSNs. To increase the network lifetime the authors opted the method, which evenly distribute the energy throughout the network instead of decreasing the overall network energy consumption. The authors proposed Minimum Spanning Tree Projection (MSTP), a new compressive data gathering method. MSTP creates a number of Minimum-Spanning-Trees (MSTs), each root node of the tree aggregates sensed data from the sensors using compressive sensing. A random projection root node with compressive data gathering helps in balancing the energy consumption load throughout the network. In addition, MSTP is extended to eMSTP, where the sink node acts as a root node for all MST.

Ma[30], *et al.* proposed a mobility based data gathering mechanism for WSNs. A mobile data collector (M-collector) can be a mobile robot or a vehicle arranged with a transceiver and battery. The M-collector traverses through specific path and identify the sensor nodes, which comes within its transmission range while traversing. It then directly gathers the data from sensor nodes, and then forwards to the BS without delays. Hence, this enhances the lifetime of sensors. The main focus of the authors is to minimize the data-gathering tour distance called single- hop data-gathering problem (SHDGP).

Rout[31], *et al.* in 2012 presented an energy Efficient Triangular (regular) Deployment strategy with Directional Antenna (ETD-DA) with 2-connectivity pattern. This pattern is achieved by orienting the directional antenna beam of a sensor in a particular direction towards the sink. Forwarding of data in the network is based on network coding for many-to-one traffic flow from sensors to sink. The proposed approach achieves better connectivity, energy efficiency, and robustness in delivering data to the Sink.

Boukerche[32], *et al.* proposed periodic, event-driven, and query-based protocol (PEQ) and its variation CPEQ. PEQ is designed for achieving the following: low latency, high reliability, and broken path reconfiguration. CPEQ is a cluster based routing protocol. The publish/subscribe mechanism is used to broadcast requests throughout the network.

Table 2 compares the different solutions proposed, the techniques used and the metrics considered. Also the drawbacks of each solution are presented in Table 2.

In the process of data gathering, energy conservation had been the main objective. The above discussed existing solutions for energy efficient data gathering concentrated on the following issues:

- Redundant data forwarding,
- Data storm problem or congestion nearer to the base station,
- Path selection in multi-hop routing, and
- Data aggregation operations.

River Formation Dynamics (RFD)[33,34] is one of the heuristic optimization method and subset topics of Swarm intelligence. RFD is based on replicating how water forms rivers by eroding the ground and depositing sediments. These rivers joined into sea by selecting the shortest path based on altitudes of the land. So for RFD has not been used to solve the above issues in WSN. We would like to propose a solution to solve path selection in multi-hop routing using RFD. By applying RFD looping in multi-hop routing can be minimized. This work will be carried out shortly and results published.

6. CONCLUSION

In this paper a detailed classification of data collection routing protocols in WSN is discussed. Data collection routing protocols use various techniques, such as clustering, aggregation, network coding, duty cycling, directional antennas, sink mobility, and cross layered solutions. These techniques are discussed for accomplishing energy efficiency, long lifetime, low latency, and fault-tolerance. Finally, this paper presents a comparison among existing solutions available on data collection. Further, we would like to propose a novel effective data collection routing method by considering the drawbacks of each solution, which are discussed in this paper.

निष्कर्ष

इस आलेख में, वायरलैस सेन्सर नेटवर्क के लिए विभिन्न डेटा संग्रह राऊटिंग प्रोटोकॉल का विस्तृत वर्गीकरण की चर्चा की गई हैं। डेटा संग्रह राऊटिंग प्रोटोकाल विभिन्न तकनीकें जैसे क्लस्टरिंग, एगीरीगेान, नेटवर्क कोडिंग, डयूटी साईकिलिंग, डारेक्षनल एंटेना, सिंक मोबिलिटी और क्रास लेयर समाधानो का उपयोग करता हैं। इन तकनीकों की चर्चा ऊर्जा दक्षता, लंबी उम्र, कम विलंबता, और दोा सहनषीलता के लक्ष्यों की पूर्ति हेतु की गई हैं। अंत में, यह आलेख डेटा संग्रह पर उपलब्ध मौजूदा समाधान के बीच एक तुलना प्रस्तुत करता है। इसके अलावा, हम इस आलेख में नवीन प्रभावी डाटा संग्रह राऊटिंग विधि की, प्रत्येक समाधान की खामियों को ध्यान में रखते हुए प्रस्तावित करते हैं जो कि इस आलेख में वर्णित हैं।

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साइबर युद्धप्रणालीः भारत में मौजूद मुद्दे और परिप्रेक्ष्य
Cyber Warfare: Issues and Perspectives in India

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सारांश

साइबर सुरक्षा और सहयोग का मुद्दा राष्ट्रीय सुरक्षा के एक महत्वपूर्ण नए पहलू के रूप में उभरा है। एक संरक्षित और सुरक्षित साइबर स्पेस सुनिश्चित करना सरकारों की दिनोदिन बढ़ती प्राथमिकता बन रहा है क्योंकि अब यह मानव जीवन के प्रत्येक पहलू को छूता है। व्यक्ति विशेष और निगमों से लेकर राज्यों तक हितधारकों की विविधता अतिप्रभावी साइबर सुरक्षा परिदृश्य में विभिन्न प्राथमिकताओं और परिप्रेक्ष्यों में सामंजस्य बैठाना एक कठिन कार्य बना देती है। साइबर युद्धप्रणाली में अनेक गतिविधियां शामिल होती हैं जैसे जासूसी और विध्वंस के लिए कम्प्यूटर नेटवर्क को हैक करना। पूर्व राष्ट्रपति और प्रख्यात वैज्ञानिक ए.पी.जे. अब्दुल कलाम ने एकबार कहा था "साइबर युद्धप्रणाली राष्ट्रीय सुरक्षा के लिए सबसे बड़ा खतरा है जो सुरक्षा खतरे के रूप में बैलिस्टिक मिसाइलों को अमहत्वूर्ण बना देगा।"

ABSTRACT

The issue of cyber security and cooperation has emerged as an important new aspect of national security. Ensuring a safe and secure cyber space is a increasing priority for governments as it now touches almost every aspect of human existence. The diversity of stakeholders, from the individual, to corporations, to states makes reconciling of different priorities and perspectives in an overarching cyber security scenarios a difficult task. Cyber warfare includes a host of activities like hacking computer networks for espionage and sabotage. Former President and eminent scientist A.P. J. Abdul Kalam has once said that Cyber warfare is the biggest threat to national security which will render even the ballistic missiles insignificant as a security threat.

Keywords: Cyber warfare, cyber security, cyber space, India

1. INTRODUCTION

We observe in our day to day life that information revolution has contributed a lot to make this world a better place to live, owing to its intrinsic characteristics of the exponential rate of growth in data processing speed and ability to share information knowledge across the globe in real time. It has impacted in many areas like freeing the society of oppressive state power, enabled the poor societies to modernize,enabled maintenance of international peace and also bringing in the Revolution in Military Affairs (RMA).

Despite all these goodies provided by Information and communication technologies (ICT) it has also brought some incomprehensible challenges to the security community all over the world. The negative personality traits of individuals, groups under the cover of inherent anonymity of ICT are finding manifestation in cyber space. The US governments National Strategy to Secure Cyberspace defined It as: 'Cyberspace is composed of hundreds thousand of interconnected computers, servers routers, switches and fabric optic cables that allow our critical infrastructure to work.

We can define national security in a simple way as 'the situation in which vital interests of nation are safe from substantial interference and disruption' and security as a 'condition in which states consider that there is no danger of military attack, political pressure or economic coercion'. Thus it can be concluded that security is not just a military issue, it relates to safeguarding the vital political, economic and strategic interests of the nation.

2. THE CYBER WORLD

One of the landmarks in technological developments in the electronic age is the rise of computers. The cyber technology has enabled the convergence of information and digital media, revolutionized the availability of information in terms of ease, efficiency, economy and wider and immediate reach with respect to any other form of media including the print media. The cyber

technology has given the power to store enormous amount of data and information into an insignificant equivalence of space memory, as compared to conventional methods along with easy access and availability. But with power comes the great responsibility.

The internet is the battle field for cyber war. It has a significant role to play in the global communication, research and development information exchange and business expansion. Internet is a labyrinth as the system is so interconnected and it commercialisation is to such an extent that it is impossible to define boundaries. And as so it has become the most used medium for cyber crimes.

To analyze the possible implications of current development on security we need to analyze from where and how the cyber power manifests itself. It is a very fuzzy (confused and not expressed clearly) concept. An attempt has been made to investigate the role of India as a developing nation state to secure cyber space by building up cyber deterrence capabilities in the form of plausible deniability and retaliation capability and further operationlising these capabilities through a comprehensive policy framework taking into account factors peculiar to India such as: the existing digital divide between developed and developing nations; coexistence of multiple socio-economic categories in the country; interdependence of cyber-space related resources among nation states; political will and vision on the information age.

Many noticeable incidents like; Rome Air Force Lab incident!1994), Kosovo War (1995) Estonia Crisis (1995) in which the computerized infrastructure of Estonia's high-tech government began to fray, victimized by what experts in cyber security termed a coordinated "denial of service"(DOS) occurred. This led a new thinking among cyber experts and several interrelated points came to the fore.

- Cyber warfare has the potential to bring a country to an economic standstill.
- Offensive actions in space can often provide a great deal of deniability. This has come up as a smart weapon of choice for inflicting blows without involving in a direct war.
- Attack can be executed from almost anywhere in the world without consideration for strategic geographic buffers.

3. UNDERSTANDING CYBER SPACE AND CYBER POWER

While cyber space is a bio-electric environment that is literally universal, it exists wherever there are telephone wires, coaxial cables whereas cyber power is the capacity to wage cyber warfare. Cyber power is that intangible virtual asset which exists in cyber space and is directly proportional to the degree of control individual or groups or a non state actor or a state could exercise over cyber space in its favor. It includes many dimensions like economic political and military dimensions.

Cyber warfare is a war waged in cyber space. It includes defending information and computer networks, deterring information attacks, as well as denying the adversary the ability to do the same. T can include offensive information operation mounted against an adversary, or even dominating information on the battlefield. It includes network penetration, DOS attacks on computers and networks, equipment sabotage through cyber space, and sensor jamming. It also includes manipulating trusted information.

The concept of world politics is essentially a struggle for power between nation-states. One school of thought introduced political realism, scholars like George Kennan and Hans Morgenthu emphasized the importance of military strength as index of state power. Later on historians focused on how nation-state was increasingly finding itself challenged for events that originated beyond its borders and whose impact transcended national boundaries.

Today we find a clear impact on information and communication technologies on contemporary society. The reality of today is that the trans-national architecture of global information network has made territorial borders less significant; the application of information technologies to both the military and civilian realms leads to blurring of boundaries between the political, military and civilian spheres. The information revolution has dramatically increased the importance information in the strategic world, alongside existing traditional military capabilities and information domain has moved centre stage in combat operations.This has given rise to newforms of warfare. Many aspects of modern warfare are conducted so called "information operations", with substantial implications for military affairs, politics and society as a whole.

The change in scope and space of warfare brings new challenges for protection of society. The development towards willful integration of civilian infrastructure and stronger shift towards deception of entire societies is alarming. Current trends such as the opening up of markets and liberalization of markets, globlisation processes that stimulate the cross-national interconnection of infrastructure and widespread access to telecommunication networks, are heightening the security requirements of infrastructure in countries across the world.

Certain observers find important tendencies toward convergence between military and civilian technologies, leading to the militiarisation of society at large and turning every conflict into information warfare and, as a consequence thereof, they point to the "sham humanitarian nature of information weapons."

Information Communication Technologies has enabled a big change in Military Affairs Application of recent technological developments to the whole range of weapons systems, information gathering, communication and surveillance, regard the global information environment as having become a "battle Space in which technology is used to deliver critical and critical content in order to shape perceptions, manage opinions and control behaviour" . The hallmark of information revolution is it has transparency of events and the global immediacy of coverage, the concept of cyber warfare and information operations play an increasingly important role to the extent that, for some, "the most effective weapon in the battlespace is the information's" dramatic development in networking technologies, networking infrastructure technologies, standardization of transmission protocols and data links that are enabling factors for the shift of military thinkers from platform-centric to network-centric concepts.

Vulnerabilities in both the military and civilian infrastructures are believed to be on the rise due to increasingly complex interdependencies. In addition, overall capacity of malicious actors to do harm is seen to be enhanced by inexpensive, ever more sophisticated, rapidly proliferating, and easy to use tools in cyber space. Sometimes experts reject the notion that cyber warfare is less violent than conventional conflicts.But the states will have to address potential threats to security that will likely to emerge as a result of an unequal distribution of soft power. Countries, regions and various groups already suffering economic hardship and political and cultural alienation are unlikely to feel the benefits of information technology easily.

4. ORGANISATIONAL SETUP IN INDIA

In India, the primary approach was initially on economic aspects with a gradual shift towards safeguarding national security The Information Technology Act of 2000 which came into force on October, 17, 2000 was enacted largely to facilitate e-commerce, with cyber crime referred to only in that context. The preamble of the IT Act only provided legal recognition for transaction carried out by means of electronic data interchange and other means of electronic communication. To remove some minor errors in IT Act-2000, the Act was again amended under Information Technology (Remove of Difficulties) Order 2002 and passed on September 19,2002 further amendments were done in 2008 and the Act was called as Information Technology (Amendment) Act, 2008.

As of now in India there are more than 12 agencies that are listed as 'stakeholders' in cyber security in a recent draft National Cyber Security Policy document released on 26 March 2011. Real oversight over cyber security could be said to be distributed among the ministries of communication and technology, home affairs, and defence and office of the national Security Advisor. On the military side also there is a profusion of agencies ranging from the Corps of Signals, to the Army Computer Emergency Response Team (A-CERT), to the IT departments of various headquarters and the Integrated Defence Staff (IDS). The Defence Information Assurance and Research Agency (DIARA) has been made the nodal Agency mandated to deal with cyber security related issues of Tri Services and Ministry of Defence' according to a statement made by defence minister in parliament in 2010. Some agencies like National Disaster Management Authority (NDMA) of Indiapay a peripheral role and many of the sectoral CERTS are yet to come up.

Ensuring the security and integrity of the networks that connect the critical infrastructure is of paramount importance since crucial sectors such as financial, energy, transportation, and telecommunications are connected through cyber networks. The horizontal and vertical expansion of the user base has meant that while the threats and vulnerabilities inherent in the internet and the cyberspace networks might have remained more or less the same, as before, the probability of disruption has grown apace with the rise of number of users.

In an era where interconnected networks are critical arteries of human existence and knowledge has become a valuable commodity, this represents serious threats to national security.Therefore in addition to securing critical infrastructure and government information networks, government also have to ensure the public at large that cyber networks on which they have become increasingly dependence.

Indian Computer Response Team (Cert-In) is the most important constituent of India's Cyber community. National information security assurance programme (NISAP) is formulated for protection of Government and Critical infrastructures. The highlights of NISAP are:

(a) Government and critical infrastructure should have a security policy and create a point of contact.
(b) Mandatory for organizations to implement security control, and report any security incident in Cert-In.
(c) Cert-In to create a panel of auditor for IT security. All organizations to be subject to third party audit from this panel once a year.
(d) Cert-In to be reported about security compliance on periodic basis by the organizations.

5. INDO-US CYBER SECURITY COOPERATION

This forum was set up in 2001, high power delegations from both sides met and several initiatives

were announced. An information Sharing and Analysis Centre was set up for better cooperation in anti hacking measures. Indo-US cyber security cooperation has become a staple discussion of high level summits and subsequent joint statements in the recent past.

The US and Indian government are intensifying on-going cooperation to address national security issues from the increasing interdependency of our critical network information systems involved in out sourcing business processing, knowledge management, software development and enhanced inter-government interaction.

On the Indian side, the emphasis has been on capacity building and research and development, and the form has provided opportunity to initiate a number of programmes in this direction. One area there is considerable scope is for cooperation is in Research and Development which, in context of cyber Security, can run the full gamut from removing loopholes in the hardware and software to creating tools law and enforcement and intelligence agencies and for, military purposes.

Today as the time between the requirement, availability andcollection of information continues to shrink, possessing, exploiting and manipulating information has become an essential part of warfare; those actions have become critical to the outcome of contemporary and future conflicts. The ability to observe, orient, decide, and act (OODA) faster operational skills faster and more effectively than an adversary is a key part of the equation.

Information warfare is split in offensive and defensive modes. Offensive activities include: military deception measures designed to mislead the enemy by manipulation, distortion and falsification of evidence. The defensive modes include activities such as operation security which denies knowledge of operation to the enemy. There by decreasing the effect of enemy's deception activities. The defensive side of information warfare is concerned with the protection and integrity of data, people within the systems.

Military Deception occurs when someone manipulates perception. Deception guides the enemy into making mistakes by presenting false information, images or statements.The aim of Military Deception (MILDEC) is to execute actions to mislead adversary military-decision makers with regard to friendly military capabilities. One of the changes brought about by networking and the information available on the net is that sophisticated attacks which were the domain of net savvy personnel now can be carried out by kids for fun or by armatures. As systems become ever more complicated, even sophisticated attackers are heading this way. Hacking is progressively becoming simpler while defence is becoming unimaginably complex.

According to the Information operation; Doctrine,Tactics Techniques, and Procedures Field Manual 3-13 of The United States Army, the threat source of network operations are as follows.

- Hackers
- Insiders
- Activist non-state actors
- Foreign IT activities
- Information fratricide

The boundaries among these threats and among capability level are indistinct, and it is often difficult to discern the origin of any particular incident.So the issue of cyber security has added a new dimension to the national security. Information operations have become extremely important aspect of war fighting. They are integral to the successful execution of military operations as they ensure efficient and effective application of lethal and non-lethal effects on battlefield to exploit or degrade the threats ability to retaliate.

6. CONCLUSION

Thus, cyber warfare is a totally new aspect of technology at war. The biggest handicap is dealing in cyber warfare is that so little is known, except for a few scientists whether in uniform or not. And yet every citizen needs to understand at least in general,if not specific scientific detail the implications of using modern communication and information systems ranging from the telephone to the internet.

निष्कर्ष

इस समय भारत में इलेक्ट्रॉनिक स्वरूप में व्यापार एक सबसे अधिक फलता–फूलता क्षेत्र है। यह पिछले कुछ वर्षों से व्यापार के क्षेत्र में क्रांतिकारी परिवर्तन लाने वाला रहा है और अब इस पर इसका अत्यधिक प्रभाव है। इसने बहुमूल्य समय और ऊर्जा की बचत कर बहुत हद तक आम आदमी के जीवन में सुधार किया है। वाणिज्य के क्षेत्र में सूचना प्रौद्योगिकी के उपयोग से बड़ी मात्रा में समय, ऊर्जा और कागजी कार्यों की बचत होती है। शासन–व्यवस्था में आईटीसी ने लोगों को अपने घरों में बैठकर माउस के एक क्लिक पर सरकार से संबंधित सभी कार्यों को आसानी से करने के!

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एकीकृत साइबर सुरक्षा के लिए इंटेलिजेंट एकीकृत मॉडल
Intelligent Unified Model for Integrated Cyber Security

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सारांश

इस पत्र का मुख्य उद्देश्य एक नई इंटेलिजेंट एकीकृत साइबर सुरक्षा प्रणाली मॉडल (आईयुमिक्स) का सर्वे, समीक्षा और विश्लेषण करना है। यह मॉडल दुनिया को साइबर खतरों से मुक्त करने एवं सही प्रभावी ढंग से समाधान करने मे सक्षम होगा। एक एकीकृत साइबर सुरक्षा तकनीक मॉडल के डिजाइन में मौलिक समस्या केंद्रीय नियंत्रण और पूरी प्रणाली की निगरानी करना हैं। पारंपरिक साइबर सुरक्षा मॉडल वर्तमान साइबर पर्यावरण मे भविष्य के साइबर खतरों एव समस्याओं को संभालने, समाप्त करने एवं उपयोगकर्ताओ की आवश्यकताओं को पूरा करने मे सक्षम नही है। कुछ उपलब्ध तकनीकों को एकीकृत कर एक साथ काम एवं सहयोग करने से आईयुमिक्स मॉडल सक्षम एवं उपयोगी बन जाता है। इस मॉडल मे कुछ इंटेलिजेंट तकनीको को समायोजित किया गया है जो कि भविष्य की साइबर सुरक्षा के लिए आवश्यक हैं, जैसे की एफसीडीस, साइबर सुरक्षा रणनीति, अगली पीढ़ी घुसपैठ का पता लगाने प्रणाली (एनजी–आईडीएस), भविष्य पूर्व चेतावनी प्रणाली (ईडब्ल्यूएस), तकनीकी–सामाजिक साइबर सुरक्षा चेतावनी प्रणाली (टीएससीएस), बादल डाटाबेस सेवाओं, साइबर युद्ध (सीडब्ल्यू) रणनीतियाँ, खतरा विश्लेषक, साइबर सुरक्षा विश्लेषक, साइबर सेंसर, अगली पीढ़ी एकीकृत खतरा प्रबंधन (एनजी–युटीएम), अगली पीढ़ी–इन्ट्रुजन जांच प्रणाली (एनजी–आईडीएस) आदि। इस पत्र के द्वारा विभिन्न मौजूदा साइबर सुरक्षा इंटेलिजेंट तकनीको और पद्दितयो का सर्वेक्षण, समीक्षा और विश्लेषण किया गया है। यह मॉडल साइबर स्पेस मे एक मजबूत, विश्वसनीय, कुशल और त्वरित उत्तरदायी परिणाम देने में सक्षम होग, जिसकी श्रेष्ठता से साइबर सुरक्षा संचालन के दौरान बेहतर परिणाम और उपयोगी सहायता मिल सकेगी।

ABSTRACT

The objective of this paper is to survey, review and analyse a new Intelligent Unified Model for Integrated Cyber Security (IUMICS) System. This model can work effectively and accurately to find solutions of cyber threats to create free cyber world. The fundamental problem in designing a unified model is integration of cyber security technique which can, centrally control and monitor the complete system. The traditional methods of cyber security models are not able to handle current and future cyber threat problems of cyber environment to fulfil up to end user requirements. Some techniques become more useful when the work along other IUMICS system. This model can include such intelligent techniques that are required for the future cyber world like FCDS, cyber security strategies, next generation-intrusion detection system (NG-IDS),future early warning system (EWS), technical-socio cyber security (TSCS) warning system, Cloud Database services, Cyber Warfare (CW) Strategies, Threat Evaluator, Cyber Security Analysts ,Cyber Sensors, Next Generation- Unified Threat Management (NG-UTM),Next Generation –Intrusion Detection System(NG-IDS), etc. In this paper a survey has been carried out to review and analyse the various existing cyber security intelligent techniques and strategies. It will result in a robust, reliable, efficient and quick responsive system to assist during the cyber security operation and approach to obtain better results in the cyberspace superiority.

Keywords: Cyber security strategies, federated cyber defence system, technical-socio cyber security warning system and early warning system

1. INTRODUCTION

The most common problems in the cyber world are cyber threats. Most of the cyber defence techniques are working in more effective manners in day to day activity, but the rate of cyber threats growth is faster compared to cyber defence solutions. A nuclear war may not be on the immediate horizon, but a cyber war has the potential to bring major cities worldwide to a standstill and affecting everything like banking, traffic networks, hospitals and even

electricity grids etc. Hence this reflects the need of integration of all techniques in a single platform for controlling and monitoring purpose. Federated cyber defence system (FCDS) was developed to minimize the number of threats and attacks that may affect the domain connected to the open network. Being technical-socio in nature, successful information systems security process relies on two pillars: technology and humans. In cyber space, information security is not limited within a local entity; it is in a working group, an organization or even a whole nation. If the security process is to be managed effectively and efficiently, then it is expected to have better understanding about the security mechanisms. Harmful activities cover broad spectrum of cyber threats and potential cyber attacks. Everybody relies on networks, and nothing can operate unless the networks function correctly. They can influence communication links, data resources, their integrity, confidentiality and availability [1]. General Douglas MacArthur once said "There is no security on this Earth, there is only opportunity".

2. IUMICS APPROACH

The main objective of the work is to review, analyse, design and develop an Intelligent Unified Model for Integrated Cyber Security (IUMICS) Monitoring and Controlling System that integrates a number of intelligent techniques, they collect time-series situation information, perform intrusion detection, keep track of event evolution, characterize and identify security events so that corresponding defence actions can be taken timely and is an effective manner.

Different organizations have different expectations on the tasks and responsibilities of the previously developed cyber security model. The differences are generally concerning the management and supervision of the responsibilities. The key and primary role of the IUMICS across the organization would be the same and include the following responsibilities:-

- Collecting and filtering computer network traffic.
- Analyzing the traffic for suspicious or unexpected behaviour.
- Discovering system misuse and unauthorized system access.
- Reporting to the appropriate parties and working to prevent future attacks.
- Centrally monitoring the whole system.

IUMICS consult the output of an automated system that provide them with network data that have been automatically collected and filtered to focus the IUMICS attention on data most likely to contain clues regarding attacks. These automated systems such as firewalls, border gateways, intrusion detection systems (IDSs), anti-virus systems and system administration tools produce log files and metadata that the IUMICS can inspect to detect suspicious activities. The IUMICS activities classified into three categories; reactive, proactive and security quality management. The Intrusion Detection Systems may have the automated incidence response in place for some kinds of attacks, but for others the onus is on the analyst to respond. Alerts from Intrusion Detection System (IDS).The cyber security IUMICS get filtered raw data from the Intrusion Detection System (IDS). This data could be network packet traffic, net flow data or host-based log data. The IDS makes initial filtering decisions based on the pre-loaded attack signatures. This process can include decisions about tuning data collection and IDS signatures to catch all new related data. The response to an incident can be automated by the IDS itself; it can be done by the cyber security analyst.

Various Cyber Panel technologies from the different areas have been integrated into an advanced cyber defence system known as Integrated Cyber Panel System [2].The Integrated Cyber Panel System is designed to provide cyber awareness and control for survivability. This system helps the operator defend the enclave against cyber attacks and maintain mission-required enclave functionality. The successful executions of many commercial, scientific, and military applications require timely, reliable, and accurate information flow in cyber space to support online transactions and remote operations. Developing effective security monitoring mechanisms to provide cyber situation awareness has become an increasingly important focus within the network research and management community. It integrates technologies and concepts in the integrated cyber security control panel areas [3].

Many infrastructure components have been developed to facilitate integration of these technologies including high-level models of the network mission and common underlying communication tools. Cyber Panel technologies provide either awareness or response functionality. The technology of Cyber Security Monitoring (CSM) is based on observation, experience, and classification of attacks, vulnerabilities, and countermeasures. The system of Integrated Cyber Security (ICS) protection should be invariant to a device through which a user gets an access to ICS.

A result of a security model has been proposed based on the analysis of contemporary cyber threats and cloud technologies, thereby creating a safe virtual environment for the end user. This model is invariant to operating system platform and device performance, because of using security services in the cloud aimed to analyze and detect a cyber threat, as well as provides a range of services such as vaccination, certification and tokenization to ensure certain level of user's security.

The unified approach for cyber security monitoring system is required in the current time, because this approach is a combination of all robust and reliable solutions of the integrated cyber security techniques. Despite reasonable investment in security tools and technologies, several successful attacks have proved that something more needs to be done to effectively detect and manage the growing numbers of threats. One of the major causes is the lack of synergy between various functions and tools within the security domain itself and across layers including physical, network, user, data and application security. Hence, in order to evolve a successful response strategy for cyber security, it is important to look at all these layers holistically and leverage the information available at every layer to develop an overall threat and response model.

In order to ensure a unified and holistic approach to cyber security, it's important to convert data available across various layers and across different functions/ tools into real actionable intelligence. The various critical steps are involved in building a unified cyber security monitoring and management frameworks as risk awareness, environment awareness, identity and data awareness, business awareness, content visibility and hidden intelligence etc. Most importantly, for any cyber security solution to work, it must be managed effectively and evolve continuously.

The overall cyber security framework should be capable of being upgraded and flexible enough to add new innovations, scale to meet new technology architecture like cloud, mobility and evolve to counter the latest emerging threats. This model is unique, more powerful, reliable, robust, and efficient as compared to previously developed cyber security models. This in fact, presents drastic change in cyber security against the cyber threats. This model can create a cyber threat free environment in cyber space using the various techniques and algorithms for both static and mobile networks. Countering focused and targeted attacks requires a focused cyber security strategy. Organizations need to take a proactive approach to ensure that they stay secure in cyber space and adopt a robust cyber security strategy which should be implemented through the IUMICS. IUMICS covers the best functions of cyber security like, risk driven, holistic, adaptable, efficient, collaborative etc. The main drawback of the today's cyber security model is its high computation cost and poor accuracy.

3. IUMICS TECHNIQUES

Analysis and evaluation of the techniques of cyber security and their results are depicted. Cyber security techniques protect our network from the outside and inside cyber threats and attacks. These techniques are becoming more useful in day to day activity with the increased cyber threats and crimes. Some of the techniques are reviewed and analysed, which are very efficient, reliable, highly accurate, robust, and quick in response in the future cyber world. The major techniques and components of the IUMICS model are shown in Figure 1.

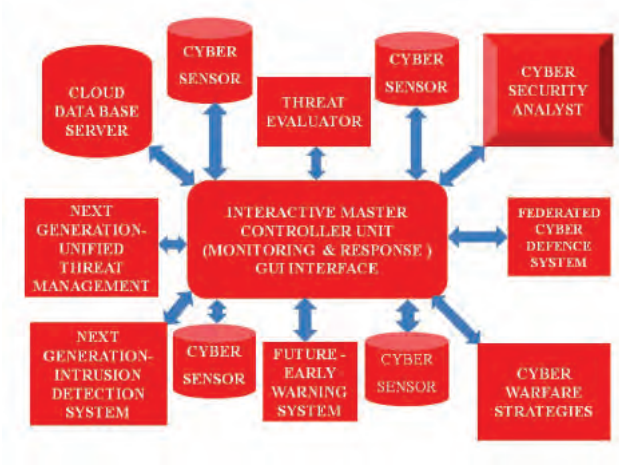

Figure 1. Intelligent unified model for integrated cyber security (IUMICS) monitoring system.

3.1 Cloud Database Server

The goal of the simulation is to create the need and opportunity for team interaction. They interact, by exchanging information both verbally and electronically, for making decisions individually and as a team. These interactions are continuously logged on to the database server in real time monitoring.

3.2 Threat Evaluator

The threat evaluator primarily classifies the classes of threats. The threat classes are identified to categorise the functionality of the threats and the results are sent to master controlling authority. The main purpose of the master controller is to query an attack scenario, the events associated with that particular attack scenario, along with some associated noise events from the database. The Master Controller distributes the events from the database to each of the cyber security host system on per role basis.

4. CYBER SECURITY ANALYST

Cyber security analyst in the context of this simulation refers to the participants. Each participant is assigned a role name corresponding to his/her specialization. The cyber security analyst also plays a major role in IUMICS model.

5. CYBER SENSORS

Cyber physical systems (CPSs) are the integration of abstract computations and physical processes, in which sensors, actuators, and embedded devices

are networked to sense, monitor, and control the physical world. The CPS reflects the decision to the physical world through a sequence of control processes.

6. NEXT GENERATION–UNIFIED THREAT MANAGEMENT (NG-UTM)

UTMs represent all-in-one security appliances that carry a variety of security capabilities including firewall, VPN, gateway anti-virus, gateway anti-spam, intrusion prevention, content filtering, bandwidth management, application control, data leakage prevention(DLP), deep packet inspection(DPI) and centralized reporting. The official definition of UTM is "Products that include multiple security features integrated into one box". Identity-based security solutions can secure every move at work, at home and at travel – from the network gateway to the endpoints. It binds security with your identity and works as a private security guard. It is the first UTM that embeds user identity in the firewall rule matching criteria, offering instant visibility and proactive controls over security breaches and eliminating dependence on IP Addresses. UTM unique Layer 8 technology treats USER as the 8th layer in the network stack [4]. UTM identity-based security offers a high degree of granularity, making policy-setting an efficient process down to the user level that can be extended to any combination of group, job function or application.

7. NEXT GENERATION-INTRUSION DETECTION SYSTEM (NG-IDS)

The Intrusion Detection is carried out as NG-IDS. Multiple detection techniques have to be combined. A behaviour-based analyse of the network traffic is done to detect known as well as new, yet unknown threats. The needed model has to be built in an unsupervised fashion in such a way, that no endangered learning phase is needed. Cross-site correlation between systems and networks can be used to reduce the false alert rates of the anomaly detection efficiently [5]. There are three basic approaches to carry out Intrusion Detection in encrypted communication, namely protocol-based, intrusive and non-intrusive.

8. FUTURE EARLY WARNING SYSTEM (EWS)

Early warning system (EWS) is a main part of the future cyber defence. A next generation early warning system is securing the internet of the future. The need to protect the infrastructure of the Internet of the Future, as well as to manage such a security infrastructure has to have the highest priority [6].

If it is assumed that data and services will be located, respectively provided in "clouds", then the architecture of a EWS must address this virtualisation aspect. Although virtualisation is a mainstream technology nowadays, it seems that security issues are often an afterthought. Existing security models and practices cannot be directly applied to a vastly different environment. Furthermore, virtualization principles could change drastically the way we do security, that forces to rethink how to manage these security items.

In recent years we have witnessed a growing series of threats and attacks on the Internet and on applications and databases. Through denial of service attacks, viruses, phishing, spyware and other malware, criminals disrupt service provisioning and steal personal or confidential business data for financial gain or other purposes.

In respect to these characteristics the aim of our requirements is the development of an efficient cooperative Early Warning System for future networks. In the current environment of the Internet, multiple distributed and heterogeneous networks are connected at which no encryption is done or is only partial.

9. TECHNICAL-SOCIO CYBER SECURITY WARNING SYSTEMS

This technique is more useful and robust, provided that it is implemented in all organizations and units. Cyber security is a global problem that requires collaboration and coordination between all countries. In order to address this vulnerability all nations should suggest a developing platform that eliminates the existing technical- socio gap between cyber security warning disseminators and end recipients. A technical-socio cyber security coordination system TS $(CS)^2$ is collaboration between the cyber security warning system original data and updated warning data. As subscribers to the TS $(CS)^2$ platform, member organizations have to regularly feed the platform operators with the information about their security implementations at the different technical and social areas, policies, operations, practices and technical implementations. The TS $(CS)^2$ operators will collect this warning and analyze it from technical-socio perspective. The TS $(CS)^2$ platform will then disseminate a guided version of the warning to the subscriber. Guided warning will ensure those subscribes are effectively responding to security warnings [7].

10. CYBER WARFARE (CW) STRATEGIES

Cyber warfare is internet-based conflict involving politically motivated attacks on information and information systems. cyber warfare attacks can disable official websites and networks, disrupt or disable essential services, steal or alter classified data, and criple financial systems among many other possibilities. Inside cyber warfare, any country can wage cyber

war on any other country, irrespective of resources, because most military forces are network-centric and connected to the internet, which is not secure. The most effective protection against cyber warfare attacks is securing information and networks. Cyber warfare refers to politically motivated hacking to conduct sabotage and espionage. It is a form of information warfare sometimes seen as analogous to conventional warfare although this analogy is controversial for both its accuracy and its political motivation. Any software-controlled system that can accept input can theoretically be infiltrated and attacked. Cyber attacks immediately follow physical attacks, cyber attacks are increasing in volume, sophistication, and coordination, cyber attackers are attracted to high-value targets, Many, if not most, targets would probably be commercial computer and communications systems, organised crime, terrorist groups [8].

11. FEDERATED CYBER DEFENCE SYSTEM (FCDS)

FCDS is a system prototype designed for the improvement of federated network cyber security. Each domain of FCDS consists of the following elements: a number of sensors (S), a decision module (DM) and a number of reaction elements (RE) [9]. The sensors forward the information to the decision module with alarms when an event is observed in the network. Decision module performs reasoning analyse and makes decision if the observed action is an attack and produces appropriate rules applicable to reaction elements. Decision modules are deployed in autonomous networks which share information about detected attacks and recommended reactions. It is assumed that information exchange between them is voluntary as well as the use of recommend reactions depends on internal domain security policy and administrator decision. When set of domains are functioning together then those are able to produce a result that is not independently obtainable. Reliable and secure communication is required for sensor data collection, distribution and reaction element remote control. The dynamic physical world and complexity of cyber world present many challenges in CPS analyse and design, such as storage restriction, resource constrain, network bandwidth, and so on. The FCDS support the flexibility integration of loosely coupled services and components. The typical applications of CPS includes: intelligent transportation, precision agriculture, and medical cyber physical system. This section analyses the technique for protecting the network from the cyber threats which arises due to attacks on the network.

12. CONCLUSIONS

In this paper various latest research techniques for cyber security have been reviewed and analyzed. An efficient and accurate cyber security model has been presented. An Intelligent Unified model for integrated cyber security (IUMICS) framework for the future internet has been analysed. The proposed model improves the performance of each cyber security technique and integrates all on a single platform for controlling and monitoring the whole cyber network.

The integration of all the techniques is always a challenging work, but best solution has been tried to analyse and design the model IUMICS. The cyber security strategy of IUMICS should have unique cyber security team performing tasks and filling roles that are appropriate for it and that these roles are not the same among all other techniques.

The IUMICS analyse is vital for developing an integrated system of cyber security. The cyber security monitoring and management system is a universal approach in cyber security required for, developing an Intelligent Unified model for integrated cyber security (IUMICS) system. Cyber threats continue to haunt internet users across the world & cyber-threats are the problems of today and the future.

In the future it is purposed to enhance the performances of proposed IUMICS cyber security model by includes few other cyber security techniques like design, optimization, simulation algorithms and include the proactive cyber threat detection techniques.

निष्कर्ष

इस पत्र में साइबर सुरक्षा के लिए विभिन्न नवीनतम अनुसंधान तकनीकों की समीक्षा और विश्लेषण किया गया है। एक कुशल और सटीक साइबर सुरक्षा मॉडल प्रस्तुत किया गया है। भविष्य के इंटरनेट के लिए एक इंटेलिजेंट एकीकृत साइबर सुरक्षा प्रणाली (आईयुमिक्स) मॉडल का विश्लेषण किया गया है। प्रस्तावित साइबर सुरक्षा मॉडल मे सभी साइबर सुरक्षा तकनीको के प्रदर्शन में सुधार एवं सभी साइबर नेटवर्कस और तकनीको को एक मंच पर एकीकृत, नियंत्रित एवं निगरानी करने योग्य बनाया गया है।

सभी तकनीकों का एकीकरण हमेशा एक चुनौती भरा काम है, लेकिन आईयुमिक्स मॉडल के विश्लेषण और डिजाइन मे सबसे अच्छे समाधान की कोशिश की गई है। आईयुमिक्स मॉडल की साइबर सुरक्षा पद्वितयॉ अद्वितीय है, साइबर सुरक्षा टीम के कार्य प्रदर्शन और भूमिकाओं के लिए बहुत उपयुक्त है जो कि अन्य सभी साइबर मॉडल तकनीकों के बीच ही नहीं है।

आईयुमिक्स मॉडल का विश्लेषण एकीकृत साइबर सुरक्षा प्रणाली के विकास के लिए महत्वपूर्ण है। साइबर सुरक्षा के लिए साइबर सुरक्षा निगरानी और प्रबंधन प्रणाली एक सार्वभौमिक

पद्वित है जो कि एक इंटेलिजेंट एकीकृत साइबर सुरक्षा मॉडल (आईयुमिक्स) प्रणाली के विकास के लिये अतिआवश्यक है।

साइबर खतरे इंटरनेट की दुनिया मे वर्तमान और भविष्य की समस्या है, साइबर खतरों के निरन्तर जारी रहेने से इंटरनेट के उपयोगकर्ताओं को अधिक समस्या एवं परेशानियो का समाना करना पड रहा है।

इस साइबर सुरक्षा मॉडल मे भविष्य के प्रस्तावित कार्यो में अच्छा डिजाइन, अनुकूलन, सिमुलेशन एल्गोरिदम ,कुछ अन्य सा. इबर सुरक्षा तकनीक, सक्रिय साइबर खतरे का पता लगाने की तकनीक भी शामिल है जिससे कि प्रस्तावित आईयुमिक्स साइबर सुरक्षा मॉडल के प्रदर्शन एवं कार्यक्षमता को बढ़ाया जा सके।

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हनीपॉट परिनियोजन को छद्मावरण देना
Camouflaging Honeypot Deployment

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सारांश

हनीपॉट की उपयोगिता किसी द्वेषपूर्ण प्रयोक्ता द्वारा इस पर बार बार हमला करने पर ही निर्भर करती है ताकि नेटवर्क घुसपैठ के भीतर विकसित तरीकों और प्रवृत्तियों का ऐसी एक प्रणाली का उपयोग कर अध्ययन और विश्लेषण किया जा सके। उपर्युक्त कार्यनीति को सुनिश्चित करने के लिए सर्वाधिक महत्वपूर्ण बात यह है कि लक्षित नेटवर्क के भीतर ऐसी एक प्रणाली के लगे होने के उद्घाटन से बचा जाए क्योंकि उद्घाटित हो जाने पर, हमलावर लगी हुई रक्षात्मक प्रणाली के माध्यम से उस मार्ग से बचने के लिए एक वैकल्पिक तरीका ढूंढ सकता है और इस प्रकार इसे नेटवर्क के भीतर अनुपयोगी बना सकता है। ऐसी स्थिति से बचने के लिए यह सर्वाधिक महत्वपूर्ण हो जाता है कि हनीपॉटों के परिनियोजन के उद्घाटन से निश्चित रूप से बचा जाए ताकि उन्हें नेटवर्क सुरक्षा के एक उपयोगी साधन के रूप में रखा जा सके। नेटवर्क ट्रैफिक का और हनीपॉटों के भीतर उपयोग किए गए अनुकृति वाले परिवेश द्वारा उत्पन्न कई अन्य विशिष्ट हस्ताक्षरों का विश्लेषण करके और वास्तविक प्रणालियों की सटीक अनुकृति के न होने के परिणामस्वरूप, जिसके कारण सामान्य प्रणाली से इतर कतिपय असामान्य व्यवहार प्रदर्शित होता है जो हनीपॉटों के परिनियोजन उद्घाटन हेतु हस्ताक्षर के रूप में कार्य करते हैं, हनीपॉट के परिनियोजन का विश्लेषण किया जा सकता है। इस पत्र में हम एक तरीके को सुझाते हैं जिसे किसी प्रणाली के साथ मौजूद ऐसे नेटवर्क के भीतर हनीपॉटों के परिनियोजन के उद्घाटन को सुरक्षित रखने के लिए अपनाया जा सकता है, जो हनीपॉट के परिनियोजन उद्घाटन से बचने के लिए सक्रिय और निष्क्रिय तरीकों के संयोजन के साथ सम्पूर्ण प्रणाली को कार्य करवाते हुए उच्च जोखिम उत्पादक स्रोतों की पहचान करने के लिए ज्ञात हमला नीतियों के डेटाबेस तथा साथ ही द्वेषपूर्ण आईपी पतों के डेटाबेस का प्रयोग करता है।

ABSTRACT

The usefulness of honeypot depends upon its being attacked again and again by a malicious user so that the approaches and trends developed within network intrusion can be studied and analyzed using such a system. The most important factor to ensure the above strategy is to avoid the disclosure of the deployment of such a system within the target network since upon disclosure, the attacker may find an alternative to avoid the passage through the deployed defensive system leaving it useless within network.To avoid such a situation it becomes the top most priority that the deployment disclosure of the honeypots must be avoided to keep them as a useful resource of the network security.The deployment of honeypots can be analyzed by analyzing the network traffic and many other unique signatures generated by the emulated environment used within honeypots and as a result of the failure of exact emulation of the real systems which leads to the display of certain unusual behavior than a usual system acting as a signature for the deployment disclosure of honeypots.In this paper we suggest an approach that can be adopted to protect the honeypots against their disclosure of being deployed within network with a system that uses a database of known attack strategies and also a database of malicious IP addresses to identify highly threat generating sources making the entire system work with a combination of active and passive approach to avoid deployment disclosure of honeypot.

Keywords: Honeypot fingerprint, firewall, intrusion,network security

1. INTRODUCTION

Honeypot is a security resource whose actual strength is hidden within their unauthorized and illicit access[1-4], so that the intrusions within network can be recorded for further analysis, delaying network attacks and designing better strategies to strengthen network security.This means that honeypot is deployed as a bait to trap the attacker by luring them to attack the network resources giving them an illusion of the legitimate system.The strategies to setup such systems

might include an emulation of the open ports, running services etc. as on real systems which would appear to be a real target to an external attacker and as they compromise the system their information like IP address, method of attack etc. can be logged for further analysis and as evidence. Considering such high value of honeypot systems towards network security based upon above factors, it becomes essential to ensure that such systems remain indistinguishable from the rest of the network.The failure of such systems to emulate the exact services and operating environment leads to the generation of certain unique signatures that can beexamined by the attackers to compromise the honeypot systems and hence intrude into the actual network[5].

2. LITERATURE SURVEY

The method (s) applied remotely towards distinction of honeypot-based system from rest of the network by analyzing the unique signatures generated by such systems is called honeypot fingerprinting. The two main fingerprinting approaches towards compromising a honeypot system are active fingerprinting and passive fingerprinting.

2.1Active Fingerprinting

In this approach TCP-and ICMP-based packets are sent to the target system and the header fields of the responses generated are then analyzed to identify the operating system on the target machine.

The features that can be exploited to identify unique signatures generated by target system for their distinction as honeypot in active fingerprintingincludes Sent_Packets, Received_Packets, Total_Packets, Sent_Bytes, Received_Bytes, Avg_Recieved_Bytes, Sent_ttl, Received_ttl, Avg_Recieved_ttl, Sent_push_flags, Received_push_flags, Sent_fin_flags, Received_fin_flags, Average_Recieved_tcp_header_length, Received_tcp_header_length, Average_recieved_tcp_length, Sent_window_size, Received_window_size, Avg_sent_ack_flags, Received_ack_flags etc.[5]

2.2 Passive Fingerprinting

It involves capturing the network traffic generated by the target system and then comparing it with the OS fingerprint database to identify the target system. This approach is also considered to be better than active fingerprinting in the way that no direct network intrusion is involved hence requiring less network traffic generation.

2.3 Criterion and Signatures for Honeypot Fingerprinting

As the problem of fingerprinting attack is mainly based upon detection of unique signatures generated by the individual system, the significance of detection of such signatures is directly related to the level of interaction between the intruder and the system[2]. Based upon the level of interaction, a typical honeypot may be classified as low-interaction honeypot, medium-interaction honeypot or high-interaction honeypot[1][7].

Low-Interaction Honeypot: It doesn't comprise of any operating system but simulates the services of the designated system making them a passive intrusion detection system (IDS). Due to the fact that these systems only simulates the services, makes them very limited but secures them from being detected by the intruder due to less interaction involved. Honeyd [6] is one of the examples of such systems.

Medium-Interaction Honeypot: These systems simulate the more complicated services as compared to low-interaction honeypots but do not involve any operating system in their operation.The increased number and complexity of services gives the intruder a chance for better interaction with the system giving them an illusion of the real target system increasing the chances of system being compromised at the same time. E.g. Honeytrap.

High-Interaction Honeypot: These systems involves the use of a real operating system to provide the attacker a real environment to intrude without any restrictions so that their activities can be logged and analyzed on a large scale for better understanding of their approaches towards compromising the network. Since these systems involves the higher level of interaction between the system and the intruder, the chances of entire network being compromised is also very high in case of system failure, hence needs to be monitored regularly and very carefully. e.g. Honeynet.

Besides the level of interaction, method of deployment (i.e. physical environment or virtual environment) is another crucial factor that contributes towards the detection of honeypot within network. The virtual environment for the installation and execution of honeypot display certain unique behavior that act as

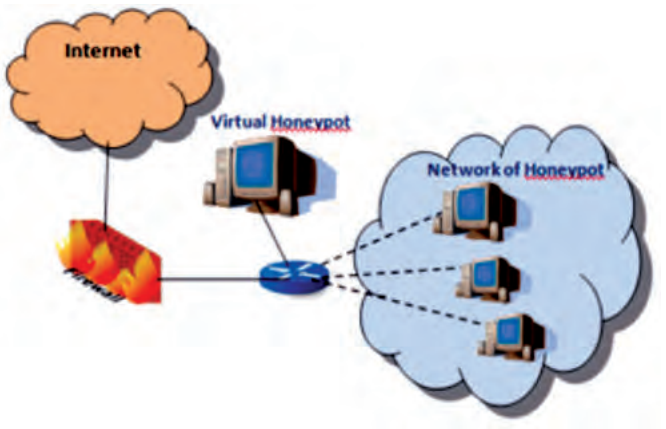

Figure 1. Overview of deployment of virtual honeypot over physical machine.

a signature for honeypot detection. For example, the VMware virtual machines are allocated with MAC address as “00-05-69-xx-yy-zz” or “00-0C-29-xxyy-zz” or “00-50-56-xx-yy-zz” which can be identified by an intruder to distinguish the system from rest of the network[7]. Further the analysis of response time for the ping (ICMP ECHO) and measurement of the link latency can also provide significant information about the presence of virtual honeypot within network where the response time for an emulated environment is greater than the response time for physical environment[3][5].

Figure 1 shows the deployment method of the virtual honeypots over physical computer system which in general gives an unusually higher value of latency when examined by an intruder; further when more than one virtual honeypot is deployed on a single system increases this latency even more giving a more accurate confirmation about the presence of honeypot within network.

3. PROPOSED SYSTEM

To overcome the above mentionedproblems we propose a system that comprises of three stage analysis of traffic before sending it to the actual honeypot.

The main components of the proposed system includes, an attack analyzer thatanalyzes the attack behavior and other parameters using a pre-existing database of malicious signatures, patterns and approach towards network intrusion to identify the presence of any known attack. The attack behavior and signatures are collected from the various research and security sources [10] [11] as well as the one being analyzed by the deployed honeypot is also stored in the same database for future reference so that if same kind of attack is suspected then an immediate action can be taken to counter the situation without waiting for the repeated analysis by the honeypot. Further it includes a permanent database of malicious IP addresses and URLs that is constructed by collecting information from varioustrusted network security sources[8][9] and by analyzing multiple attacks from a specific IP address for a long period of time.The architecture has another database of malicious IP addresses that stores the address temporarily (~for a period of 48 hours) to analyze any further attempt of intrusion from the same source.The two databases are used by a malicious address comparator module to analyze the known attackers and consider the network activity to be hostile in case a match is found.

Stage1

In Stage1, if thetraffic is analyzed for some attacking service request in spite of probe request or general service request, then the traffic is forwarded to the attack analyzer module of the proposed system

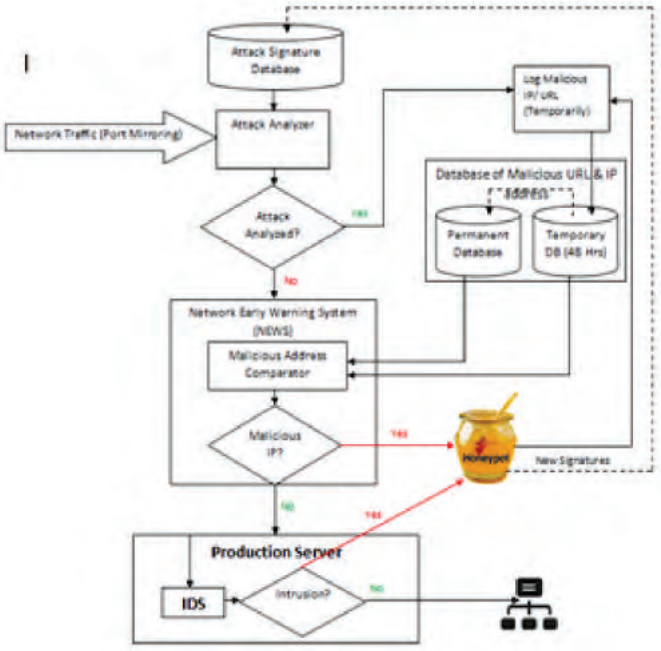

Figure 2. Architecture of the proposed system.

through port mirroring to analyze the behavior of the attack by comparing it with the standard vulnerability rule base and analysis of its approach for compromising the network. If the traffic shows a pre-existing behavior of attack, then its address is logged and accessed is denied or redirected to a decisive server.

Stage2

If the attack is not analyzed by stage1 then it is sent to stage2 that acts as network early warning system (NEWS). In this stage the source of the traffic is compared with the database of the source of the malicious addresses, where the traffic of the matched addresses is redirected towards the honeypot otherwise the traffic is allowed to flow to the production server.

Stage3

If the traffic passes through the previous two stages then in the third stage we make use of a highly efficient intrusion detection system deployed with production server that finally analyzes the traffic for any intrusive approach and redirects the traffic to the honeypot if found positive, otherwise the traffic is allowed to flow to the network. This stage is mainly useful mainly in the case when attacker uses a dynamic IP address to mount a new type of attack every time otherwise will be countered at stage1 or stage2 itself.

The detection and determination process of stage1 and stage2 are totally dependent on the information and signatures stored in the database, hence it becomes crucial to update and maintain these databases for higher efficiency, therefore to ensure this, the information about the new attacks analyzed by the honeypot and the address of the malicious traffic is also stored in the

database each time a hostile activity is encountered. The malicious IP address storage is done using two different databases, where one acts as permanent storage and stores the addresses collected from standard sources like[8] as well as the addresses from the temporary storage that have been analyzed for generating multiple attacks over a long period of time. The other database acts as the temporary database for the storage of malicious IP addresses and stores all the IP detected to be intrusive for a period of 48 hours after which it analyzes if there exists multiple attacks from the same IP within 48 hours then that IP is transferred to the permanent database and rest all addresses are cleared. This database is useful in the case where the attacker uses dynamic IP address to launch an attack, so blacklisting that particular address permanently can't restrict the attack.

The choice of the honeypot to be deployed with such a system is also an important aspect of the proposed strategy where the deployment of highly interactive honeypot may disclose its own deployment within network through system level detection, so a medium interaction honeypot is the best choice for such a system.

4. REAL-TIME MONITORING

The proposed system camouflages the deployment of honeypot by means of analysis of the mirrored live traffic flowing through the system where the time consumption for analyzing intrusive approach decreases with the use of signature base within the system as compared to repeated analysis of same approach using the deployed honeypot. The whole system initially analyzes the traffic for hostility using static approach and then proceeding towards dynamic approach if a result is not obtained by the former. Advanced forensic techniques used on the basis of looking MAC (Modify, Access, Change) can helps us to determine the attacker's action within the system to construct a more efficient signature base by using the tools like Coroners toolkit designed by Dan Farmer and WietseVenema[12].

5. CONCLUSION

In this paper we have discussed an approach towards hiding the deployment of a honeypot within network involving a passive approach in which the incoming hostile traffic is analyzed by the means of a database having the information about the nature of attack collected from the deployed honeypot and other sources, which on discovering a positive intrusion could either forward the traffic to some defensive system or could restrict the access hence avoiding the direct interaction with the honeypot in known attack cases. The use of database of malicious addresses acts as an early warning system in the suggested approach, which alerts the network administrator regarding a potential intrusion hence adding an extra layer of security so that necessaryaction can be taken within time. The results suggest that, if signatures and approaches are identified accurately to construct the database then stage1 can avoid the disclosure of honeypot deployment within network.

Only the highly interactive honeypots may lead to disclosure of its deployment through system level detection, so it is suggested that a medium interaction honeypot must be used to avoid such a situation.

निष्कर्ष

इस पत्र में हमने नेटवर्क के भीतर हनीपॉट के लगे होने को छिपाने के लिए एक तरीके पर चर्चा की है जिसमें एक निष्क्रिय तरीका शामिल है जिसमें आने वाले अहितकर ट्रैफिक को ऐसे डेटाबेस के माध्यम से विश्लेषित किया जाता है जो परिनियोजित हनीपॉट और अन्य स्रोतों से एकत्रित हमले के स्वरूप क संबंध में सूचनाएं रखता है और जो सकारात्मक घुसपैठ का पता लगने पर या तो ट्रैफिक को किसी सुरक्षात्मक प्रणाली में भेज देता है अथवा पहुंच पर रोक लगा देता है और इस प्रकार ज्ञात हमला मामलों में हनीपॉट के साथ प्रत्यक्ष अन्योन्यक्रिया को हटाता है। द्वेषपूर्ण पतों के डेटाबेस का उपयोग सुझाई गए तरीके में एक पूर्व चेतावनी प्रणाली के रूप में कार्य करता है, जो नेटवर्क प्रशासक एक संभावित घुसपैठ के संबंध में सजग कर देता है और इस प्रकार सुरक्षा की एक और परत बनाता है ताकि समय के भीतर आवश्यकर कार्रवाई की जा सके। परिणाम दर्शाते हैं कि यदि डेटाबेस का निर्माण करने के लिए हस्ताक्षरों और तरीकों की सटीकता से पहचान कर ली जाती है, तो चरण 1 नेटवर्क के भीतर हनीपॉट के परिनियोजन के उद्घाटन को रोक सकता है।

केवल उच्च अन्योन्यक्रियात्मक हनीपॉट प्रणाली स्तर पर पता लगाने के माध्यम से इसके परिनियोजन के उद्घाटन कर सकते हैं, अतः, यह सुझाया जाता है कि ऐसी स्थिति से बचने के लिए एक मध्यम अन्योन्यक्रियात्मक हनीपॉट का ही प्रयोग किया जाना चाहिए।

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बैंकिंग में सेवा उन्मुखी वास्तुकला के साथ सुरक्षा
Security with Service Oriented Architecture in Banking

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सारांश

परंपरागत रूप से उद्यम आईटी आर्किटेक्चर आवेदन केंद्रित खराब interoperable और कड़ा कर दिया गया है बिजनेस प्रोसेस प्रबंधन के लिए बहुत कठोर है। सेवा– उन्मुखीकरण की धारणा शिथिल युग्मित सेवा वास्तुकला में फ्लोरिडा exible, पुनः प्रयोज्य, प्रक्रिया उन्मुख उद्यम आईटी वास्तुकला देने के लिए करना है। सामान्य में , सेवा उन्मुख कम्प्यूटिंग (समाज) भविष्य बैंकिंग उद्योग के लिए एक आधार के रूप में कार्य करता है जो सेवा उन्मुख आर्किटेक्चर (SOA) के निर्माण के लिए नींव प्रदान करता है। SOA 'एक आवेदन के सभी कार्यों व्यापार प्रक्रियाओं के लिए फार्म व्यवस्थित दृश्यों में कहा जा सकता है, जो अच्छी तरह से डी फाई नेड प्रतिदेय इंटरफेस के साथ स्वतंत्र सेवाओं के रूप में नेड डी फाई रहे हैं जिसके भीतर एक आवेदन वास्तुकला' है। वेब सेवाओं सेवा उन्मुखीकरण के लिए वास्तविक कार्यान्वयन प्रौद्योगिकी बन गए हैं। वेब सेवाओं को देखने की प्रक्रिया बिंदु से सेवाओं orchestrating के लिए संदेश, डी फाई निंग सेवाओं के लिए डबल्यूएसडीएल, और BPEL के साथ बातचीत के लिए संचार के लिए इंटरनेट, साबुन का प्रयोग करें। फोकस बैंकिंग उद्योग के क्षेत्र में सेवाओं और की विविधता के साथ SOA के उपयोग पर है संगठनों, शीर्ष पंक्ति विकास में सुधार समाधान है कि निर्माण लागत को कम करने, परिचालन जोखिम को कम करने, और संगठन की वृद्धि की ब्रांड वैल्यू के लिए अग्रणी ग्राहक अनुभव में सुधार करने के लिए SOA का उपयोग कैसे कर सकते हैं आज के प्रतिस्पर्धी माहौल में।

ABSTRACT

Traditionally enterprise IT architectures have been application-centric poorly interoperable and inflexible that too rigid for business process management. The notion of service-orientation aims to deliver flexible, reusable, process-oriented enterprise IT architecture in loosely coupled service architecture. In general, Service oriented computing (SOC) provides the foundations for building Service oriented architecture (SOA) which serves as backbone for future banking industry. SOA is an application architecture within which all functions of an application are defined as independent services with well defined callable interfaces which can be called in systematic sequences to form business processes. Web Services have become de-facto implementation technology for service- orientation. Web services use internet for communication, SOAP for interacting with messages, WSDL for defining services and BPEL for orchestrating services from process point of view. The focus is on use of SOA with variety of services in the banking industry sector and how organizations can use SOA to construct solutions that improve top line growth, reduce costs ,reduce operational risks and improve customer experience leading to increased brand value of the organization in today's competitive environment.

Keywords: Service oriented architecture, service oriented computing, WSDL, SOAP, BPEL

1. INTRODUCTION

Modern enterprises demand changes to be incorporated in the existing system spontaneously. The quick response against change is the key to survive in present competitive and global scenario. To attain stability in businesses, enterprises are required to streamline the existing business processes and procedures while exposing certain applications throughout the enterprise in highly standardized manner. A contemporary approach for addressing these critical issues is represented by Web services that can be easily assembled to form a collection of autonomous and loosely coupled business processes.

The advancement in Web services and standards in combination with automated business integration tools leads to the enhancement in software integration and Service-oriented Architecture. This architecture aims to address the requirements of loosely coupled,

standards–based, and protocol independent distributed computing and mapping enterprise systems appropriately to the overall business process flow.

In Banking SOA the services demands great level of security. Banking services are infact serves as backbone to other organizations. The question here is to 'define a service in banking environment' and 'what are the types of services available in such environment' and last but not the least 'What concepts and principles should define a secure collaborative and attractive service environment'.

2. SERVICE ROLE AND TYPES

The functions of an application are decomposed into independent modules. These modules help in execution transparent to the underlying application. An SOA provides a versatile architecture that integrates business processes by modularizing large applications into differentiated services.

Services in an SOA exhibit the following main characteristics:

1. Self-Contained
2. Platform-Independent
3. Dynamic

In Banking environment, market segment can be categorized as:

1. Customer Information Management.
2. Payment Related
3. Authentication
4. Authorization
5. Inter-departmental Communication
6. Loan management
7. Credit/Debit Card Management
8. Operations Management

3. SOA ENVIRONMENT

SOA framework can be viewed as group of services communicating with each other irrespective of the technology platform used for service development. This shows the interoperability and flexibility of using this architecture. A typical SOA environment in Banking can be viewed as Fig. 1.

4. SOA SECURITY ISSUES IN BANKING

As SOA integrates loosely coupled services under one common roof aiming at Application integration, Transaction management, and Compliance towards the security policies of the organization.

The major classes of security threats includes :

1. Authentication and Authorization
2. Harmful Soap Attachment
3. SQL Injection
4. Capture and Replay of Digital Signatures
5. SLA violation

4.1 Injection Inadequacies

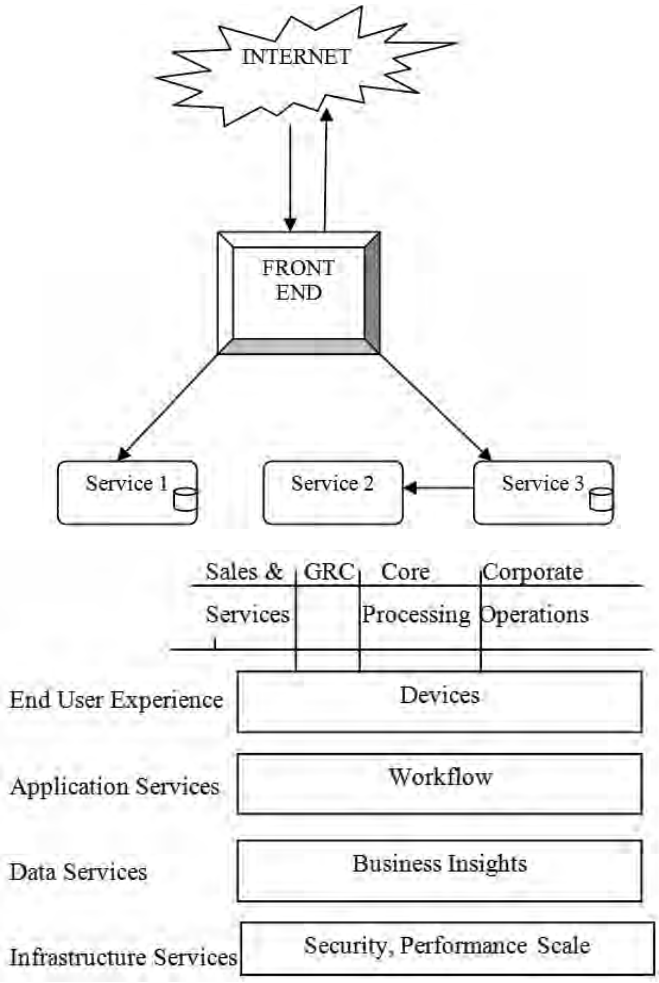

Figure 1. Service organisation in banking

This type of threat is induced generally while validating the input during the authentication process. Validation can be done on client side or else on the server side. An intruder could manipulate the input that eventually causes the web service software to carry out the sequence of operations on behalf of the intruder. Different types of flaws related to this category of threat includes-SQL Injection, XPath Injection and cross-site scripting.

4.2 XML Denial of Service Issue

Extensible Markup Language (XML) is a widely used data exchange standard on web, however complex parsers can be processor intensive and hence a concern for security arises here. If an intruder forms an XML message with a very large payloads, content which is recursive, excessive nesting, or with malicious DTDs (Document Type Definition) then a denial of service can occur.

Mitigations include, using filters and gateways while parsing XML messages. This provides protection in terms of limiting the rate of messages per second, the number of XML attributes, the nested XML elements,

the length of an XML node name, and the DTDs. Alternatively, schema validation can be used to validate xml input but it is not as efficient as the XML parsing is done before validating the document.

4.3 Replay Attack Flaws

When the attacker replays the messages to the server multiple times for invoking an action replay attack occurs. Mitigations include the use of digital signatures and encryption policies. Furthermore in case of attack related to encrypted messages, signed timestamps can be used. Client can also include unique message identifiers (nonce) which can be used by servers for message tracking to keep the record of processed unique messages.

4.4 Insufficient Logging

Logs are very important if a hacking or intrusion attempt occurs. Mitigations policies include maintaining logs of transactions incorporating both successful and unsuccessful authentication attempts, unsuccessful authorization and various application errors. Log files can also be encrypted for ensuring their confidentiality. In addition, only recording the logs is not sufficient, someone needs to monitor it regularly. Automated log scanning and audit reduction proves to be useful in monitoring the log records.

5. DEFENSIVE MECHANISMS FOR SECURITY OF FINANCIAL INSTITUTION

Protection is a main concern for the banking entities. It involves customers, employees and various assets. The behavior of invaders involved in fraud is in most of the cases are unpredictable. Therefore, the situation here is a bit risky.

To overcome risk environment, a check on financial criminals and money launderers is required, as they are very smart, by hook or by crook, trying every possible way to evade detection. Moreover if existing approach doesn't works well, new strategies were evolved.

Unfortunately in today's world of highly trained individuals who are taking care of managing these funds besides having support of high equipped and challenging teams are failing to provide security from the terrorists, money launderers. Reason being the complexity of identity concealing strategy followed by them. They usually follow a series of transactions to hide the origin of the illicit funds. Consequently, the investigators are confused in these complex webs of transactions known as 'Hidden Relationships'. Money launderers often establish rings of accounts that appear to be unrelated and then used it to move assets between several of these accounts.

5.1 Regulatory Framework

Some Regulations in Europe and United States urge the financial institutions to keep a track on patterns of transactions performed between unrelated accounts from security point of view. In recommendation 11 of its 'Forty Recommendations,' the Financial Action Task Force on Money Laundering (FATF) states:

Financial institutions should pay special attention to all complex, unusually large transactions, and all unusual patterns of transactions, which have no apparent economic or visible lawful purpose. The background and purpose of such transactions should, as far as possible, be examined, the findings published, and made available to help competent authorities and auditors.

Hidden relationships and networks, by their very purpose, have no legitimate economic or lawful purpose. Regulations in the United States and their guidance offer similar guidance to financial institutions and instruct them to look for patterns. The summary statement from adoption of the rule states.

The language in the rule requiring the reporting of patterns of transaction is intended to recognize the fact that a transaction may not always appear suspicious on a standalone basis. In some cases, a broker-dealer may only be able to determine that a suspicious transaction report must be filed after reviewing its records, either for the purposes of monitoring for suspicious transactions, auditing its compliance systems, or during review.

5.2 Hidden Relationship

The term hidden relationship itself states that while existing in performing course of transactions appears to be hidden. Financial Institutions needs to detect these networks of transactions by analysing log, nature, place and various other aspects of transaction lifecycle. For example, we have four accounts in a bank. Account 1 shares a piece of information such as an address, phone number or beneficiary in common with Account 2. Account 2 shares a different piece of data with Account 3, and so on. Figure 2.

It appears that Account 1 and Account 4 share absolutely nothing in common. However, there exists a hidden network which can be used by criminal to launder funds. Unfortunately, hidden relationships or networks are rarely that easy to define or identify in real time transactions.

5.3 Patterns of Funds Transfers Between Correspondent Banks

The money laundering from correspondent bank is considered to be vulnerable is not taken care properly. Therefore, due diligence procedures and regular monitoring should be imposed by financial

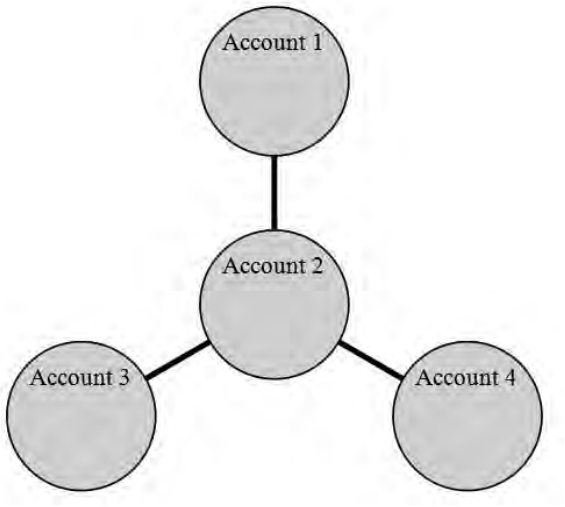

Figure 3. An example of hidden relationship.

institutions to their correspondent (respondent) bank. For this, the activity pattern of the correspondent bank is required, which ultimately improves the understanding of institution's information in terms of its customers and related areas of concern. Patterns of potentially suspicious activity among correspondent bank accounts, such as high levels of activity or activity that suggests exclusive relationships between correspondent banks, indicates a precursor of hidden relationship.

5.4 Patterns of Funds Transfers Between Internal Accounts, Customers, and External Entities

A Financial Institution can have a variety of customers. This includes the one who has multiple accounts which spans through various business lines and is not clearly visible in current transaction or account systems. These types of customers are considered a threat for money laundering because the customer can, without detection, wire funds between seemingly unrelated accounts (which may be titled differently) to aid in the layering and integration of illicit funds. Analogously, this activity may take the pattern of potentially suspicious activity between internal accounts/ customers and external entities. Understanding patterns in client accounts and customer activity helps to improve the institution's knowledge of its customers and identify potential areas of concern.

6. STRATEGIES TO IDENTIFY HIDDEN RELATIONSHIP

After understanding the concept of hidden relationship, the analysis can be done with the given approaches:

6.1 Link Analysis

Link analysis aims to find hidden links between accounts and storing this information into huge webs of interrelated accounts. For instance, consider three accounts where first two accounts were having same address and other two accounts having same contact number which brings to the conclusion that all these three accounts are interlinked. However, this example considers small numbers of accounts, though the main principle in real world remains the same for huge webs of accounts. Link among accounts could be more complex for instance, sharing same beneficiary proving that involved parties are business partners by transferring funds to each other. Behaviour of linked accounts can be identified once we find the linked accounts. Link Analysis is preferred where rings of violators are involved.

6.2 Sequence Matching

Sequence Matching is applied where a particular cycle of events points to important clue about hidden relationship. For example, a stock broker orders trade ahead of receiving customer orders in anticipation. By doing this, he can make instant profits. Similarly, webs of accounts can be determined by analysing sequence of various transactions between accounts.

Sequence Matching first identifies order of events in advance and then it identifies persistence of a significant sequence among thousands of transactions that takes place on a given day. As fraudsters keep on adapting their behaviour as per existing detection system, their complex behaviour is difficult to analyse. Financial Institutions must apply most sophisticated technology like behaviour detection, link analysis and sequence matching in order to expose hidden relationships among web of accounts which otherwise would have remained uncovered.

निष्कर्ष

विविधता और लेन–देन के वेग बहुत तेज गति से बढ़ रहे हैं के रूप में बैंकिंग SOA में आज के परिदृष्य सुरक्षा खामियों में महत्वपूर्ण है। हालांकि, व्यावहारिक रूप से इन मुद्दों को खत्म करने के लिए पूरी तरह से संभव नहीं है। तो, नुकसान की हद तक कम करने के लिए अपने डोमेन सेवा प्रवाह तदनुसार विश्लेषण किया जाना चाहिए। नतीजतन, बैकएंड में एक स्पष्ट तस्वीर होने स्पष्ट दृश्यपटल प्रबंधन को बढ़ावा मिलेगा। इस पत्र में मुख्य रूप से शिथिल युग्मित बैंकिंग वास्तुकला में भुगतान संबंधी धोखाधड़ी से संबंधित है। यह अपने सदस्य की एक विशेष प्रक्रिया में मौजूद हैं, जो पर आधारित लेन–देन के पैटर्न को उजागर करने, फंड ट्रांसफर करने की प्रक्रिया पर केंद्रित है। बाद में, यह लिंक विश्लेषण कर रहे हैं और अनुक्रम क्रमश का विश्लेषण करती है, जो दो रणनीतियों के माध्यम से निष्पादन वातावरण को खोजने के लिए जाता है। भविष्य में, अध्ययन के दायरे से आगे बैंकिंग SOA में (इस पत्र में शामिल नहीं किया गया है), जो सुरक्षा से संबंधित मुद्दों में जांच की जाएगी।

7. CONCLUSION

In Today's scenario Security loopholes in Banking SOA is critical as the variety and velocity of transactions are growing at very fast pace. However, practically to eliminate these issues completely is not possible. So, in order to minimize the extent of damage, the service flow in its domain should be analysed accordingly. Consequently, having a clear picture at the backend will lead to clear front-end management. This paper mainly deals with payments related frauds in loosely coupled banking architecture. It focuses on the process of fund transfer, uncovering the pattern of transaction based upon its members who are present in a particular process. Afterwards, it tends to find the execution environment by means of two strategies which are link analysis and sequence analyses, respectively.

In future, scope of the study will be further examined in security related issues (which have not been covered in this paper) in banking SOA.

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साइबर सुरक्षा– एक सर्वेक्षण
Cyber Security-A Survey

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सारांश

मशीनें सिर्फ सर्वव्यापी ही नहीं अपितु आपस में जुडी हुई हैं। कम्पयूटर थोडे से समय में बेहद महत्वपूर्ण स्तर तक पहुँच गया हैं। 'साइबर साम्रगी' के साथ तेज और अक्सर अप्रत्याशित परिणाम प्राप्त हुए हैं। साइबर सुरक्षा के पहलुओं में काफी जोखिम बढ़ा है, लेकिन हम पाते हैं कि इनकी रोकथाम करना एक अत्यन्त महत्वपूर्ण समस्या है। साइबर सुरक्षा का उद्देश्य डाटा, संसाधन (जैसे हार्डवेयर जो भंडारण और गणना करते हैं, सॉफ्टवेयर और कुशल कर्मियों) की रक्षा करना है। सुरक्षा के उचित तरीकों और तकनीकों के मदद से संगठनों के डेटा और संसाधनों और अन्य स्पर्श्य एवं अस्पर्श्य संपत्ति की रक्षा कर सकते हैं। विभिन्न साइबर हमलों को समझना और उनके रोकथाम से खतरे को कम कर सकते हैं और अधिक सुरक्षित सूचना प्रणालियों को प्राप्त कर सकते है। यह आलेख साइबर हमलों से रक्षा के लिए विभिन्न मुद्दों, चुनौतियों, और रोकथाम के तरीकों का वर्णन करता हैं।

ABSTRACT

Machines are not just omnipresent but are also interconnected. The immensely important but incredibly short history of computers has reached a defining point. With the "cyber stuff" there are rapid and often unexpected consequences. Aspects of cyber security raise real risks but how we perceive and respond to them poses a more crucial problem. The purpose of cyber security is to safeguard data, resources such as hardware used for storage and computation, software and skilled personnel. Selection of proper security methods and techniques can help organizations protect their data and resources and other tangible and intangible possessions. Understanding the various cyber attacks and their prevention can reduce the risk to attack and a more secure information systems can be obtained. This paper addresses the various issues, challenges, and prevention methods for protection against cyber attacks.

Keywords: Cyber attacks, cyber security, response team, security policies

1. INTRODUCTION

Modern life is fundamentally dependent on internet. And the issues that result challenge everyone from businessmen to politicians. It affects us as individuals. There is possibly no issue that is so important and that touches so many and still remains so inadequately understood. Cyber security, also known as information technology security, aims at protecting devices, networks, programs, applications and data from unplanned or illicit access, change or damage. It aims to realize the full benefits of the digital revolution, provide users with the confidence that their sensitive information is secure, commerce is not compromised, and the infrastructure is not penetrated. Nation states also need confidence that the networks supporting their national security and economic prosperity are safe and elastic.

2. PREVIOUS CYBER ATTACKS

These case examples prove that cyber crime is a really expensive catastrophe:

Bank of the West–A web site of a California financial institution was attacked in 2012, distracting the officials from an online account takeover against its clients. The loss was estimated to be more than $900,000[1].

Efficient Services Escrow Group – In 2013, a cyber theft of $1.5 million against a California escrow firm forced the company to shut down.

Target – Target fell victim to a massive data breach in 2013 compromising the e-mail, mailing address, phone numbers, and financial information of nearly 110 million customers.

NASA breach-US space agency NASA has decided is to encrypt all its mobile computers after the loss of a laptop containing personal information about more

than 10,000 employees and contractors.

Cyber criminals target Skype, Facebook and Windows users-Multiple Blackhole exploits were used to target users of Skype, Facebook and Windows in October. A number of blackhole exploits in the form of fake Facebook login, account verification, emails, pop ups, etc were discovered.

2. METHODS OF ATTACKS

Computer viruses and worms are the most common forms of attack, ergo cyber terrorism are also known as computer terrorism. The attacks can be in general of three different categories[2].

(a) Physical Attack: The computer hardware or other storage devices might be damaged or stolen.

(b) Syntactic Attack: This type of attack includes damaging the hardware by hampering the logic or software of the system and hence make it incompetent and useless. Computer viruses , worms and Trojans are often syntactic types of attacks.

(c) Semantic Attack: No harm to the hardware is done. Instead, the transmitted or receiving information is modified or changed so that it no longer represents the initial message.

3. TOOLS OF CYBER TERRORISM

Newer methods are being exploited to unleash this new world of cyber terrorism[3-5]. Some of them are:

(a) Hacking: Any attack that involves unauthorized access to a device or network is called hacking.
Packet sniffing, password cracking and buffer outflow facilitates include hacking. The most commonly used method for hacking is eavesdropping on credulous users to recover their accounts, passwords and other personal information.

(b) Trojans: These include programs or applications that pretend to do something but are intended to do something else. Checking and managing information security are debilitated by trojans. The Trojan programs are often mistakenly executed enabling them to gain control of the infected computer; they can then easily read, delete, move, damage and execute any file or program on the computer.

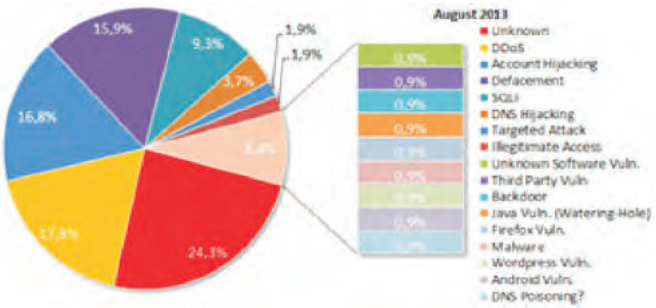

Figure 1. Distribution of attack techniques.

(c) Computer Viruses: are any program or application, that has the capability to infect other computer, programs by modifying or damaging them can be called a virus. They can spread very fast and can become cumbersome.

(d) Computer Worms: The term 'worm' in cyber security refers to program or a set of them that are able to spread functional copies of themselves or their segments through network connection to other computer systems. E-Mails are the usual hosts.

(e) Denial of Service is when an authorized persons is denied access to a computer or computer network. Flooding the user with large number of messages and spamming are common methods of attack.

(g) Cryptology is the use of encrypted messages and data links is widespread. It would be a formidable task to decrypt the information terrorist is sending by using a 512 bit symmetric encryption.

(h) Phishing aims at acquiring sensitive and personal information such as password, account number etc by masquerading as a legal and trustworthy entity. Sympathy gaining through aid-seeking emails or phone calls, Link manipulation, filter evasion and website forgery are common types of phishing techniques.

(i) Botnets commonly known as a zombie army, they are a number of computers that have been set up for forward transmissions (including spam or viruses) to other computers on the Internet, oblivious to their users.

(j) Instant Messaging (IM) attacks include the spIM and Peer-to-Peer(P2P) attack

- spIM (Spam over instant messaging) is an uncalled-for e-mail or a pop up that shows up on a personal computer screen in response to touch or any activity.
- P2P programs compete for computer resources such as files, CPU cycles and application and therefore can be used to launch an attack on the system

(k) Root kits are software's that can be used to hide or obscure the fact of the system being compromised. Root Kits open a backdoor to the system enabling the attacker to take control of the computer's operating system. They can also act to evade the operating systems security scan and antivirus giving the user a fake sense of safety.

(l) Web application attack these attacks target poorly programmed web pages. Remote code execution, SQL injection, Format string vulnerabilities, cross site scripting (XSS) and user name enumeration are some of the most common attacks.

(m) Hacking with Google Advance operators can be used in Google's search engine to trace specific

strings of text in the search results. This type of hacking can be used to locate specific versions of susceptible Web applications.

(n) Malware or 'malicious software', are programs designed for unauthorized access to a network. Malwares can control a target system or a website server, disrupt or block the user's system and making them accessible to further attacks.
Adware (malware to serve obstructive ads on the attacked device), Chargeware (malware used to illicitly charge money from the user) , Ransomware (malware that denies the access to a device unless payment is done to unlock the device) and Spyware (malware that can access and transmit sensitive information from a device) are common types of malware[6].

(o) Unsecured Internet Connections: A range of internet connections are used every day for different internet purposes each of which may involve access sensitive accounts and data. Access over wireless access points is usually ignored and these unsecured connections expose the companies data to attacks when proper security measures are not taken.

(p) Weak Passwords and Encryptions: Generally password is the only protection to our data, secrets, and identifying information. Organizations must be observant in ensuring they use a variety of composite and multifarious passwords that change often. However passwords are vulnerable .

(q) Device Theft & Loss: As laptops, smart phones, and tablets have become omnipresent in the workplace, the risk of theft or loss of workplace devices has risen.

(r) Foreign Contact: For Businesses foreign travel might invite security risks, as aggressive search and seizure policies vary from country to country. Internet communications may be closely monitored and so companies should be aware that their businesses communications in countries may be subject to foreign corporate espionage and surveillance by the government.

(s) Drive-By Downloads Some websites trigger the automatic download of an application or install a malware .

(t) Browser exploit Take advantage of susceptibilities in your mobile web browser or software launched by the browser such as a Flash player, PDF reader, or image viewer.

(u) Web Defacing is the modification or changing the contents of a web page so that it no longer depicts the correct information.

(v) Publishing Obscene Material: Publication of obscene and coarse material or data over websites, social networking sites etc.

4. HOW IS CYBER SECURITY USABILITY EVALUATED

Similar to the general system usability field , there are two major methods for evaluating the usability of cyber security systems. The two known methods are user studies and expert-based evaluations . In the first of these methods, a group of users are chosen to test the system's usability. lab based testing, interviews, experiments and assessment are some examples of user studies. In the expert based evaluation method usability experts scrutinize and assess the functions and usability of the system using their knowledge[7].

5. CYBER CRIME IN INDIA

A significant rise in cyber space activities and usage of internet has been observed in India . India is not only one of the major but also has the third most number of internet users. Cyber security comes with its challenges. It is extremely prone to damage and mischief and is a major concern for being extremely prone to criminals and terrorists alike conducting espionage, theft and fraud. With 14 million active websites, 150 million users and 180 million e mail accounts India is ranked among top 5 countries for web hosting and 5 fold increase in spam emails[8].

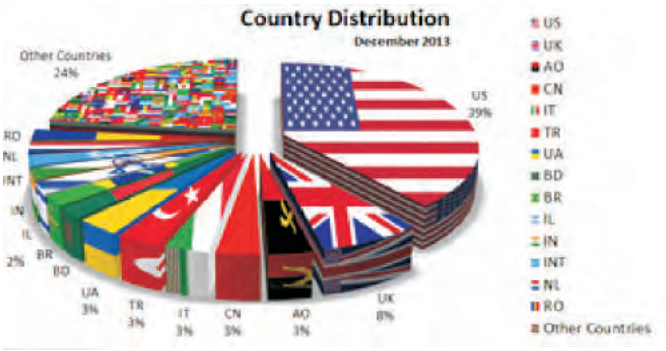

Figure 2. Country-wise distribution of cyber crimes.

A loss of 28.79 crores due to cyber crimes was estimated in 2012 in India[4]. There is a big rise in the Cyber Crimes (as per Information Technology Act, 2000) in India. The previous number of 2761 in 2012 has now risen to 4192 in 2013. A s per the Indian panel code this number reaches 5500 out of which 3301 criminals have been said to be arrested. A 122 % increase in attacks was observed in india. in particular a 50 % rise in cyber crime has been seen in Maharashtra and Andhra Pradesh. Such crimes in other states were : Karnataka (513), Kerala (349), Madhya Pradesh (282) and Rajasthan (239) and Gujarat(61) in 2013. Table 1 show the attack vise statistics for the year 2012 and 2013 and Table 2 for 2011 and 2012.

Table 1. Statistics of cyber attacks in india in the year 2012 and 2013.

Name of attack	2012 statistics	2013(sep) statistics
e-mail messages received	44520	27909
Indian website defacement attack	23014	19886
proxy servers /bot infected systems tracked	6494717	5917695
Security drills	6	1
Security audits	6	16
Incidents handled	22060	42434

Table 2. Statistics of cyber attacks in india in the year 2012 and 2013.

Name of Attack	2011	2012
Damage to physical storage systems .	826	1440
Damage of electronic evidence	9	9
Obscene publication/transmission in electronic form	496	589
Hacking	157	435
Attempt of illicit access	5	3
Obtaining license or digital signature by suppression/false fact.	6	6
Breach of privacy	26	46
Forgery	259	259
False electronic evidence	1	4

Existing Counter Cyber Security Initiatives National Informatics Centre (NIC) - A foremost organization acting as the network backbone and providing e-governance support to the state and Central Government, Union Territories and Districts. It provides a spectrum of IT services including nationwide communication network for decentralized planning enhancement and better transparency of government.

Indian Computer Emergency Response Team (Cert-In)—One of India's most important constituency, cert in focuses on ensuring cyber space security and improving the information infrastructure. It also lays rules regarding security incident prevention and response and security assurance.

National Information Security Assurance Programme (NISAP)—This policy was mainly devised for governmental and significant other infrastructures with its highlights being:

(a) Concerned infrastructures must have a security policy and a point of contact to report any security incident to Cert-In.
(b) Cert-In to create a panel of auditor for IT security. And All organizations inspect this panel once a year.

6. SECURITY POLICIES IN INDIA

(1) National Cyber Security Policy India: It is a proposed law by the Department of Electronics and Information Technology (DeitY), Ministry of Communication and Information Technology and the Government of India have proposed a National Cyber Security Policy which aims at safeguarding the public and private infrastructure from cyber attacks ergo protecting personal, financial and banking information. It aims to set up centers to promote research and development of cost efficient and tailor made security methods and the commercialization of such products.
(2) National Security Policy of India: it identifies the roles and responsibilities of the public and private sectors in cyber security, since they own the majority of the infrastructure.
(3) National Telecom Security Policy of India: The policy aims for socio-economic development by providing secure, reliable, cheap and good quality telecommunication services [9]. It also aims to create an environment that is investor friendly and create job opportunities in various sectors. It lays special emphasis on rural and village areas[10].
(4) E-Mail Policy of India: The email policy of India further includes the following policies:
    (a) Management of email accounts and their effective use according to the effective email services and use policy.
    (b) Password and security policy for users
    (c) NIC Policy on format of e-mail address
    (d) Password policy
    (e) Security policy for user
    (f) Service level agreement

The Indian government has further decided to come up with a new email policy that will secure official communications in the government.

(5) Cyber Security Awareness in India: Seminars are organized on diverse subjects by the Cyber Security Awareness society in several cities of India in order to improve the level of security preparedness.
(6) Cyber Security Disclosure Norms in India: The Indian government has planned to bring a legislation that would discuss cyber security disclosure rules. If a company becomes a prey of a cyber attack, the company is expected to divulge the details about its impact to the clients on the safety of their data and information and in some cases to the government too[11].

Other policies include imported software and telecom equipment security, cyber security of e-governance, cyber security of private banks in India, mobile payment cyber security, cyber security capabilities[12].

7. CHALLENGES AND CONCERNS

Some challenges and concerns are highlighted below:

(a) Lack of knowledge about the practices and the culture of cyber security at personal as well as organizational level.
(b) Lack of skilled and trained professionals to device the counter measures.
(c) Lack of funds for the many information security organizations that have been set up.
(d) A weak and redundant IT Act subject to*6 non exploitation and age old cyber laws[13].

8. RECOMMENDATIONS

Certain recommendations are given below:

(a) Need to educate the common citizens about the dangers of cyber terrorism.
(b) Joint effort is required by all Government agencies order to attract skilled personnel for implementation of counter measures.
(c) Financial and governmental support should be given to all organizations working for cyber security. monopoly should not be permitted.
(d) Agreements, issues and research relating to cyber security should be given due and not be neglected.
(e) Close vigil on potential adversaries should be kept and policies should be renewed based on this study.

9. RESEARCH AREAS IN INDIA

Quantum cryptography and secure multiparty computation R&D activities in India are focused both on the contemporary requirements and high-tech and futuristic need of security in cyberspace. Research in futuristic area such as quantum cryptography which allows conducting various cryptographic tasks that are proven to be impossible with classical processing is being undertaken by the researchers. This results in a highly secured communications (such as sharing of keys or sharing of information which is accessible to the receiver only at a specific location) and allows detection and elimination of eavesdropping during the transit.

9.1 Threat Intelligence

Response to cyber threats has changed to reactive from the previous proactive. This change now makes necessary the need of a robust threat intelligence system for defence. Research in areas such as threat research & response, worm propagation and detection, targeted remote malware clean-up, advanced persistent threat countermeasure, anomaly detection for zero-day attack, intrusion detection systems, SPAM detection & filtering, antivirus and anti-malware research, exploitation and reverse engineering, among others is being conducted at various centers. Research on advancement of automated tool to simulate human hackers, is also being conducted.

9.2 Next Generation Firewall

Research organizations are also working in future-ready security solutions and multi identity-based technology such as next generation firewall, that offer security intelligence to enterprises and enable them to apply required and best suited security controls at the network perimeter. Integration of aforesaid technology with other security solutions such as threat intelligence and management systems, Web application firewall, web filtering, anti-virus, anti-spam, etc, will help in creating more efficient and secure ecosystem.

9.3 Secured Protocol and Algorithms

In India, research has also been undertaken at protocol and algorithm level such as secure routing protocols, efficient authentication protocols, reliability enhanced routing protocol for wireless networks, secure transmission control protocol and attack simulation algorithm, etc.

9.4 Authentication Techniques

In the country, research is moving towards authentication techniques such as key management, two factor authentication, automated key management which provides the ability to encrypt and decrypt without a centralized key management system, File protection both on rest as well as in transit, access controls solutions on cloud, among others.

9.5 BYOD, Cloud and Mobile Security

Application, Network and Mobile security testing technologies, BYOD risk mitigation, Cloud security assessment and protection are some of the areas where advancement of technologies is taking place through R&D activities.

9.6 Cyber Forensics

In India, the research is being carried out to build indigenous capabilities for cyber forensics. Some of the specific areas in which research is taking place in the country are: Disk forensics, network forensics, mobile device forensics, memory forensics, multimedia forensics and internet forensics.

Other areas in which researches are being undertaken are internet monitoring systems, extensive web security,

wireless network security enhancement, VOIP security, encryption & cryptography, and encryption as a service among others.

9.7 Mobile Devices and Apps

The rapid growth of mobile devices demands an equal growth in security. Every device, is just another window for a cyber attack and is another susceptible access point to network[14].

9.8 Social Media Networking

The growing use of social media contributes more and more for the increase in personal cyber threats. To combat the risks, companies will need to look beyond the basics of policy and procedure development to more advanced technologies such as data leakage prevention, enhanced network monitoring and log file analysis[15].

9.9 Cloud Computing

More and more companies are shifting to cloud computing for its efficiency and cost savings. A well devised security measure will help organizations to administer the risks of cloud computing. cloud security is yet to get its due attention. As indicated by recent surveys and reports, companies are underrating the significance of security.

9.10 Protect systems rather Information

The emphasis should be on protecting information, not just systems. As more and more data is stored online instead of computer systems the security requirements will go beyond simply managing systems to protecting the data these systems house.

9.11 Everything Physical can be Digital

Information written manually on a piece of paper, the report binders and even the pictures or photos can be converted to digital format and gleaned for misuse. This type of misuse requires special security management techniques and research is yet to be started in this area[5].

Other areas include network and system security, monitoring and forensics and vulnerability remediation and assurance[4].

10. TECHNIQUES SPECIFIC CYBER SECURITY TECHNOLOGIES

There are various tools that have been designed for intrusion detection. For early detection and minimization of loss these tools can be used.

(a) Global intrusion detection tools (i.e. intrusion detection systems) monitor and analyze network traffic data for suspicious patterns and generate alerts for patterns that are matched. For many network security engineers, this is the main way in which they detect attacks.

(b) Logs (e.g., network traffic capture tools) containing detailed information, coupled with the engineers expertise helps network security engineers to understand and assess the situation when an intrusion occurs. Typically, engineers filter through the data using textual commands in a computer shell.

(c) Public information sources (e.g., e-mailing lists) provide details of the latest intrusions and attacks. It should be kept up-to date.

(d) Code Samples enable engineers to better understand an intrusion as well as help engineers to find vulnerabilities in the network that a given intrusion exposes.

(1) Access Control and Identity Management-The username/password/authorization are the fundamental combinations that have proven to be sufficient.

(2) Authentication- Documents can be authenticated using watermarks or digital signatures in order to verify the involved parties in a communication and to ensure the original state of the document.

(3) Malware scanners-Software that can detect the presence and eradicate malicious content in a device.

(4) Firewalls- A firewall program monitors the incoming and outgoing traffic and intervenes if an unauthorized access is detected.

(5) Cryptography-Data can be stored or transmitted in an encrypted form to make it difficult to be accessed and read.

(6) Anti-Virus Software-Anti virus and anti phishing software should be installed on every device and updated regularly.

Some well known software's that can identify suspicious events and collect data regarding them (like date, time, possibly the source and destination address and type of attack) are realized below:

(a) Snort: It is a network intrusion detection and prevention system that can analyze the at traffic and packet logging on IP networks. It uses protocol analysis, pre-processors and content searching to detect worms, exploits and illicit access. Also it can decide whether to collect or pass traffic based on a flexible rule-based language.

(b) OSSEC: The open source host-based intrusion detection system can perform log analysis, file integrity checking, policy monitoring, root kit detection, real-time alerting and active response.

(c) BackLog :It's a software to collect and evaluate Event Log information.

(d) System intrusion analysis & reporting environment (SNARE): It detects any host-based intrusion.

(e) Precursor like Honey pot logs can collect information

on precursors..

(f) Third-party monitoring service: A third party can monitor the the publicly accessible services, such as web, domain name system (DNS) and FTP servers of a company.

11. RESPONDING TO CYBER INCIDENTS

Although focusing on preventive measures is important it should be made clear that no preventive measures are 100% effective and hence an organization must be prepared for any cyber attack.

Even small institutions should be ready for the after effects of a cyber incident and ensure that its resources are being used efficiently and wisely.

An effective incident response ("IR") plan will likely lead to faster and better choices, which in turn will help to mitigate any damage that may have been caused[16].

Forming an Incident Response Team

In forming an IR team, roles and responsibilities have to be assigned and made communicated. Whom to contact in case of an attack should be clear[17].

Response Planning

Next, outline the basic steps of IR plan by establishing checklists and clear action items.the following steps might be useful in responding to a cyber incident

(a) Don't turn off your computer in the event of a cyber incident, the attacked device may contain information critical to analyzing the incident and switching off may destroy evidence and erase clues that might help a forensic expert .

(b) Contact law enforcement-Many law enforcement organizations have specialized and experienced personnel and computer experts in their e-crime sections that can help in investigation .

(c) Document the expected reach and impact of the attack. Document and circulate the current known and recorded facts about the. Facts such as the reason for suspicion, progress in the analysis and loss estimated may be included.

(d) Determine notification requirements. The real challenge is in detecting, analysing, containing, handling and covering of a breach. There might arise a need to consider outside help if the capability to respond to the incident internally is not there. Retain the information and software on the system, don't alter the database and network device logs.

12. CHALLENGES

Cyber security challenge that target individuals or organizations may result in the loss of sensitive information, financial loss, facilitate repeat attacks, or facilitate a distributed denial of service attack[3].

Many users are unaware of how their computers might be compromised by malware. They may not even know that their devices could be used without their knowledge. Another challenge is the slow pace in tackling malicious activities , unexpected and new forms of cyber crime. The problem of not having a continuous availability of internet access is going to increase with the increase in societal dependence on cyber space. Network devices can be targeted physically. Rapidly changing security and threat landscape. Responsibility to ensure that proper processes, technology, governance structure and compliance to laws and regulatory requirements are followed in a border less environment. Growth in the volume and complexity of the IT industry and the need for security measures for them.

Information security should be based on following eight major elements

(a) The method applied should be in accordance with the objectives, policies , rules and present and future needs of an organization.

(b) Protection methods must be economical. Employed method should be proportional to the level of estimated risks.

(c) For any program to be effective to cyber security policy must be made explicit and communicated well. The policies should clearly identify roles and responsibilities of different groups.

(d) If any system has external users then their activities should be clearly monitored and apt security measures should be taken.

(e) Awareness: Access to any knowledge pertaining to the security measures, methods and techniques should be allowed.

(f) Ethics: Any security measure installed must be in accordance with the interests of the user. Users privacy and rights should not be violated.

(g) Multidisciplinary principle: All aspects and opinion of educational , legal , administrative, directorial, operational, market and technical aspects must be evaluated in the formulation of policies, procedures and techniques.

(h) A comprehensive and integrated approach. Is required for Information protection to be effective. Security should be made a part of the development process. For example, information security can include risk analysis, a business impact analysis and information classification document during the initial or analysis phase.

(i) Cyber security measures should be periodically reassessed in order to improve their functionality and with respect to time, need and objectives. MNC's must make special adjustments depending on the various countries they are located at[17,18].

13. FUTURE SCOPE

While it's difficult to summarize where the future of cybersecurity lies, it is important to pay attention to the present key trends that demand more research. cheaper and handy devices for computations and storage in the future may create a need to understand and analyze security at a whole new level. Better tools to understand the ever growing data set can yield unparalleled knowledge but may also break down boundaries (social, legal and ethical) that humans aren't prepared to scout. It is required that We accept and manage the risks both real and online because of all that they provide us.

14. CONCLUSION

Everyone irrespective of their roles in society must be involved In making decisions about cyber security that could help shape the future beyond the world of computers. Basic terms, concepts and knowledge that define what is possible, legal and proper are being missed and are often vague. This paper aims to bridge the gap between threats that are overblown and others that are missed[17].

निष्कर्ष

हर व्यक्ति समाज मे उनकी किसी भी भूमिका के बावजूद साइबर सुरक्षा से सम्बन्धित निर्णयों में भाग ले सकता हैं जिससे वह कंप्यूटर की दुनिया से परे भविष्य को आकार देने में मदद कर सकता है। बुनियादी शब्दावली, विषय और ज्ञान जो बताते हैं कि क्या सम्भव, कानूनी और उचित हैं अक्सर गायब और अस्पष्ट रहते हैं। इस आलेख का उद्देश्य खतरे (जो हद से ज्यादा) हैं और खतरे (जो अनुपस्थित है) के बीच के अंतर को भरना हैं।

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साइबर सुरक्षा की चुनौतियाँ
Challenges in Cyber Security

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सारांश

सूचना और संचार प्रौद्योगिकी के क्षेत्र में प्रगति ने देशों को जल्दी सूचना आदान–प्रदान के लिए उनके संचार नेटवर्क को बेहतर करने की सुविधा प्रदान की हैं। कई घरेलू और अंतरराष्ट्रीय आतंकवादी समूहों ने साइबर हमले के लिए नेटवर्क से जुडे हुए कम्पयूटरों की दृष्टित कमजोरियों को लक्ष्य बनाया हैं। पिछले दो दशकों में, साइबर हमलों ने अपने परिदृष्य को काफी बदल गया है। साइबर आतंकवादियों समूहों नें समन्वित साइबर हमलों के लिए काफी जटिल प्रौद्योगिकी का इस्तेमाल और कुशल साइबर विशेषज्ञों की भर्ती की हैं। यह आलेख साइबर हमलों के विभिन्न तरीकों की जांच करता हैं और साइबर सुरक्षा के क्षेत्र में विभिन्न चुनौतियों पर प्रकाश डालता हैं।

ABSTRACT

Advancements in information and communication technology have facilitated countries to develop and improve their communication networks for quick information exchange. Many domestic and international terrorist groups target networked computers with exposed vulnerabilities for cyber attack. In past two decades, cyber attacks have changed its landscape tremendously. Cyber terrorists groups are applying more sophisticated technology and recruiting skilled cyber experts to conduct coordinated cyber attacks. The paper investigates the different methods of cyber attacks and highlights the various challenges in cyber security.

Keywords: Cyber-security, cyber-terriorism, cyber space

1. INTRODUCTION

With the emergence of internet it became possible to retrieve information quickly with minimum human efforts. As far as we know, it is the only medium that can advertise business in very short time across the globe. Exponential growth of internet also affected India positively as it has faced significant rise in web related activates in last three decades. India is ranked on third position in the usage of internet after USA and China[9]. It is considered one of the popular IT destination in the world. The growth in the usage of internet and networking has empowered the individuals and posed new challenges to governments and cyberspace administration as well.

Cyber security is now being considered as a major concern across the world as it is being exploited by criminals, hackers and terrorists to succeed in identity theft and financial fraud. Terrorists are using internet as a weapon to carry out their activities and stealing information from different countries. The emergence of mobile phones also added more complexities in cyber world. Moreover, complicated and malicious software damage more often computer systems and block the network as well. All these established the cyber security as global issue for development of economy and national security.

2. CYBER SECURITY AND CYBER TERRIORISM

Cybersecurity threats from well-funded and motivated adversaries are capable to disturb critical services provided by private organizations at home and abroad[14]. Threats are targeting core services of the government, economy and national security infrastructure, creating a shared risk for both public and private sectors.

2.1 Cyber Security

The word “Cyber” has been taken from the world “Cybernetic” that means by using the computer [1]. Cybernetic covers the theory of communication and control of regulatory feedback. The word “Cyberspace” is very common in today’s computational world was introduced by W. Gibson in his novel “Neuromancer” in reference to internet in 1991[1].

Cyberspace security is now being considered as common and international problem[11]. The term “Cyberspace” denotes the fusion of all communication

networks, various databases and different information channels in huge [1]. It is interconnected global digital infrastructure that comprises of internet, telecommunications networks, computer systems, processors and various controllers in different organizations. The Cyberspace includes computer systems, mobile-phones, tablets, computer networks and internet as well. Cyberspace becomes anonymous and borderless in nature. The internet user can access any node connected to the global network from any part of earth. It is very easy for professional hackers to mask their identity and impersonate. It becomes virtual and spread globally, exists in presence of telephone wires, coaxial cables and other transmission media. The term Cyber security concerned with making cyberspace safe from threats, namely cyber-threats [1]. Cyber security includes technologies, processes and practices used to protect networks, computer hardware, software, programs, information and data from attack, damage or unauthorized access. In context of computing, the term security denotes cyber security that includes various elements such as application security, information security, network security and data recovery.

2.2 Cyber-Terriorism and Botnet

The treat of terrorism has presented large number of challenges in cyber-war period. Terrorists are targeting to major cities, research laboratories across the globe and making communication channel unsecure. Although few serious efforts have been made in this direction but seems inefficient as most of mechanism are based on conventional paradigm. These conventional mechanisms become effective only in conventional cyber attack. The rapid growth of Information Technology (IT) has laid a huge database of information about anything and everywhere. Unfortunately, this growth is also adding a new dimension to terrorism. Few recent researches support this fact that terrorist are recruiting best cyber security players at higher compensation.

Cyber-terrorism denotes unlawful attacks and threats of attacks against computers, networks and information contained in [2]. It is done to intimidate or pressurize a government and its people for political benefits or social objective. Cyber-terrorism takes place when cyberspace and terrorism converge. According to Denning, "Cyber-terrorism is an attack that includes violence against persons to generate fear"[4]. Cyber criminals often inject vulnerability in computers on network and gains control over, install various programs with ability to keep track of all their cyber crime related activities. A set of such types of computers under control of terrorist group or individuals is known as 'Botnet'.

3. METHODS OF CYBER ATTACK

A cyber attack towards the computer and network may interrupt equipment performance and network reliability, often changes processing logic and performs the task of stealing and corrupting data [2]. Various cyber attack modes use different kind of vulnerabilities with different cyber weapons. On the basis of our literature survey, we identified three major categories of cyber attack that are described below.

3.1 Physical Attack Conventional

This is conventional weapon that can be directed towards computer hardware, computer facility and transmission lines [2]. Physical attacks often interrupt the performance of equipments, fragment the memory and generate circuitry heat and unusual manipulation in network lines. In 1991, U.S. armed forces interrupted the Iraqui communication lines through the use of cruise missiles and sprinkled carbon filaments to short circuited communication line[2]. On September 11, 2001, Al Qaeda diminished World Trade Centre and Pentagon, during this attack, number of database linked globally, were destroyed[2].

3.2 Electronic Cyber Attack

Cyber attacks are inexpensive and easy to conduct [12] [13]. An electronic attack includes the power of electromagnetic energy like a weapon. Intruders often use electromagnetic pulse (EMP) to create power and signal fluctuation to damage computer circuitry. Now a days EMP is being considered as a dangerous weapon for cyber security. An EMP is defined as the burst of electromagnetic radiation generated during the detonation of nuclear weapon or when a non-nuclear EMP is used [3]. EMPs can be so high frequency as the flash of light beam. An EMP takes less than a nanosecond to grow and continue for longer hours[3]. The consequences of an EMP include physical damage of electronics instruments, short circuiting and electric shocks to people.

3.3 Computer Network Attack

A computer network attack (CNA) includes malicious program code to infect computer to harm computer Software, configuration and security as well in any targeted organization. It affects the integrity or authenticity of existing data, often changes logic, control and processing of data that result the error in output[2]. If a computer is injected with malicious code, the system can be remotely controlled easily by hackers. Computer network attack actually targets that system that has software errors or lack of antivirus and firewalls[2].

4. CHALLENGES IN CYBER SECURITY

As the use of information technology is growing rapidly worldwide. Significant increase in cyber related activities and large utilization of internet resulted more chances for cyber related crimes. Due to lack of adequate knowledge about system protection and possibility of anonymous, result cyber crimes in society. Several countries have witnessed significant increase in spamming, virus infection and worm infection. India is also experiencing the cyber security problems with various challenges as discussed below.

4.1 Cyber Security is Borderless

For most of us the internet is essential part of our daily routine to keep in touch with social media, academics, online shopping and paying bills. In our profession, we also use internet and other information technologies to enhance efficiency, quality of services and to access new markets across the world. As internet offers large number of benefits, there are also security challenges related with its use. Rapid use of internet has established new opportunities for criminals and terrorists to access our personal and corporate information. The major problem with the cyber security is its borderless nature[5].

As the cyberspace connects the system across the world so it often becomes difficult to locate the origin of attack.

4.2 Anonymity of Actors

Although we are actively fighting and preventing cyber crime related activities from damaging hardware and infrastructure but it is difficult to locate the origin of cyber attack. In the virtual cyberspace it becomes difficult to locate the political borders and culprits as well[5].

The major problem in cyber security is the identification of actors in a virtual space where acquiring anonymity is easy and where period gap between the intruder action and its effects. In addition, the continuous rapid growth of sophisticated computer technologies among the skilled population also makes reorganization of the attackers extremely difficult.

4.3 Fuzziness of Terminology

The fuzziness of terminology is also a major problem in reference to develop global rules for cyber security that diminishes the capability of policymakers to prepare the rules for world population [6]. In addition, cyber security is defined in different various ways and several different cyber terms are being used with the same intention.

There is no globally accepted definition of cyber security and cyber crime, various terms are in use with related meanings.

4.4 Large and Amorphous

Cyberspace is large, amorphous and continuously growing in nature. It is virtual and interconnected worldwide. It does not cover any physical or geographical area. The complexity of cyberspace is mounting day-by-day, because of links between computers, mobiles, tablets, servers, routers and other components of the Internet's infrastructure. Cyberspace includes complex technologies, whose expansion, construction and existence are imagined only during the process of maintenance. It is difficult to chart or map to cyberspace.

4.5 Speed of Technology Development

IT is still considered as an innovative and dynamic sector that is continuously emerging new technologies rapidly. The time period between evolution of new vulnerability and the development of a sophisticated tools or techniques that fail the cyber attacks is getting shorter. In other words, the technologies we are developing are not efficient for long term. We are still unable to develop a technology that can permanently prevent the cyber attacks. We are required continuous efforts to tackle with this problem. As it is confirmed that world is facing cyber army problem and very few experts are able to present the solution of sophisticated cyber attacks. On the other hand, cyber attackers, criminals, hackers and cyber terrorists are executing their planning world widely. It becomes very essential for us to form a capable cyber army that can save us from financial fraud and information loss.

4.6 Tracking the Origin of Crime

Internet was never constructed to track and trace the behavior of users[8]. The Internet was actually constructed to link autonomous computers for resource sharing and to provide a common platform to community of researchers [8]. It was constructed to expand the different possible usage of networking. It is very important for a nation to track and trace the origin of any cyber attack and infrastructure to block such types of attacks for nation's long term survival and prosperity. A better cyber security tracking and tracing infrastructure can restrict future cyber attacks. The process of tracking and tracing a cyber attack often results sufficient details about the technologies being used in the attack and criminals as well. Time is also an important factor during the identification and tracking of cyber treats. How quickly you identify the cyber attack and present solution to interrupt the progress of attack is also important.

4.7 Shortage of Cyber Expertisation

Today, world is facing rapid increase in the number of cyber attacks in government offices, private organizations and companies. Requirement for skilled

cyber security experts who are capable to protect organizations from cybercrime is high worldwide, but the shortage is particularly severe in the government organizations that often fail to offer salaries as high as the private sector. It is highly required to fill the gap between supply and demand. Martin c. Lmbicki et. al. [7] carried out semi-structured study with representatives of five U.S. government organizations, five educational institutions, two security companies, one defense organization, and one outside expert. Authors made following conclusions.

- The cyber experts who are capable enough to detect the presence of advanced threats often claim compensation more than $200,000-$250,000 a year[8].
- Normally the organizations avoid to provide expensive cyber training to their employees because of the fear that employee will take out the skills to other employer[8].
- Now organizations do not wait for individuals to become graduate with specialized degrees. They are now more concerned with those personality characteristics that correlate best with the requirements of cyber security.

On the basis of these three points, we are able to say that because of expensive and advanced training, nations often fail to form strong cyber army.

4.8 Links with Hackers-Terrorist-Sponsoring Nations

The U.S. Department of state published a list in October 2004, highlighted seven states as terrorism sponsors nations. These nations were identified as sponsors of terrorism for funding, supplying weapons and harmful software needed to execute terrorism related operations [2]. It is very difficult to confirm the relationship among hackers, terrorist and terrorist-sponsoring nations as participant individuals are highly-skilled, very exclusive and hacking related activities are performed with sophisticated hacker tools. We can categorize the cyber hacker groups in two categories. First that concerns with political interests and particular religion called 'supra-national' while second group becomes motivated by profit [2]. The individuals of this group may desire to sell computing services rather than political interest.

5. CYBER SPACE USAGE IN INDIA

The Department of Electronics and Information Technology reported that Indians have achieved 3rd position with approx 100 million internet users in June, 2011[9]. Ministry of Communication and Information technology declared in fifty second annual report [9] that India has managed to get sixth position in webhosting as shown in the Table 1. USA and China holds first and second position respectively in webhosting.

Table 1. Web hosting comparison

Country	Rank in 2011	Percentage in 2011	Rank in 2012	Percentage in 2012
United State	1	47	1	44
China	2	7	2	9
South Korea	3	7	4	8.5
United Kingdom	4	5	5	7
Canada	5	5	6	5
India	14	0.82	12	1.5

*** The data of table 1 and table 2 has been taken from fifty second report. Cyber Crime, Cyber Security and Right to Privacy, Ministry of Communications and Information Technology, Department of Electronics and Information Technology, Govt. of India, February 2014.*

This report[9] also demonstrates a comparison of cyberspace usage in India and across world as summarized in Table 2.

Table 2. Internet usage comparison

Cyber Space Usage	Worldwide		India	
	2005	2012	2005	2012
Total websites	7.5 Million	698 Million (Registered) 209 Million (Active)	1.7 Lakhs	14 Million 1.7 Million (Registered) 1 Million Active
Internet users	720 Million	2.41 Billion	21 Million	150 Million
E-Mail account	315 Million	3.146 Billion	11 Million	180 Million

From above study, we conclude that evolution of cyberspace is now being considered as fifth domain of human activity. In last 20 years, internet usage has grown rapidly. India also experienced significant rise in internet related activities [10]. Computer engineers and software professionals converted India in a popular IT destination that stands at no. 3 position in usage of internet after USA and China[9]. Such continuous and rapid growth in the usage of internet and networking has on the one hand empowered users and on the other hand presented new challenges to Governments and cyberspace administrators[9].

Criminals and terrorists use internet and cyberspace as a secure medium to conduct identity theft, financial fraud, disturbing infrastructures, facilitating illegal activities, corporate information theft and malicious software planting. The appearance of cloud and mobile technology also made cyberspace landscape more complicated. Users bear financial loss during forgery also face loss of reputation through identity theft.

In India, More than 100,000 virus/worms are reported to be active daily on internet and 10,000 out of which are new and unique that presume how cyber criminals and attackers are active [9].

6. CONCLUSION

In this paper, we look at how the topic cyber security is important for our society and why it is being a central concern in whole world. We have focused our attention to three methods of cyber attacks that are being used by cyber-terrorists and hackers and examined some recent attacks with involvement of these methods. Further, we examine major challenges available in cyber security and showed that how it is difficult to locate the origin of cyber crime. Finally, we have shown that India has been established as popular IT destination and experiencing the problems of cyber security and shortage of cyber experts as well.

निष्कर्ष

इस आलेख में, हम यह देखते है कि साइबर सुरक्षा किस प्रकाश हमारे समाज के लिए महत्वपूर्ण हैं और पूरी दुनिया में चिंता का केंद्र हैं। हम साइबर आतंकवादियों और हैकर्स द्वारा इस्तेमाल किए गए तीन साइबर हमलों पर ध्यान केन्द्रित करेंगे और इन तरीकों के इस्तेमाल से हाल के किए गए हमलों की जांच करेगें। इसके अलावा, हम साइबर सुरक्षा में प्रमुख चुनौतियों की जांच करेंगे और यह बताएगें कि साइबर अपराध का स्त्रोत को ढूढना क्यों मुश्किल हैं। अंत में, भारत में लोकप्रिय सूचना प्रौद्योगिकी संस्थानों की स्थापना और साइबर सुरक्षा में अनुभव की जाने समस्याएँ और साइबर विशेषज्ञ की कमी को दर्शाया गया हैं।

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सुरक्षा कारकों और ओओ डिजाइन कंस्ट्रक्ट्स के बीच अंतर को पाटना
Bridging the Gap between Security Factors and OO Design Constructs

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सारांश

हमारे दैनिक जीवन की व्यापार प्रक्रियाओं में उपयोग की जा रही प्रौद्योगिकी में तेजी से हो रही प्रगति निश्चित रूप से दक्षता और उत्पादकता को बढ़ाती है, लेकिन यह सॉफ्टवेयर की सुरक्षा के प्रति चिंता करने के लिए बाध्य करती है। ओओ पाराडाइम सॉफ्टवेयर विकास के लिए सर्वाधिक लोकप्रिय पाराडाइम्स में से एक है। सुरक्षित सॉफ्टवेयर के विकास के लिए कई शोधकर्ताओं द्वारा सॉफ्टवेयर के प्रारंभिक/पूर्व चरण पर सुरक्षा एकीकरण पर विचार करने का सुझाव दिया जाता है। इसलिए, डिजाइन चरण पर सुरक्षा को कार्यान्वित करना लाभप्रद होगा। डिजाइन चरण पर सुरक्षा को एकीकृत करने के लिए, डिजाइन कंस्ट्रकट और सुरक्षा कारकों के बीच संबंध का विश्लेषण किए जाने की आवश्यकता है। इस पत्र में, सुरक्षा कारकों के संबंध में लक्ष्योन्मुख डिजाइन कंस्ट्रक्ट के प्रभाव पर समीक्षा की चर्चा की गई है।

ABSTRACT

Rapid advances in technology being used in our daily life business processes surely increase efficiency and productivity, but it also compels to show about concern security of the software. The object-oriented paradigm is one of the most popular paradigms for software development. It is suggested by many researchers for the development of secured software to consider security integration at the initial/preliminary stage of the software. Therefore, it will be beneficial to implement security in the design stage. In order to integrate security in design stage, it is required to analyze the relationship between design construct and security factors. In this paper, a review on impact of object-oriented design constructs on security factors has been discussed.

Keywords: Software security, security factors, design constructs, object-oriented

1. INTRODUCTION

Security is one of the major attributes of software quality. It is strongly believed that achieving security attributes may also have side effects of other factors. These side effects can be used to trade-off between security attributes. Skeleton of the object-oriented software has been designed and decided in the design phase of software development life cycle. So, these trade-offs may easily tackle efficiently and effectively in the design phase[1,2]. Development of security architecture for software is not a onetime built process; it is based on reuse of existing security specifications. It is suggested by many researchers for the development of secured software to consider security integration at the initial/preliminary stage of the software[3].

During the security certificate process, it is required to measure the specific security non-functional attributes of the software[4]. Design level vulnerabilities are one of the most destructive defect categories[5]. Identification of security attributes may facilitate disclosing vulnerability at design level. Therefore, it will be beneficial to implement security in the design stage[15]. In this paper, a review on impact of object-oriented design constructs on security factors has been discussed.

2. SECURITY DURING THE DESIGN PHASE

Design phase uses information available in the requirement and analysis phase-and based on available information, architecture of software may be established. Architecture of software defines behaviour of components. What software is going to be delivered? Answer to the question may be given using design phase document or its output. Design phase gives an idea that how software is going to implement security features. It is recommended to avoid implementing security features at the later stages of development.

The design phase is best phase for security considerations as user authentication or sensitive data are entertained or handled here easily[6]. In comparison to traditional penetrate and patch approach to handle security problems, fixing security problems in the early stage of software development life cycle is more efficient and effective. In the area of software engineering, the result of recent studies concludes that 80 per cent of the security bug and flaws are introduced in the early stages of software development life cycle[7]. So, it is required to consider security as early as possible. This will help to reduce vulnerabilities and loss because of these vulnerabilities.

3. SECURITY FACTORS

Security factors are information, other than cryptographic keys, that are needed to establish and describe the protection mechanism that secures the communications (information/data). In the early steps, security attribute requirements are identified and prioritized as there is need to have a set of security attributes built into the system. Reckoning security factors are a step towards the security estimation engineering field. The literature survey reveals that there is no such methodology exists to identify security factors and also no common accepted set of security factors available, so it is required to identify set security factors[12].

Identified Security Factors includes

- *Authentication:* Authentication means that accession will be permitted only those users who claim to be authenticated.
- *Authorization:* Authorization ensures that the user has right to access information with their limitations. It supports access control.
- *Confidentiality:* Confidentiality ensures that only authorized users access the information.
- *Integrity:* Integrity ensures that the information is accessed and modified by those who are authorized to do.
- *Availability:* Availability ensures that the relevant information or services will be available whenever it is demanded. Many times loss of availability is considered as denial-of -services.
- *Complexity:* Measure of the degree of difficulty in understanding and comprehending the internal and external structure of design hierarchy.
- *Reliability:* Reliability characteristic provides the ability to perform failure free operation for a specified period of time in a specific environment.
- *Non-repudiation:* Non-repudiations ensure that system or software cannot deny for services or information to recognize users.

4. IMPACT OF OBJECT-ORIENTED DESIGN CONSTRUCT ON SECURITY FACTORS

Information security is a concept that still lacks unambiguous definitions. For security measurement, it is required to develop methodologies. An easy way has been suggested to find out its dimensions. Most common identified dimensions are Confidentiality, integrity, and availability. *Scandariato[8], et. al*. floated an idea of security properties of software that are quantitative in nature with regard to assessment. They further described proactive estimation of software security, especially during the architecture/design phases, using suitable security metrics[8].

Rapid advances in technology being used in our daily life business processes surely increase efficiency and productivity, but it also compels to concern security of the software. The object-oriented paradigm is one of the most popular paradigms for software development. Due to its inherent ability to represent conceptual entities as objects, it is gaining more popularity gradually. These objects can be categorized, described, organized, combined, and manipulated easily. It has been proven by the experts that object-oriented design constructs have an impact on software quality attributes and security is one of the major attributes of quality[14]. Analysis of software from a security perspective is vital to software dependent society.

Design artifacts are flexible in nature, and can easily be changed. Several methodologies are available for quantitative assessment of the quality attributes including maintainability, understandability, complexity, etc.[9-10]. These methods are well-suited for the design phase. Design phase is the most flexible phase of software development. Class diagrams lay the foundation of the latest phase of development (for coding and implementation phases). From the high-level design of software, one can get all details of design characteristics and methods. Methodologies to quantify quality attribute motivate to quantify security attributes. Literature survey reveals the fact that software based on object-oriented concepts provides facility to quantify security attributes and strengthen the motivation[11].

Security attributes may get affected in more than one phase. The set of security attributes may help during identification of security factors phase-wise at a given point of time, security factors can be prioritized based on their phase-wise activities and it may provide the base to analyze the effect of a particular security factor. It is important to think about the measures of security of software and how to go about measuring them. To solve the purpose, there is need to figure out what behaviour is expected to the software. Several security factors get affected

in the design phase. Selection of security attributes depends on according to their user, environment, and resources. It will provide a base to decide which security attributes need to be integrated in the software. Object-oriented design concepts affect security attributes[13]. These attributes include authentication, authorization, confidentiality, integrity, and availability. Some of the security attributes have positive or negative impact due to these design concepts. Some of these have been illustrated in Table 1.

Security estimation of software does not produce or ensure best software; it only gives an indication of security level of software. This process is required to identify object-oriented software characteristics that are activated during the design phase of the software development and serve to define a variety of security factors. Some of the popular object-oriented characteristics, which affect security of software are inheritance, coupling, cohesion, abstract, and encapsulation.

It is possible that a system allows access to authorized users; it may also allow access to users who should not have access. So, it is required to scrutinize software architecture. For ex: let us assume that a security check is being already designed for group A. However, because of the sharing of methods and attributes through inheritance, coupling and cohesion, sensitive information is shared by group B, who are not completely authorized for that service. Such logic errors violate security design principle 'least privilege'. So, it is required to quantify such errors and its impact to improve the security level. It also supports access control mechanisms. During the step some object oriented constructs have been identified that affect security attributes as shown in Figure 1.

5. SIGNIFICANCE AND CONCLUSION

A metrics based approach may be used to assess vulnerabilities and their impact of object oriented design. Based on the result of these measurements,

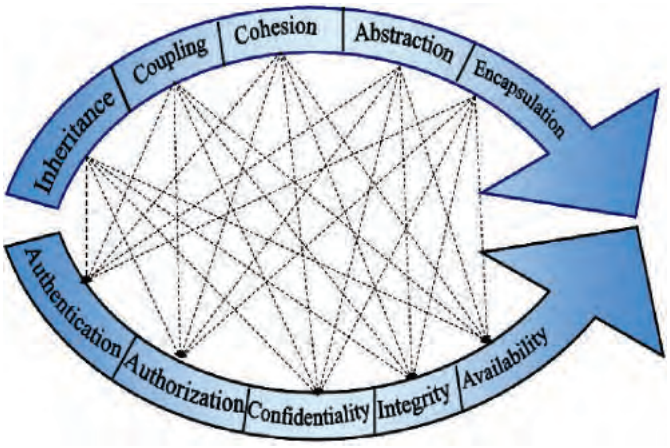

Figure 1. Relationships among security factors and design constructs.

vulnerabilities of an object oriented design can be minimized, and hence, security can be improved at early phase of development. Object-oriented design constructs such as inheritance, coupling, cohesion, and encapsulation have impact on security. Therefore, these constructs may contribute to improve security of an object-oriented design

In building complex systems, one of the major difficulties is to recognize the interfaces between components at the early stage of software development process. Impact of security factors in a quantifiable manner facilitates a way to understand the nature of security attributes and they impact on one another. It will give the basis to rank the level of achievement of software security attributes and will support rating the software security.

महत्व और निष्कर्ष

दुर्बलताओं और लक्ष्योन्मुख डिजाइन पर उनके प्रभाव का आकलन करने के लिए एक मेट्रिक्स आधारित दृष्टिकोण का उपयोग किया जा सकता है। इन मापों के परिणाम के आधार पर, एक लक्ष्योन्मुख डिजाइन की दुर्बलताओं को न्यूनतम किया जा सकता है और इसलिए विकास के शुरूआती चरण पर सुरक्षा

Table 1. Relationship between design constructs and security attributes

Design constructs / security attributes	Authentication	Authorization	Confidentiality	Integrity	Availability
Inheritance	↓	↓	↓	↓	↓
Coupling	↓	↓	↓	↓	↓
Cohesion	↓	↓	↓	↓	↓
Abstraction	↑	↑	↑	↑	↑
Encapsulation	↑	↑	↑	↑	↑

में सुधार किया जा सकता है। उत्तराधिकार, युग्मन (कपलिंग), आसंजन, और संपुटीकरण जैसे लक्ष्योन्मुख डिजाइन कंस्ट्रक्ट का सुरक्षा पर प्रभाव पड़ता है। इसलिए, ये कंस्ट्रक्ट लक्ष्योन्मुख डिजाइन की सुरक्षा में सुधार करने में योगदान दे सकते हैं।

जटिल प्रणालियों को बनाने में, एक प्रमुख कठिनाई सॉफ्टवेयर विकास प्रक्रिया के शुरूआती चरण पर घटकों के बीच इंटरफेस को पहचानने में आती है। एक गणनीय रूप में सुरक्षा कारकों का प्रभाव सुरक्षा विशेषताओं के स्वरूप और एक दूसरे पर इसके प्रभाव को समझने का एक तरीका प्रदान करता है। यह सॉफ्टवेयर सुरक्षा विशेषताओं की प्राप्ति के स्तर को श्रेणी प्रदान करने का आधार प्रदान करेगा और सॉफ्टवेयर सुरक्षा को श्रेणी प्रदान करने में सहायता देगा।

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विशेषज्ञों के दल का उपयोग करके डिस्ट्रीब्यूटीड डिनायल आफ सर्विस अटैक का पता लगाना
Detection of Distributed Denial of Service Attacks Using Panel of Experts

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सारांश

डीडीओएस को डीओएस आक्रमण के नए संस्करण के तौर पर देखा जा सकता हैं जो हमलावरों के द्वारा उचित उपयोगकर्ता को सेवा प्रदान करने में रूकावट पैदा करता हैं। यह आम तौर पर उच्च दर और कम दर को डीडीओएस के रूप में वर्गीकृत किया जाता है। कम दर डीडीओएस में हमलावर उपयोगकर्ता की मशीन के अनुप्रयोगों में किसी कमी का शोषण करता हैं जबकि उच्च दर डीडीओएस हमलावर पीडित की मशीन को बोट नेटवर्क तैयार करके जिसे बोटनेट कहते हैं भर देता हैं। यद्यपि डीडीओएस हमला एक दशक से अधिक पुराना है यह अभी भी साइबर सुरक्षा के लिए एक प्रमुख खतरे के रूप में जाना जाता है। हमले का पता लगाने के प्रमुख कठिनाई इसकी समानता सामान्य स्थिति जिसे फ्लैश इवेंट कहते हैं से हैं जहाँ सर्वर वास्तविक उपयोगकर्ता के द्वारा पैदा किए गए भारी यातायात को अनुभव करता हैं। इस आलेख उच्च दर डीडीओएस हमले पर ध्यान देता हैं, पता करने के मौजूदा तरीकों का विश्लेषण करता है और प्रस्तावित समाधान पर चर्चा करता हैं। इस आलेख में, प्रशिक्षित विशेषज्ञों का एक दल जो कि अलग–अलग डेटा आयामों पर उन्नत हैं के द्वारा एक माडल तैयार करते हैं जिसका प्रयोग असामान्य व्यवहार को सामान्य व्यवहार से अलग वर्गीकरण करने में किया जाता हैं। विशेषज्ञों के निर्णय को डेम्पसटर–साफर सिद्धांत से जोडकर अंतिम वर्गीकरण करते हैं। इन परीक्षणों को सार्वजनिक रूप से उपलब्ध और पैदा किए डाटासेट पर करते हैं जैसे स्पैमबेस, एनएसएल–केडीडी कप, आईएससीएक्स, एसएसई–नेट इत्यादि। प्रस्तावित माड्ल की मौजूदा समाधानो से तुलना के बाद हम पाते हैं यह ज्यादा सटीकता से कार्यान्वन करता हैं।

ABSTRACT

DDoS can be viewed as the extended version of DoS attack to deny the services to the legitimate users by a number of attackers. It is generally classified into High rate and Low rate DDoS. In low rate DDoS, attacker exploits a vulnerability in applications of the victim machine while in high rate DDoS the attacker floods the victim by creating a network of bots called botnet. Even though DDoS attack is more than a decade old, it is still considered as a major threat to the cyber security. The major difficulty of attack detection lies in its similarity with the normal situation called flash event where server experiences a heavy traffic from legitimate users. This paper focuss on the high rate DDoS attack, analyses the existing detection methods, and discusses the proposed solution. In this paper, a model consisting of a panel of experts trained on different data dimensions is proposed to classify abnormal behavior from the normal behavior. The decision of the experts is combined using the Dempster-Shafer theory to get the final classification. Experiments have been performed on various publically available and generated datasets such as Spambase, NSL-KDD Cup, ISCX, SSE-Net, etc. The proposed model is compared with the existing solutions and found to be performing with much better accuracy.

Keywords: DDoS, panel of experts, ensemble, random feature subspace, Dempster-Shafer

1. INTRODUCTION

Distributed Denial of Service is an attack where the attacker intentionally makes the services unavailable to the intended users or legitimate users. In cyber security, DDoS attack is one of the major threats that mainly results in a financial and reputation loss [1]. With the advancement of attack tools the intensity of DDoS attacks are growing stronger [2]. The working of DDoS attack is depicted in Fig. 1. The DDoS attack is characterized into two categories: infrastructure level attack and application level attack. In application level attack, the attacker exploits the existing vulnerabilities in the target machine. An example of this type of an attack is “ping of death” that exploits the buffer overflow vulnerability at the target system that may lead to a system crash. Application level attacks can be avoided through patching known vulnerabilities, strengthening security policies, etc., On the other hand, if an attacker floods the victim machine resources or network resources with the intent to deny the

services to the legitimate users then these attacks come under infrastructure level DDoS attacks. Examples of such type of attacks are ICMP floods, SYN floods, TCP floods, etc. In this paper, our focus is on the infrastructure level attack, specifically to the network layer DDoS attack.

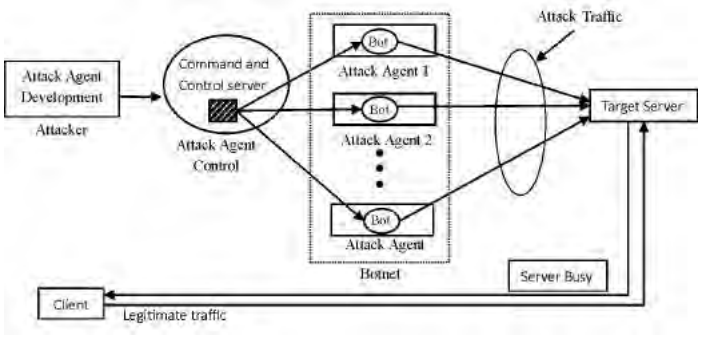

Figure 1. Working of DDoS Attack.

The vast majority of research[3-7] proposed in the literature uses machine learning, including neural networks, SVM, expert systems, etc. for the attack detection. From the literature, it has been observed that most of the detection mechanisms consider few features from the total available feature set in an attempt to classify attack traffic from normal traffic. This may reduce the computational complexity, but on the other hand compromises with the classifier ability to learn on different dimensional aspects of the available data. Therefore, the approach taken in this paper is to train the weak classifiers with different set of mutually exclusive features on different instances at each step. The intuition behind such an attempt is to encourage a set of classifiers to learn different aspects of training data to get improved predictions.

The paper is organized as follows: Section 2, gives an overview of the existing solutions. Section 3 gives the motivation for the research. Section 4 discusses the proposed Ensemble model. Section 5 presents the experiment results and the observations. Finally, Section 6 concludes the paper.

2. EXISTING WORK

For the past few years, there has been research work revolving around the ensembling of classifiers to get a better prediction rate than a single classifier can achieve [8-10]. The concepts used have been to make a weak learner a strong learner by combining weak learners together, viz., Bagging [8], Boosting [9], Adaboost [10], etc. The underlying process in bagging is to create data subsets by choosing data randomly with replacement. Each subset is then trained with the base classifier, and the final output is considered after taking the weighted mean of each classifier. Although this algorithm performs well on small dataset, it is shown to underperform if dataset is large [11]. Boosting on the other hand is similar in terms of random subset creation. But number of classifiers used are limited to three and trained on the informative data provided by the previous classifiers. This algorithm is susceptible to noise and outliers and limited to binary classification problems [9, 11].

In AdaBoost, the ensemble hypothesis are generated by training a weak classifier, with an objective of making it a strong learner by combining the hypothesis of several same base classifier, taking a majority vote from all trained classifiers. The limitation of this method is that the data distribution information is required before generating hypothesis [10, 11]. In NFboost [11], the original data set is divided into several subsets and each subset is used for training an ANFIS (Adaptive Neuro fuzzy Interface System) with a base classifier. The results from each classifier is taken as weighted mean before taking the ensemble decision through majority voting. The limitation of NFboost algorithm is the need of large amount of data before generating a hypothesis.

3. MOTIVATION

Most of the ideas in machine learning target the specific dimensions of the data, but recent researches[2,12-15] show that an attacker mimics the characteristics of the legitimate traffic in order to bypass the defence filters. Therefore, there is a need to consider other dimensions of a given traffic before reaching out to the final decision. As in real world scenarios, major decisions should be taken only after considering the advice of a panel of experts. The various experts' advice may help to reduce the error rate by learning different aspects of the underlying problem. Hence, in this paper. training the base classifier (weak classifier) in different solution space" has been proposed for getting more appropriate results by reducing false positives. The challenge is that even if the attacker mimics some characteristics of legitimate traffic the algorithm should consider other classifiers decision and combine with some appropriate process to prepare the final result (strong classifier).

4. PROPOSED MODEL

The proposed Ensemble Model consists of four phases as shown in Fig 2.

Phase I - Preprocessing of network traffic,

Phase II - Feature Extraction and Selection (creating exclusive feature sets),

Phase III – Classification with base classifiers [weak learn], and

Phase IV - Combining the different classifiers result [Ensemble decision].

The descriptions of the four phases are as follows:

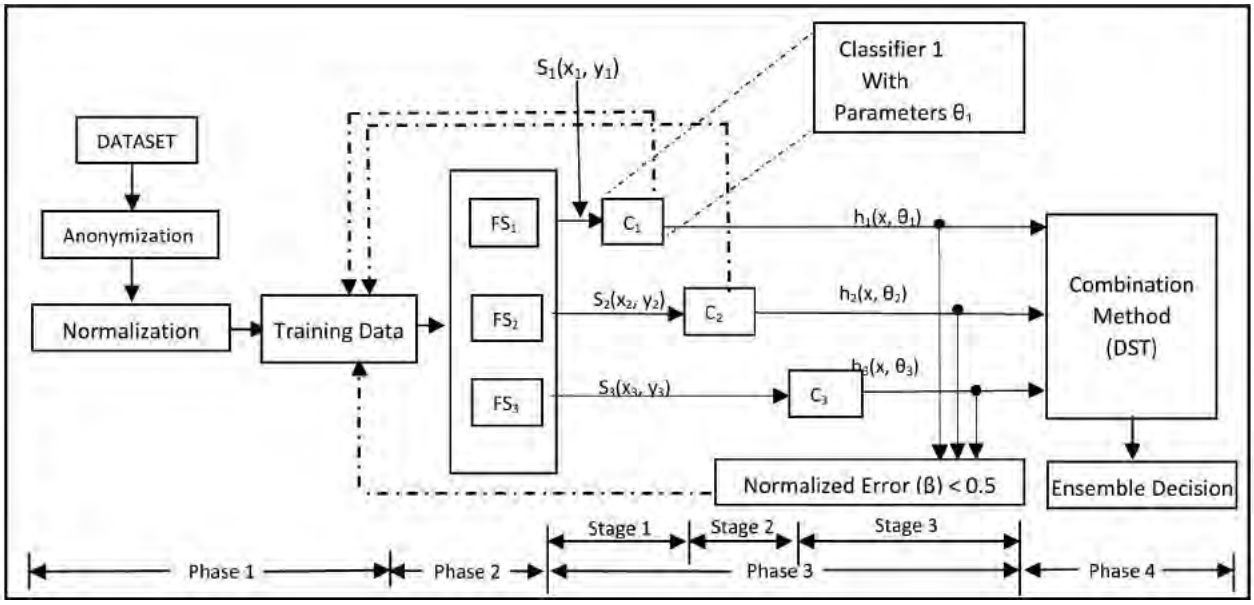

Figure 2. The proposed Ensemble.

4.1 Preprocessing

The data preprocessing is needed to format the data, normalize data to the same scale, and remove irrelevant features and noise. The input to the preprocessing module is the raw data in the form of network traffic and output of this module is the normalized dataset for use as the training dataset. Preprocessing phase is further divided into two phases, viz., Anonymization and Normalization (Feature scaling).

4.1.1 Anonymization

NSL KDD-CUP dataset contains different DDoS attacks such as, Neptune, Back, Smurf, Pod, Land, and Teardrop. All these are generalized and renamed to attack and all other normal traffic are labeled as normal. Hence, the resulting dataset consists of two class labels attack and normal only. Same process is done for other datasets such as, spambase, ISCX, and SSE-NET also.

4.1.2 Normalization

Normalization or feature scaling is a technique used to standardize the range of independent variables or features of data. In this work, the raw data used varies widely. Hence there is a need to normalize the data so that it is consistent in some way. The goal is to make sure that no features are arbitrary large. All features should have roughly the same scale.

4.2 Rationale Behind the Choice of Random Feature Selection

In machine learning, the feature selection plays a crucial role in utilizing the classifier to its optimum. Providing all the features in one dataset to the classifier may increase the computational complexity in medium to large datasets and may become cumbersome in case of very large datasets. But at the same time considering limited features may undermine the classifier ability. Therefore, there is a need to create the correct balance between the two.

Hence, in order to utilize most of the features without compromising on the computational side is by creating different subsets from the preprocessed network traffic and training each classifier with different sets. Each subset contains mutually exclusive feature set which represents diverse data containing different feature sets. These extracted outputs from the feature selection module will form the input to the classifiers.

4.3 Feature Selection Phase

In feature selection phase, the objective is to create an exclusive feature set with diverse instances. This can be achieved by creating a separate field called priority field P_s which is initialized to zero for all instances. After every classification step, the value will be modified based on the classification results. The benefit of this field are twofold: (i) optimum results can be achieved by training different classifiers with diverse datasets[16] and (ii) Reduces the size of dataset for every other phase. This can be achieved by providing only those instances to classifier at each step whose values are highest after every classification phase. Thereby at each step the size of data used for training classifiers will be reduced substantially and results in less computation. The input to this module is the full dataset, and output will be a subset containing few randomly selected feature set (S_t) including field P_s. The module utilizes all the features instead of concentrating on a few best features. In every step the feature selection module returns a subset with

a randomly selected feature set to the classification module.

4.4 Classification

The classification phase is further split into three stages. In each stage the unclassified training instances from the previous stage with randomly selected features form the input to the next stage classifier. The feedback from the every stage classifier changes the priority of training instances.

Algorithm: Proposed Model

Input

- Training data, D of size N with correct labels ωi ϵ Ω= {Ω1…. Ωk} represents k classes.
- Weak learning algorithm, 'WeakLearn'.
- I, indicating the size of individual feature subsets to be created.

Training

1. Create dataset D1 by selecting instances having the highest value in the Ps field and with random feature subset f_1, of size I<N, I=number of features.
2. Call 'weaklearn' and train with D_1 to create classifier C_1 and receive hypothesis Ht.
3. Compute the error on Ht:
$$\epsilon_t = \frac{\sum_{i=1}^{n}[H_t(x_i) \neq y_i)]}{n}$$
4. If ϵ_t>0.5, then drop the hypothesis and go to step 1.
Else, add H_t to the Ensemble, E.
5. Compute normalized error:
$$\beta_t = \frac{\epsilon_t}{1-\epsilon_t} \quad 0 < \beta_t < 1$$
6. Update the original dataset Ps field
$$P_s(x_i) = \begin{cases} P_s(x_i)+1, & if\ h_t(x_i) \neq y_i) \\ P_s(x_i) & if\ h_t(x_i) \neq y_i) \end{cases}$$
7. Create dataset D_2 by selecting instances having the highest value in Ps field, with random feature subset f_2, of size I<N, by selecting those instances in which C_1 disagrees. Train the second classifier C_2 with D_2 and compute Ht and repeat steps 4, 5, and 6.
8. Create dataset D_3 by selecting instances having the highest value in Ps field, with random feature subset f_3, of size I<N, by selecting those instances in which C1 and C_2 disagree. Train the third classifier C_3 with D_3 and compute H_t and repeat steps 4, 5, and 6.
9. Compute Composite Hypothesis, CH:
$$CH_i = avg\ \ mean \sum_{t=1}^{n} (\log \frac{1}{\beta_t})$$

Table 1. Comparison with Different Combination Methods

Datasets/ Combining Methods	NSL-KDD Cup	Spambase	Ionosphere
Majority Voting	.821	.90	.89
Maximum	.816	.87	.84
Sum	.817	.92	.89
Min	.819	.87	.85
Average	.817	.92	.89
Product	.819	.87	.85
Dempster-Shafer	**.83**	**.93**	**.91**

Testing

1. Classify instance X by C_1 and C_2, if they agree with the class, this class is the final classification.
2. If classifier C_1 and C_2 disagree, then choose a class based on the result of Dempster-Shafer Combination Method.

The Aim is to reduce the overall false positives by training a second classifier with the unclassified instances of previous classifier but with different feature sets. Each stage completion triggers the next stage as shown in Fig. 2. The classifiers with normalized error less than the threshold are dropped and the process is repeated until all three classifiers surpass the threshold. The combined hypothesis, CH is calculated using the algorithm mentioned.

4.5 Combining Outputs of Each Classifier

The various combining methods are discussed in literature are as Majority voting, maximum, sum, min, etc. But in our proposed model every classifier performs training on different data dimensions. The Dempster-Shafer (DS) method is used to combine the result of independent classifiers[16]. In our proposed model, the datasets provided to each classifier are diverse in nature. Every classifier is trained on different parameters, θ. In DS theory, instead of similarity, the proximity, $\Phi_{(s,t)}$ (x)[17] of the t_{th} classifier is calculated. According to the Dempster's rule of combination, the evidences (belief values) from each source should be multiplied to obtain the final support for each class[13].

The final support for each class μ_s can be calculated as:

$$\mu_s(x) = M \prod_{L=1}^{L} b_s(R_L(x))$$

Where M is a normalisation constant to ensure that the total support for class, ω_s for all classifiers is 1. b_s and R_L are calculated using the equation given in[17], which are not restated due to the page limit constraint.

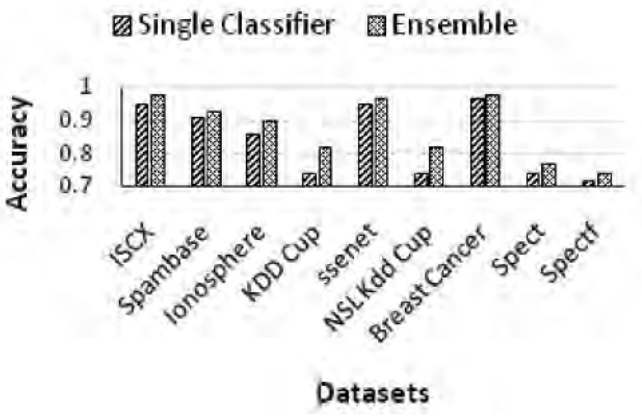

Figure 3. Comparing average accuracy of single classifier versus ensemble solution.

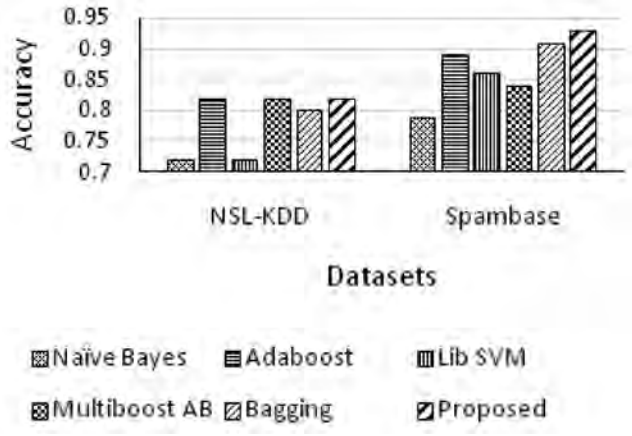

Figure 4. Analysis of ensemble on NSL-KDD Cup and Spambase Datasets.

5. EXPERIMENTS AND RESULTS

The Experiments were carried out on several datasets such as 10% NSL- KDD-Cup, Spambase, SSE-Net, and ISCX datasets using Matlab and Weka tools. The 10% NSL- KDD Cup dataset is used instead of original KDD-Cup (1999) dataset due to some inherent problems in original KDD-Cup dataset as mentioned in [18]. All the datasets were first anonymized to the two classes, viz., attack and normal and then feature scaling was done as mentioned in preprocessing section. The other datasets such as Diabetes, Ionosphere, Spect, Breast cancer have also been considered in order to analyze the result for generalized classification problem.

In this section, following experiments have been done to prove the proposed concept:

- *Experiment 1: Analysing the Effectiveness of Dempster-Shafer as a combining method*

Experiments are done with several datasets such as NSL-KDD cup, SSE-Net, ISCX, etc., to analyze the performance of the Dempster-Shafer as a combining method with other existing methods. Table 1 shows the results obtained and the best results are highlighted.

- *Experiment 2: Single Classifier Vs Ensemble Solution*

In this experiment, for Ensembling, Multi-Layer Perceptron (MLP) is taken as the weaklearn classifier. The single classifier (MLP) is allowed to train on a normalized dataset and tested with the test instances. This routine is repeated to calculate the average accuracy that needs to be compared with the average accuracy of the proposed model. The proposed ensemble model is also provided with the same normalized dataset and classifier and after several repetitions the average result is obtained. The results obtained by a single classifier versus the proposed ensemble model are depicted in Fig. 3. The results obtained clearly support our initial argument of generating strong learner from weak learn.

- *Experiment 3: Comparison of proposed approach with Existing Solutions*

In this experiment, the comparison of the proposed model is made with the existing methods available in the literature such as Ensemble solutions like Adaboost, Bagging, or other methods such as Naïve Bayes,

Table 2. Comparison of proposed ensemble with the existing solutions

Algorithm/features	Boosting	Bagging	Adaboost	Nfboost	Proposed
Method used to combine classifiers	3-way Majority voting	Majority Vote	Weighted Majority voting	Weighted Mean	Dempster-Shafer
Feature Selection	Provided as the input	Provided as the input	Weighted feature sets	Subset of features using wrapper method	Randomly selected Subsets
Data subset for training	Creates informative dataset	Creates a random subset	Draws from updating data distribution	Draws from updating data distribution	Draws from updated dataset at each step
Disadvantages	Susceptible to noise and outliers. Works only for binary classification	Performed well only for a small subset	Frequent retraining and prior knowledge of data distribution needed.	Large amount of data traffic needed for training of classifiers.	One extra field is created to maintain instance priority
Advantages	Informative dataset is provided to last two classifiers	Simple to implement	Capable of handling for multi class and regression problems	No retraining of classifiers	Performed well for both small and large datasets

Random forest, Lib SVM, etc., using the NSL- KDD Cup dataset only. The normalized dataset with all 41 features are provided to the each method. In case of a single classifier, the results are obtained by taking a subset of best features because taking all features may result in overfitting of classifier. While in case of proposed model, all features are considered while creating the dataset because the proposed model inherently takes care of further splitting of the dataset. The results obtained after experiments using Weka and Matlab are shown in Fig. 4.

From Fig. 4 it is seen that Adaboost and Multiboost AB are performing nearly with the same accuracy as our proposed method.

Therefore, this gave us the motivation to test our method further on other publicly available datasets such as Spambase and the result clearly shows that the proposed model performs better over existing ones. Further, Table 2 lists out major differences among the proposed and the existing solutions.

6. CONCLUSION

In this paper, a model with a panel of experts (classifiers) trained in different data dimensions is proposed. Each expert is independent with respect to the parameters, which is achieved by training each classifier with different set of features. The preprocessed data is provided to the individual experts and based on the classification results the unclassified instances are recorded and provided to different independent expert. This process of unclassified instances given as input to other expert is repeated. Each expert output is combined using Dampster-Shafer theory, where the final support by each classifier is calculated through belief values from each source. The final combined hypothesis is considered as the ensemble solution. The proposed ensemble method has been tested against the single classifier prediction rate. From the experiments conducted it is found that the proposed method has better classification rate than the existing solutions.

निष्कर्ष

इस आलेख में, प्रशिक्षित विशेषज्ञों का एक पैनल जो कि अलग–अलग डेटा आयामों पर उन्नत हैं के द्वारा एक माडल को प्रस्तावित किया जाता हैं। प्रत्येक विशेषज्ञ मापदंडों के हिसाब से स्वतंत्र है जिसमे हर क्लासिफायर को अलग गुणों के आधार पर प्रक्षिशित किया गया हैं। अप्रसंस्कृत डाटा को प्रत्येक विशेषज्ञ को दिया गया हैं और इनके द्वारा किए गए वर्गीकरण परिणामों से अवर्गीय उदाहरण दर्ज किए गए है और विभिन्न स्वतन्त्र विशेषज्ञों को दिए गए हैं। प्रत्येक विशेषज्ञ का परिणाम डैमसटर–साफर सिद्धान्त से जोडा गया हैं जबकि अंतिम समर्थन की गणना प्रत्येक सोर्स के विश्वास मूल्य से की गई हैं। अंतिम संयुक्त परिकल्पना को समाधान के रूप में जाना जाता है। प्रस्तावित विधि की जांच सींगल क्लासीफायर दर से की जा चुकी है। किए गए परीक्षणों से परिणाम निकलता है कि प्रस्तावित विधि मौजूदा समाधान की तुलना में बेहतर वर्गीकरण दर है।

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मल्टीमीडिया में इमेज सुरक्षा : एक सर्वेक्षण
Image Security in Multimedia : A Survey

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सारांश

आजकल लोग सूचना प्रौद्योगिकी युग से अधिक जुड़ चुके हैं। यह लोगों को अधिक से अधिक आकर्षित करता है क्योंकि इसने प्रयासों को कम कर दिया है और बिना किसी समय सीमा के संचार तरीकों को व्यापक कर दिया है। संचार में इबारत, इमेज, आडियो–वीडियो आदि शमिल हैं। संचार में सरलता के कारण अब नेटवर्क पर डाटा एक्सचेंज और अधिक बढ़ गया है। डाटा सुरक्षा की चिन्ता अब आईटी क्षेत्र में प्रमुख विषय बन चुका है। इस समस्या को क्योटिक क्रिप्टो सिस्टम के डाटा एन्क्रिप्शन तकनीक के माध्यम से हल किया जा सकता है। यह डाटा को अपठनीय प्रारूप में तब्दील करती है और डाटा की उल्लंघन होने से सुरक्षा करती है। क्योटिक प्रणाली प्रारंभिक स्थिति और नियंत्रण के मानकों के प्रति संवेदनशील हैं। इस समीक्षा लेख में डाटा एन्क्रिप्शन अपनाने के लिए विभिन्न पहलुओं और दृष्टिकोणों की समीक्षा करने का प्रयास किया गया है।

ABSTRACT

Today people are more associated to the information technology era. It attracts people at the most as it has reduced the effort and broadens the ways of communication in no span of time. Communication is comprised of text, image, audio, video etc. Due to the ease in communication, data exchange over the networks is growing every now and then. It has led to the security concerns of the data which has become the major issue in the IT sector. This problem can be resolved by data encryption technique of a chaotic cryptosystems. It converts data in un-readable format and protects data from violation. Chaotic systems are sensitive to the initial conditions and control parameters.In this review paper an attempt has been made to review the various aspects and approaches to be adopt for data encryption.

Keywords: Image Security, multimedia, encryption

1. INTRODUCTION

Now-a-days people are more technology freak. Data in terms of multimedia can be of many types like audio, video, image, text, etc., which are widely used in the various fields. Its applications where in this technology has existed in practice are medical, animation, communication, space, etc. With so many effortless applications and techniques, the usage of data has become more easy to use, handle efficiently and largely it brings some insecurity towards the data integrity and authenticity. So in order to deal with such multimedia threats, there are some encryption techniques, which help in making data safe and secure by converting it into the unreadable format. Thus the attacking ability on the data becomes more restricted.

Chaotic theory is a technique, adopted in many research areas like physics, economics, biology, and philosophy. It has vital properties like control parameters and sensitivity to initial conditions, which are used in the applications so that the desired is obtained. These terms are associated to the cryptography, so therefore chaotic crypto systems make a powerful combination to provide security.

2. ENCRYPTION METHODOLOGIES

Encryption methodologies are categorized on the basis of approach used to build the encryption technique. It could be chaos based or non-chaos based. In chaos-based, chaotic maps will be referred to adopt the approach and can be further categorized in various ways such as encryption by pixel permutation or encryption by value transformation.

2.1 Chaotic Cryptosystem

The chaotic systems are deterministic and dynamic

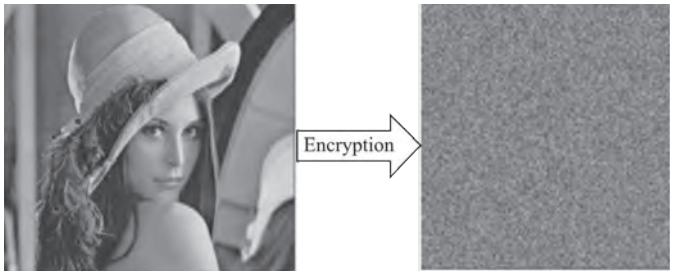

Figure 1. Image encryption.

by nature. They are sensitive to the initial conditions and the control parameters. Such system behaves on random basis due to which it shows associativity with the disturbance. The combination of chaos and cryptography makes an algorithm,which is so powerful that its nature on the network becomes unpredictable and hence provides high security level and efficient communication on the network. Here the key feature of the chaotic cryptosystems is to generate random sequences, which are used to integrate with the image or any other type of data, so that it becomes unrecognizable at the intruders end. Whereas at the receiver's end it becomes easily recognizable and readable. Chaotic systems havecome up from the chaotic theory and chaotic maps. Chaotic maps are of various types and dimensions. It could be of 1-D, 2-D or 3-D by nature. They have some control parameters and sensitive initial conditions, which plays a key role to exhibitthe unpredictable nature. Control parameters are like some specific range defined for particular chaotic map within which the system behaves chaotic. And the sensitive initial conditions are some of the fragile conditions which cannot be approximated or varied at any cost because a little change in values can lead to undesirable output. So there are many chaotic maps like Logistic map, Arnold cat map, Lorenz map, Chebyshev map, etc. One of the chaotic maps representations is in Fig. 2. This figure has been taken from Wikipedia so thanks to the source.

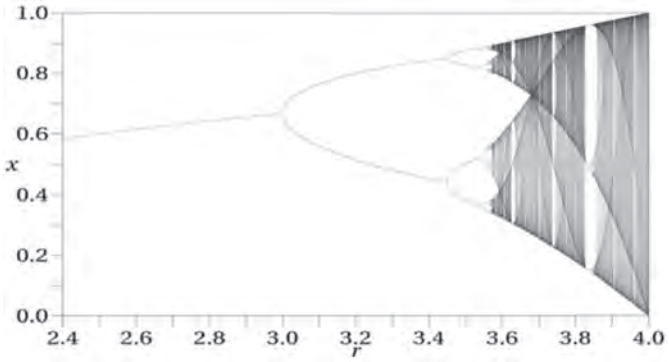

Figure 2. Logistic map.

2.1.1 Chaotic Cryptosystem Architecture

Chaotic cryptosystems architecture is divided into the 2 phases. The one is confusion and the other one is the diffusion process as we can see in the Fig. 3. This architecture refers to the entire procedure of performing encryption and decryption of the data. Here the procedure commences with the very first stage that is confusion wherein the pixel permutation is being done. Pixel permutation refers to the scheme where in the position of the pixel are shuffled within the image or data matrix.

After performing confusion phase, it has been observed that confusion alone is not sufficient to provide tight security to the data as it is easily attackable by the intruders in the network. So in order to achieve it diffusion phase came in existence. It is the process wherein the objective is to change the values of the pixels among the entire image or data matrix. Here the process is performed with the help of chaotic maps, which are basically responsible of generating random sequences to perform the above procedure. Hence the randomness behavior plays a vital role and helps in achieving the desired goal of security.

3. RELATED WORK

Baheti[1] proposed an efficient symmetric encryption scheme, which is associated to the cyclic elliptic curve

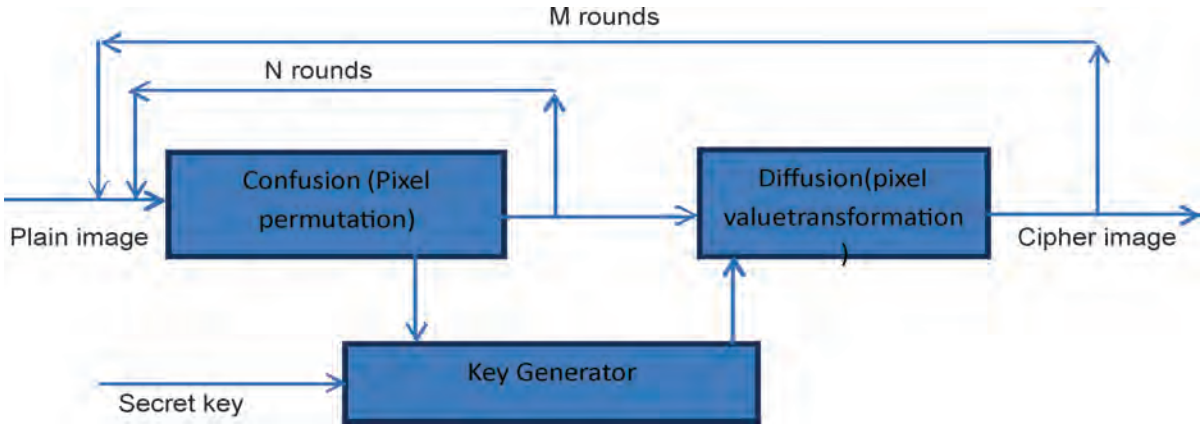

Figure 3. Architecture of chaotic cryptosystems.

and chaotic system. This scheme encrypts 256-bit plain image into the 256-bit of cipher image within eight 32-bit registers. This proposed algorithm generates pseudorandom bit sequences for round key in association of piecewise non-linear chaotic map. Finally resultant sequences are added to the key sequences. It has also proposed an authentic code generation algorithm. In this algorithm an authenticated code will be generated which is referred to compare with the code generated from the decrypted image. If the code is match able then it leads to the authentic output. Here the algorithms includes steps which starts making the blocks of 8x8 size then after that change the original image into the binary form and apply DCT on all blocks. Now matrix shuffling is performed followed by one to one mapping among the bits. Finally zig-zag scanline is performed and authenticated code is generated. So is considered to be a good secured way to protect the data on network.

Hossain[2] introduced an algorithm which is a combination of pixel position and its values transformation techniques. The encryption scheme proposed is implemented along with the XOR operations. The steps included are like at the very first place generate 3D chaos followed by equalizing the histogram. Afterwards rotating row and column and finally combine with XOR operation.

Panduranga[3] proposed an algorithm for an image encryption where in it is a concept of a block-wise shuffling in association of the mapping equation pixel are being permuted according to the mapping equation. In order to perform the partial image encryption, randomly any block-size can be selected.

Yuewu[4] introduced a new way of encrypting the image which is wheel-switch chaotic system. Here the maps are not fixed so the special attributes is the nature of changing chaotic map via wheel-switch scheme as per the controlling sequence. Afterwards it is followed by the permutation and substitution.

A scheme proposed by Lei[5] is a concept of solving two problems with the help of one algorithm. Here compression and encryption both can be done jointly in association of the context based adaptive binary arithmetic coding and is implemented with the collaboration of piecewise linear chaotic maps.

Zhouzhe[6] proposed a technique of image encryption wherein the chaotic maps referred are Arnold cat map and Chebyshev map. Here 2D Arnold map is converted to 3D map for designing by S-box afterwards diffusion processing is being processed by Chebyshev map and after iterating for many times the encryption is being done after a particular no. of iterations.

Jianquan[7] has introduced an improved version of algorithm which can solve many problem of the logistic map, like stable window, black window,uneven distribution of the sequences and it can be controlled by controlling the parameter values and sensitive initial conditions. Due to which security and key size has increased.

Niu[8] has proposed a scheme the main idea is to retain the file size of the JPEG image after the encryption and do not impact the signal processing of the image. All this has been achieved by following the three steps of the algorithm. The very first step is to encrypt the DC differential residues with key of same size like the data stream in association of the XOR operation. Now chaotic maps are used to scramble the DCT 8x8 blocks of the image. Afterwards the information gathered so far will be embedded with the AC coefficients.

4. SECURITY FEATURES

Security feature is the key criteria to detect the particular data or region which is highly prone to the malicious attacks. There are various ways to analyze the security of the data while transmission over the network. The analysis is completely dependable to the access on plain text, cipher text, etc.

- Key Space: In cryptography key space is termed as the number of attempts made to find out the key by examining all the possible keys. It is also best suited to determine the strength of the cryptosystem.
- Key Sensitivity: Key sensitivity is an security measure which is most likely to be used to detect the impact of various different values of the independent variables on the dependent variables. It is another way of predicting the result, if the conditions are same but the situations have turned out to be different.
- Entropy: Entropy in terms of information is defined as the average information contained in a message. It is the term which is best fitted for measuring uncertainty of occurrence of event.

Chaotic map	Key Space	Key sensitivity	Entropy
Logistic	10^{45}	High	7.9996
Arnold Cat	2^{148}	High	7.9981
Chebyshev	2^{167}	High	7.9902
Lorenz	2^{128}	High	7.9973

5. CONCLUSIONS

The data transmission over the internet and the open network is a major concern of security. So in order to secure data, in this survey paper we have analyzed some of the chaotic maps and there key features, which helps us in authenticating their performance and resistance power against the various attacks. Therefore all the encryption schemes in association

with the chaotic cryptosystems are considered as the most effective and efficient way of securing data over the network. We may provide the higher level of security by incorporating the multiple chaotic maps in the encryption scheme.

निष्कर्ष

इंटरनेट और खुले नेटवर्क पर The data संचरण सुरक्षा का एक प्रमुख चिंता का विषय है। इसलिए इस सर्वेक्षण अखबार में, डेटा को सुरक्षित करने के क्रम में हम विभिन्न हमलों के खिलाफ उनके प्रदर्शन और प्रतिरोध शक्ति के सत्यापन में हमें मदद करता है जो अराजक नक्शे और वहाँ प्रमुख विशेषताओं में से कुछ का विश्लेषण किया है। इसलिए अराजक क्रिप्टो के सहयोग से सभी एन्क्रिप्शन योजनाओं नेटवर्क पर डाटा को सुरक्षित करने का सबसे प्रभावी और कुशल तरीके के रूप में माना जाता है। हम एन्क्रिप्शन योजना में कई अराजक नक्शे शामिल करके सुरक्षा के उच्च स्तर प्रदान किया जा सकता है।

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वायरलेस सेंसर नेटवर्क के लिए मैट्रिक्स आधारित कुंजी की पूर्व वितरण योजना
Matrix Based Key Pre-distribution Schemes for Wireless Sensor Network

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सारांश

वायरलेस सेंसर नेटवर्क पर भेद्यता वृद्धि हो रही है के रूप में, सुरक्षित संचार सुनिश्चित करने के लिए पिछले कुछ वर्षों से ध्यान दिया जा रहा है। इस पत्र में, उन लोगों के नेटवर्क के संसाधन पर विचार करके, दो प्रमुख पूर्व वितरण योजनाओं का प्रस्ताव है। पहली योजना सही कनेक्टिविटी और लचीलापन प्रदान करती है जो जोड़ी वार कुंजी पूर्व वितरण योजना है। भंडारण उपरि कम करने के लिए, कुंजी पूर्व वितरण योजना–2 का प्रस्ताव है। यह योजना भी लचीला है और बेहतर कनेक्टिविटी प्रदान करता है।

ABSTRACT

As vulnerability on wireless sensor networks are increasing, ensuring secure communication has gained a lot of attention for the past many years. In this paper, by considering the resource constraints of those networks, two key pre-distribution schemes are proposed. First scheme is pair-wise key pre-distribution scheme, which provides perfect connectivity and resilience. In order to reduce the storage overhead, key pre-distribution scheme-2 is proposed. This scheme is also resilient and provides better connectivity.

Keywords: Attacks, key pre-distribution, sensor, resiliency

1. INTRODUCTION

The benefits and profit, of using small wireless devices such as wireless sensor nodes revolutionize the era of technology. It is making the society smart and effective. Sensor devices are used to address the problems of day to day activities. However human beings are natural sensors. He/she can measure the length, weight and smell, etc., but the accuracy is not appropriate. The importance of accuracy and to sense the things that human beings can't predict, makes the people to accept the wireless sensor network (WSN) technology. It is playing the vital role in the field of military, forest surveillance, healthcare, industrial automation and control systems, etc. The data from these devices, when used in such critical applications, are sensitive and prominent. So this requires the secure transmission of data. Hence use of cryptographic keys is essential. In WSN, secure key establishment can be established in three ways[1]: first is using trusted arbiter, i.e. using a trusted server scheme, second is using public-key schemes. However the resource constraints including limited battery, computation and communication overhead make the use of above two approaches as infeasible. In order to handle this, the simplest way is key pre-distribution, i.e. preloading the secret keys prior to their deployment in the field. With this approach, several key pre-distribution, schemes have been proposed so far.

Blom[2] makes use of secret symmetric matrix and public matrix to share the secret keys between the nodes. Blundo[3], *et al*., makes use of symmetric bi-variate polynomial to establish secure communication. Eschenauer and Gligor[4] (basic scheme for WSN) makes use of large key pool to assign the keys to nodes. Any two nodes which are able to find the common key from their loaded key chain can communicate securely otherwise using path key establishment secure communication will be established. The basic scheme security and resilience is extended in[5], it is q-Composite scheme. Instead of one common key, this scheme requires at least q common keys to set up a link. Chan and Perrig[6] proposed the PIKE. Here the node identifiers are arranged in a square grid structure. If two nodes are present in the same row or in the same column, then they share a pair wise key and can thus communicate directly. If not, using at most one intermediate node, those two nodes which are not shared keys, can establish their shared key. Kalindi[7], *et al.* have modified the PIKE scheme. The keys are placed in the grid, which is 2-comosite

simple grid scheme. To reduce the number of keys that needs to be stored in nodes, the entire grid is divided into small grids and proposed sub-grid key vector assignment. Ruj and Roy[8] proposed partially balanced incomplete block (PBIRD) scheme designs was proposed by Ruj and Roy[8]. It is a matrix based scheme, in which every node is preloaded with a set of keys according to their location in the matrix. Here every pair of nodes can communicate directly. But if more nodes are compromised, resilience decreased. Sadi, Mohammed[9] a grid-based pairwise key pre-distribution scheme for WSNs was proposed. In this scheme, multiple polynomials for each row, each column, and each diagonal in the grid are con-structed. Using the pre-distributed polynomials, the node establishes the pair-wise key with other nodes, which are placed in the same or other rows, columns and diagonal. Cheng and Agrawal[10], Distributed pair wise Key Establishment for wireless sensor networks was proposed. It is a matrix based scheme, in which each sensor node is preloaded with t rows and t columns keys from the constructed matrix. Because of intersection between the rows and columns, the sen-sor nodes can communicate directly without the third node's participation. Zhang, Yuexin[11], *et al.*, using Blom's scheme, a matrix based pairwise key establishment scheme for wireless mesh networks was proposed. This scheme considered public matrix of Blom's scheme as secret matrix to establish the pairwise keys. Zhang[12], *et al.*, the author has modified the Blom's scheme. Instead of vandermode matrix, adjacency matrix is used to reduce the computation and memory overhead. Gives an extensive survey on existing key pre-distribution and key management schemes[13-15].

2. PROPOSED KEY PRE-DISTRIBUTION SCHEMES

In this paper we have proposed two key pre-distribution schemes for WSN. First key pre-distribution scheme is pair-wise key pre-distribution scheme. Pair-wise key pre-distribution scheme is the best key pre-distribution scheme to achieve complete connectivity and perfect resilience. In pair-wise key pre-distribution scheme, each node/device has to store N-1 secret pair-wise keys, where N is the number of devices in the network. To make the system avail-able, supporting complete connectivity and resilience is essential. To achieve this, an efficient way for generating the pair-wise keys is proposed in key pre-distribution scheme-1. By con-sidering the constraints of sensors memory, without compromising on the connectivity and resilience another key pre-distribution scheme-2 is proposed.

The proposed pair-wise key pre-distribution scheme-1 has following steps:

step 1: Generation of pool of random keys: KDC (Key distribution center) generates a key pool P of random keys {r1, r2, r3….rn}.

step 2: Key Generation Phase: Based on the number of devices (N) that needs to be deployed in the network, the KDC generates a symmetric matrix of order N using the keys which are drawn randomly from the key pool P. Symmetric matrix A is given by,

step 3: Key pre-distribution phase:The rows of the generated matrix A are used as the key ring to the devices. In offline key pre-sharing phase, each device is just preloaded with one row as its key ring which is selected randomly from the generated matrix. Along with storing the row, its corresponding row num-ber is also stored in the devices. It is assumed that secure and trusted channel is maintained between the KDC and the nodes while sharing the secret rows and row number.

$$A=\begin{bmatrix} r1 & r2 & r3 & r4 & \cdots & rn \\ r2 & r5 & r6 & r7 & \cdots & rn1 \\ r3 & r6 & r8 & r9 & \cdots & rn2 \\ r4 & r7 & r9 & r10 & \cdots & \vdots \\ \vdots & \vdots & \vdots & \vdots & \ddots & \vdots \\ rn & rn1 & rn2 & \cdots & \cdots & * \end{bmatrix}$$

Figure 1. Symmetric matrix.

step 4: Shared key discovery phase:Once the nodes are pre-loaded with the secret keys i.e. a secret row, they are randomly de-ployed in the network. To establish the secure communication, nodes exchange their row numbers to find the secret key that is shared between them. The row number specifies the cor-responding key in the preloaded key chain. So just using preloaded row number information, nodes are able to find the shared key with other devices of the network. Since the proposed scheme provides complete connectivity, path key establishment phase is eliminated in the proposed scheme.

Analysis:

- The scheme provides complete connectivity and perfect resilience.
- No separate algorithms are used in shared key discovery phase. Thus memory required to store and execute separate algorithms is saved.
- No path key establishment is required.
- The scheme has no communication overhead.
- The complete connectivity makes the network available.
- The scheme is location independent scheme.

For small networks the proposed scheme-1 provides good solution. However, in case of large networks the

node has to store N-1 keys, the resource constraints of sensor node limits the storage space. In order to handle this, we are proposing key pre-distribution scheme-2. In this scheme, the generated rows are used as key ring for the devices. It has following phases:

Phase 1: *Key generation phase*

The key generation phase of proposed key pre-distribution scheme-2 has following steps:

step 1. Generation of pool of random keys

KDC generates a key pool K of random keys {r1, r2, r3….rn}.

step 2: Generation of symmetric matrix

KDC generates a symmetric matrix of order N*N. In the proposed scheme, the elements of the symmetric matrix are considered as keys. The keys are drawn randomly from the generated key pool K. Throughout this paper; we make use of order 8 matrix to explain the proposed key pre-distribution scheme-2. However based on the memory availability of sensor nodes, it can be applied for any even order matrixes. This is the main advantage because we can configure the matrix size according to the memory of the devices. For example, consider a symmetric matrix

		C1	C2	C3	C4	C5	C6	C7	C8
A=	R1	r1	r2	r3	r4	r5	r6	r7	r8
	R2	r2	r9	r10	r11	r12	r13	r14	r15
	R3	r3	r10	r16	r17	r18	r19	r20	r21
	R4	r4	r11	r17	r22	r23	r24	r25	r26
	R5	r5	r12	r18	r23	r27	r28	r29	r30
	R6	r6	r13	r19	r24	r28	r31	r32	r33
	R7	r7	r14	r20	r25	r29	r32	r34	r35
	R8	r8	r15	r21	r26	r30	r33	r35	r36

Figure 2. Symmetric matrix A of order 8.

A of order 8 is given by,

From Fig 2, it can be observed that the matrix A is symmetric with respect to the diagonal key elements {r1, r9, r16, r22, r27, r31, r34, r36}. Since it is 8X8 order matrix, it has eight rows {R1, R2…R8} and eight columns {C1, C2….C8}. Once the symmetric matrix is generated, the next step is separating the alternative columns.

step 3: Separate the alternative columns

KDC separates the alternative columns of the generated symmetric matrix. In total, if there are N(even) columns in the generated matrix, the columns {C1, C3, C5…Cn-1} forms one matrix and the columns {C2, C4, C6…Cn} forms another matrix. For example, for the generated symmetric matrix A in step 2, the separated alternative column matrixes are given by, From Fig 3 it can be observed that the generated matrix A in step 2 is separated into 2 matrixes A1 and A2. Totally we have 16 rows together from A1 and A2 matrixes. Once the alternative columns are separated, the next step is to separate the connected and unconnected rows.

		C1	C3	C5	C7			C2	C4	C6	C8
A1=	R1	r1	r3	r5	r7	A2=	R1	r2	r4	r6	r8
	R2	r2	r10	r12	r14		R2	r9	r11	r13	r15
	R3	r3	r16	r18	r20		R3	r10	r17	r19	r21
	R4	r4	r17	r23	r25		R4	r11	r22	r24	r26
	R5	r5	r18	r27	r29		R5	r12	r23	r28	r30
	R6	r6	r19	r28	r32		R6	r13	r24	r31	r33
	R7	r7	r20	r29	r34		R7	r14	r25	r32	r35
	R8	r8	r21	r30	r35		R8	r15	r26	r33	r36

Figure 3. Alternative columns of Symmetric matrix A.

step 4:Separate the connected and unconnected Rows

KDC separates the connected and unconnected rows for the separated alternative column matrix, which is generated in step 3. The rows are said to be connected if they have at least one common key and the rows are said to be unconnected if they don't have common key. In an alternative column separated matrix, if N rows are connected, then exactly N/2 rows are not connected. For example, in A1 matrix of Fig 3, the row R1 with key elements {r1,r3,r5,r7} and row R3 with key elements {r3,r10,r12,r14} are connected because they have the common key r3. Similarly, in A2 matrix of Fig 3, the rows R1 {r2,r4,r6,r8} and R2 {r9,r11,r13,r15} are unconnected because they don't have any common key. The separated connected rows of Matrix A (A1&A2) is given by,

From Fig 4, in A1 matrix it can be observed that;

		C1 C3 C5 C7						C2 C4 C6 C8			
		Connected Rows (C1)						Connected Rows (C2)			
A1=	R1	r1	r3	r5	r7	A2=	R2	r9	r11	r13	r15
	R3	r3	r16	r18	r20		R4	r11	r22	r24	r26
	R5	r5	r18	r27	r29		R6	r13	r24	r31	r33
	R7	r7	r20	r29	r34		R8	r15	r26	r33	r36
		Unconnected Rows(U1)						Unconnected Rows(U2)			
	R2	r2	r10	r12	r14		R1	r2	r4	r6	r8
	R4	r4	r17	r23	r25		R3	r10	r17	r19	r21
	R6	r6	r19	r28	r32		R5	r12	r23	r28	r30
	R8	r8	r21	r30	r35		R7	r14	r25	r32	r35

Figure 4. Connected and unconnected rows of matrix A1 and matrix A2.

the rows R1 and R3 have a common key r3, the rows R1 and R5 have a common key r5 , the rows R1 and R7 have a common key r7, the rows R3 and R5 have a common key r18, the rows R3 and R7 have a common key r20 and the rows R5 and R7 have a common key r29. So in A1 matrix, the rows {R1, R3, R5, R7} are completely connected. Similarly in A2 matrix, the rows R2 and R4 have common key r11, the rows R2 and R6 have common key r13, the Rows R2 and R8 have common key r15, the Rows R4 and R6 have common key r24, the Rows R4 and R8 have common key r26 and the Rows R6 and R8 have common key r33. So in A2 matrix the rows {R2, R4, R6, R8} are completely connected.

The remaining rows which do not have share keys

with any other rows are separated as unconnected rows. From Fig 4, the rows {R2, R4, R6, R8} of A1 matrix are unconnected rows. Similarly because of no common keys, the rows {R1, R3, R5, R7} of A2 matrix are unconnected rows.

By observing connected rows and unconnected rows, one more important observation that we can make is, rows of unconnected rows {R2, R4, R6, R8} of A1 matrix share common keys with unconnected rows {R1, R3, R5, R7} of A2 matrix. For example the unconnected row R2 with key elements {r2,r10,r12,r14} of A1 matrix share a separate key with all the unconnected rows {R1, R3, R5, R7} of A2 matrix. In specific, the row R2 of A1 matrix shares common key r2 with row R1 of A2 matrix, common key r10 with row R3 of A2 matrix, common key r12 with row R5 of A2 matrix and common key r14 with row R7 of A2 matrix. Similarly the rows R4, R6 and R8 of A1 matrix also have common key with rows R1, R3, R5 and R7 of A2 matrix.

In this key pre-distribution scheme, the generated rows are used as key ring for the nodes. The main aim of this key pre-distribution scheme is to increase the connectivity with storing small number of keys in the nodes. As we can see if we preload the generated rows in step 4 as key ring for the devices, the connectivity is established between the connected rows (C1) of A1 matrix, between the connected rows (C2) of A2 matrix and unconnected rows (U1) of A1 matrix with unconnected rows (U2) of A2 matrix. With this, the connectivity is achieved to some extent. But because of no common key elements, the connected rows of A1 matrix are not able to connect with connected rows of A2 matrix and also with unconnected rows of A1 and A2 matrix. In order to establish connectivity, the KDC performs the next step.

step 5: Assignment of diagonal elements

The generated rows are shown in Fig 4. From this figure, we can observe that, the diagonal elements are not shared with any rows of the matrix. In order to make it useful, the KDC extracts the diagonal elements of the constructed matrix. For example in Fig 4, the diagonal elements are {r1, r9, r16, r22, r27, r31, r34, r36}. Once the KDC extracts the diagonal elements, it distributes the diagonal elements to other rows. In general, for any order matrix, the distribution of diagonal key elements in the following manner will increase the probability of connectivity.

- The diagonal elements of connected rows of A1 matrix should be shared with alternative rows of connected rows of A2 matrix. Once it is done, the remaining key elements should be equally shared among the unconnected rows of A1 and A2 matrix.
- The diagonal elements of connected rows of A2 matrix should be shared with alternative rows of connected rows of A1 matrix. Once it is done, the remaining key elements should be equally shared among the unconnected rows of A1 and A2 matrix.

Fig. 5 shows an example of distributing the diagonal elements to the generated rows which is shown in Fig. 4.

In Fig 5, the random values stored in rows {R1,

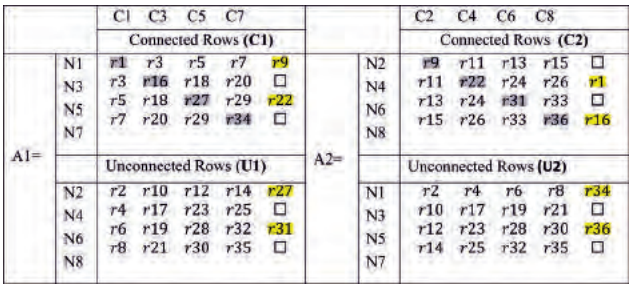

Figure 5. Assignment of diagonal elements to rows.

R2…R8} are stored in nodes {N1, N2 …N8}. From Fig 5, we can observe that, the assignment of diagonal elements increases the connectivity and makes it possible to establish the connection between the connected and unconnected rows. For example, because of sharing the diagonal element r1 of the node N1, which belongs to connected rows of A1 matrix with node N4 of connected rows of A2 matrix; the node N1 and N4 are connected. To increase the connectivity to some more extent, we place some extra keys in the empty places of the generated matrix. For example, in the connected rows of A1 matrix, empty places are there at the node N3 and N7. Similarly, we have empty places in other matrixes also.

In Fig 5, because of no common key element, the nodes in the unconnected rows of A1 ma-trix are not able to connect each other. Similarly, the nodes in the unconnected rows of A2 matrix are not able to connect each other. In order to make the connection possible between unconnected rows and also to increase the connectivity between connected rows of A1 and A2 matrix, we make use of some extra keys from the generated key pool K in step1.In general, for any order matrix the distribution of extra keys should be perform in the following manner:

- First count the number of empty spaces in the unconnected rows of A1 matrix. Then ex-actly draw count/2 key elements from the key pool and assign them randomly to the rows. The same keys needs to be assigned to remaining empty spaces of unconnected rows of A1 matrix. Similarly, follow the same procedure for A2 matrix.
- Count the total number of empty spaces in any one of the connected rows matrix (either A1 or

A2 matrix). Then exactly draw counted number of keys form the key pool K and assign them to the rows of any one of the matrix (here it is assume that for A1 matrix). Assign the same keys to the empty spaces of other connected matrix (A2 matrix).

Figure 6 shows an example of assigning the keys to empty spaces of connected and unconnected rows. The key K1 which is drawn from the key pool K is shared between the nodes N4 and N8 of unconnected rows of A1 matrix. Similarly, the key K2 which is drawn from the key pool K is shared between the nodes N3 and N7 of unconnected rows of A2 matrix. Since the connected rows of A1 matrix is already completely connected, there is no need to share the extra keys between the rows of A1 matrix. Also, the connected rows of A2 matrix are com-pletely connected; there is no need to share the keys between the rows of A2 matrix. But be-cause of limited common keys between connected rows of A1 and A2 matrix, there is a need for sharing the keys between connected rows of A1 and A2 matrix. The Keys K3 and K4 are shared between the connected rows of A1 and A2 matrix. This way of arrangement helps us to increase the connectivity of the system.

Phase 2: Key pre-distribution phase

		C1 C3 C5 C7							C2 C4 C6 C8				
		Connected Rows (C1)							Connected Rows (C2)				
A1=	N1	r1	r3	r5	r7	r9	A2=	N2	r9	r11	r13	r15	k4
	N3	r3	r16	r18	r20	k3		N4	r11	r22	r24	r26	r1
	N5	r5	r18	r27	r29	r22		N6	r13	r24	r31	r33	k3
	N7	r7	r20	r29	r34	k4		N8	r15	r26	r33	r36	r16
		Unconnected Rows (U1)							Unconnected Rows (U2)				
	N2	r2	r10	r12	r14	r27		N1	r2	r4	r6	r8	r34
	N4	r4	r17	r23	r25	k1		N3	r10	r17	r19	r21	k2
	N6	r6	r19	r28	r32	r31		N5	r12	r23	r28	r30	r36
	N8	r8	r21	r30	r35	k1		N7	r14	r25	r32	r35	k2

Figure 6. Assignment of keys to empty places of rows.

In the proposed scheme, the generated rows obtained by assigning diagonal elements as discussed in step 4 of phase 1 is used as the key ring for the nodes. In general if the order of the generated symmetric matrix is N, then the total number of keys in key pool is N^2. The number of generated rows is 2N. So our key pre-distribution scheme supports the key ring for 2N nodes when the order of the matrix is N. Each sensor node contains N/2+1 keys.

In offline key pre-sharing phase, each device is preloaded with one row as its key ring which is selected randomly from the generated matrix rows. Along with storing a row, the key identifiers of the keys which are present in the stored row is also preloaded. It is assumed that secure and trusted channel (out of band channel) is established between the KDC and the nodes while sharing the secret rows and key identifiers to the devices.

Phase 3: Shared key discovery phase

Once the nodes are pre-loaded with a secret row, they are randomly deployed in the network. To establish the secure communication, nodes broadcast the list of identifiers of the keys available on their stored secret row to find the secret key which is shared with the communicating node. The nodes that have common key identifier can communicate directly in the network. Authors have used challenge response protocol to find the shared key between the nodes[5].

Phase4: Path key establishment phase

Use of symmetric matrix enables perfect connectivity. In order to overcome the memory constraints, the proposed scheme generates the secret rows as discussed in phase1. This results in some nodes not able to connect directly, i.e., they can't directly establish communication with the communicating node. Thus path key establishment is essential to discover the shared keys for the nodes that are not directly connected with the shared secret key.

2.1 Analysis and Comparisons

Connectivity: Use of symmetric matrix enables us to achieve more connectivity. The elements of the matrix are symmetric w.r.t the diagonal of the matrix. Thus a key is present exactly twice in the matrix. This provides high connectivity in the network.

Resilience: Use of pair-wise keys provides perfect resilience in the network. Any node capture will not affect the secure communication between non-compromised nodes. Thus the proposed scheme is resilient to node capture attacks.

Figure 7 shows the resilience analysis. In x-axis

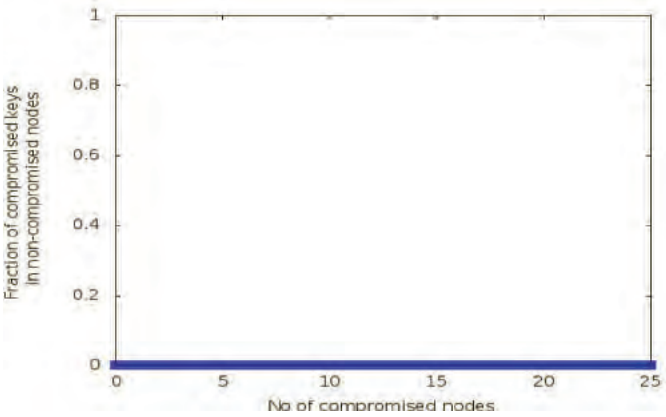

Figure 7. Resilience analysis.

number of compromised nodes is considered and in y-axis fraction of compromised keys in compromised nodes is plotted. It can be observed that as the number of compromised nodes increases, fraction of compromised keys in non compromised nodes is zero. The blue line shows the resilience factor.

Number of keys: The pair wise scheme needs to store N-1 keys. However, the resource constriants of the sensor nodes limits the storage space. Inorder

to handle this, in the proposed scheme each node needs to store nearly N/2+1 keys. With achieving high connectivity and perfect reslience , the proposed scheme also reduces the number of keys that needs to be stored in the nodes.

2.3 Analysis

- The probability of connectivity is increased.
- The scheme provides perfect resilience.
- Based on the device memory, we can configure the matrix order. In case of some key pre-distribution scheme, there is a restriction in storing the number of keys. So our scheme provides flexibility.
- The key generation phase has five steps. However this is one time operation and it happens at KDC. The KDC has sufficient memory and computation capabilities.
- The number of keys that needs to be preloaded in nodes is relatively small.
- The scheme is simple and efficient.
- When compare to the proposed scheme-I, the shared key discovery phase in proposed scheme-II requires more bandwidth.
- It can be clearly observed that in key pre-distribution scheme there is a tradeoff between connectivity, resilience and storage.

To communicate securely with neighbors, the nodes may require path key establishment. While establishing secure links through secure routes, the number of hops required to reach destination node may be different. The secure link established via one hop will correspond to direct key establishment phase, otherwise two or more hops are required to establish the secure links.

In case of probabilistic schemes, when the key ring is equal to or greater than some number of keys, then only the probability of connecting secure links in the network is possible to be determined. Thus the probabilistic schemes restrict the key ring i.e. number of keys that should be stored in the devices to establish the secure links irrespective of the device memory. If the device memory is less and it is not possible to store the restricted number of keys, it is difficult to apply probabilistic key pre-distribution scheme because the network gets disconnected when the key ring is small. However in our scheme there is no restriction in the key ring size; based on the device memory, the desired order of matrix can be generated and using the stored rows, devices can establish the secure links.

Table 1 shows the analysis of the proposed scheme with respect to number of hops needed to establish secure links. Use of symmetric matrix enables the connectivity ratio high. In general if N nodes are there in the network, each node contains (N/4 +1) keys. Since the node has (N/4 +1) keys it is possible to establish direct connectivity with N/4 +1 Nodes. The use of symmetric property of the matrix and its arrangement has made possible to connect half of the nodes using one connecting node and maximum of two connecting nodes are required to es-tablish communication from source node to any destination node in any size network.

Table 1. Analysis of effect on network topology

Parameter	Value
Number of nodes in the network	N
Number of keys in a node	N/4 +1 keys
Direct connectivity	N/4 +1 Nodes
Half of the nodes in the network are reachable by	One connecting node
Maximum average path length (L)	Two connecting nodes

3. CONCLUSIONS

This paper presents two key pre-distribution schemes using symmetric matrix. First key pre-distribution scheme is pair-wise key pre-distribution, which supports cent percent connectivity and resilience. In order to overcome the memory constraints, second key pre-distribution scheme is proposed. In this scheme, the number of keys that needs to be stored is less and it provides perfect resilience. In future we would like to study the possible attacks and to make the scheme resilient to identified attacks.

निष्कर्ष

इस पत्र सममित मैट्रिक्स का उपयोग करते हुए दो प्रमुख पूर्व वितरण योजनाओं को प्रस्तुत करता है। पहली कुंजी पूर्व वितरण योजना के शत–प्रतिशत कनेक्टिविटी और लचीलापन का समर्थन करता है जो जोड़ी वार कुंजी पूर्व वितरण, है। स्मृति की कमी को दूर करने के क्रम में, दूसरी चाबी पूर्व वितरण योजना का प्रस्ताव है। इस योजना में जमा होने की जरूरत है कि कुंजियों की संख्या कम है और यह एकदम सही लचीलापन प्रदान करता है। भविष्य में हम संभावित हमलों और उन्हें पहचान करने के लिए लचीली योजना बनाने के लिए अध्ययन करना चाहते हैं।

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वायरलेस सेंसर नेटवर्क के लिए प्रौबैबलिस्टिक ईएम मॉडल का उपयोग करके ऊर्जा न्यूनीकरण के लिए क्यू–लीच प्रोटोकॉल को रूपांतरित करना

Modified Q-LEACH Protocol for Energy Minimization using Probabilistic EM Model for Wireless Sensor Network

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सारांश

सुधार की प्रक्रिया में एक प्रोटोकॉल उपलब्ध है जिसे क्यू–लीच प्रोटोकॉल कहा जाता है। मूलतः क्यू–लीच प्रोटोकॉल ऊर्जा बचत मोड के प्रसंस्करण के लिए दो भिन्न–भिन्न राउटिंग प्रोटोकॉल का एक संयोजन है। क्यू–लीच प्रोटोकॉल सीमित शक्ति थ्रेसहोल्ड फैक्टर पर आधारित क्वाडैट्रल मोड चयन के सिद्धांत पर डिजाइन किया हुआ है। लीच और क्यू–लीच के बीच अनुसंधान अंतर कलस्टर नोड प्रक्रिया के चयन के लिए सूचनाओं के साझाकरण का है। कलस्टर नोड चयन के दौरान अधिक विद्युत खर्च होती है। अब इस शक्तिशाली प्रभाव के ह्रास ने कलस्टर हेड के चयन और बेस स्टेशन के लिए डाटा ट्रांसमिशन के लिए ईएम प्रौबैबिलिस्टिक मॉडल का उपयोग किया। प्रस्तावित पद्धति दो फैक्टर में बनी है–एक है कलस्टर हेड के निर्माण के दौरान शक्ति का मापन और दूसरे चरण में, सेंसर नोड के साथ डेटा एग्रीगेशन की प्रक्रिया का उपयोग किया गया है। सेंसर नोड का डिप्लायमेंट मॉडल विभिन्न खंडों में विभाजित है। परिणाम का हमारा अनुभवाश्रित मूल्यांकन दर्शाता है कि रूपांतरित प्रोटोकॉल एम–क्यू–लीच लीच और क्यू–लीच के संपीड़न में बहुत कुशल है। यह प्रक्रिया ऊर्जा की खपत लगभग 45 प्रतिशत कम कर देती है।

ABSTRACT

In the process of improvement Q-LEACH protocol is available. Basically, Q-LEACH protocol is a combination of two different routing protocols for the processing of energy-saving mode. The Q-LEACH protocols designed on the principle of quadatral mode selection based on limited power threshold factor. The research gap between LEACH and Q-LEACH is sharing of information for the selection of cluster node process. During the cluster node selection, more power is consumed. Now reduction of this powerful effect for EM probabilistic model for the selection of cluster head and data transmission for the base station has been used. The proposed method has two factor, one is a measurement of power during formation of cluster head, and in second phase used the process of data aggregation with sensor node. The deployment model of sensor node is distributed in different sections. The distribution of these sensor nodes in random fashion according to mobility model of sensor network. Our empirical evaluation of result shows that the modified protocol M-Q-LEACH is very efficient in compression of LEACH and Q-LEACH. The process reduces the consumption of energy about 45 per cent.

Keywords: WSN, Energy, EM Model, LEACH

1. INTRODUCTION

In current scenario, wireless sensor network suffered from distribution of power for the selection of base node and cluster node. The utilization of power factor in sensor network is limited. Due to this reason most of the authors used the process of energy consumption for increasing the life of the network. The power supply process of wireless sensor network is fixed type. The process of power used battery[1,2]. Now most of the authors followed the location-based and heretical-based protocol for the minimization process of the energy factor in wireless sensor network. In consequence of efficient energy utilization one protocol which is very famous is LEACH protocol[4,5]. The LEACH protocol is based on the concept of location and threshold parameters for the selection of cluster head. Energy consumption and life of the network is a major research area of the wireless sensor network. In this network sensor is a tiny electronic device that takes more power for the processing of sensor data. The processing of data

and a lifetime of the network depends on consumption of power[6]. Now in current research trend various routing protocols are designed for a minimization of energy consumption in wireless sensor network. Some protocols are based on location, some are based on performance. In the series of protocols one protocol is called LEACH protocol. The LEACH protocol is very efficient in concern of energy saving and life of the network. But the process of data propagation in form of bidirectional and most of the node are going in phase of sleep mode. So this is the reason these protocols also need some improvement. In the process of improvement, one protocol is available is called Q-LEACH protocol [7]. The Q-LEACH protocol are based on quad direction of LEACH protocol and the process of protocol based on variable threshold concept. Basically the Q-LEACH protocol are based on the concept of location-based routing and hierarchal clustering head processing technique. In that phase of the protocol, one gap is issue the information of network to the cluster head of the network. The fill of this gap and to modify these protocols is called M-Q-L-LEACH Protocol.

The process of modification based on the model of probability for the process of knowledge based on the processing of cluster head and network for the processing of data. Energy aware routing is a variant of directed diffusion and is intended to increase the lifetime of the network[8]. It differs from direct diffusion in that it maintains a set of sub-optimal paths instead of maintaining or enforcing one optimal path at a higher rate. These paths are maintained and chosen by a certain probability. In the whole process some point of information is lacking such as information relation between selection processes of cluster head.

Some problem discusses here. Wireless sensor networks consist of a number of sensing nodes, which are distributed in a wide area. They sense an event occurring in the environment and these sensing nodes are distributed or placed according to the requirements of the application. The base station (sink), which collects data from other nodes, interacts with a user (someone interested in monitoring the activity). Data can be collected in many ways from a sensing node to a sink node using hopping techniques or transmitting data on certain frequencies. Sinks have more advanced features than sensing nodes in terms of data transmissions and processing capabilities, memory size and energy reserves[9,10]. There can be multiple sinks for a network so that there is no single point of failure.

Energy dissipation is a major factor in WSNs during communication between the nodes. Energy should be saved, so that the batteries do not get depleted or drained quickly as these are not easily replaceable in applications such as surveillance. Quality of service ensures the effective communication within the given or bounded delay time. Protocols should check for network stability, redundant data should be transmitted over the network for any type of traffic distribution. It also needs to maintain certain resource limiting factors, such as bandwidth, memory buffer size and processing capabilities.

2. LEACH PROTOCOL

In this section discuss pervious Q-LEACH algorithm process. They discuss network characteristics and working principle of the proposed scheme for efficient performance. In order to enhance some features like clustering process, stability period and network life-time for optimized performance of WSNs. According to this approach sensor nodes are deployed in the territory. In order to acquire better clustering, we partition the network into four quadrants. Doing such sort of partitioning better coverage of the whole network is achieved. Additionally, the exact distribution of nodes in the field is also well defined[14]. Describes the optimal approach of load distribution among sensor nodes. Moreover, it also presents an idea of efficient clustering mechanism which yields significantly better coverage of the whole network. We deployed random nodes in a 100 m × 100 m filed. Based on location information, network is divided into four equal parts, i.e., (*a1, a2, a3, a4*). Defining overall network area as below:

$$A = a1 + a2 + a3 + a4 \quad (1)$$

$$an = A(xm, ym) \quad (2)$$

where $n = 4$. And $m = 100$. Hence, overall field is distributed as follows:

$$Ym=0:50\ limXm=0:50\ an + Ym=0:50\ limXm=51:100\ an + Ym=51:100 limXm=0:50an + Ym=51:100\ limXm=51:100an \quad (3)$$

Portioning of network into quadrants yields in efficient energy utilization of sensor nodes. Through this division optimum positions of CHs are defined. Moreover, transmission load of other sending nodes is also reduced. In conventional LEACH cluster are arbitrary in size and some of the cluster members are located far away. Due to this dynamic cluster formation farther nodes suffers through high energy drainage and thus, network performance degrades. Whereas, in Q-LEACH network is partitioned into sub-sectors and hence, clusters formed within these sub-sectors are more deterministic in nature. Therefore, nodes are well distributed within a specific cluster and results in efficient energy drainage. Concept of randomized clustering as given in[1] for optimized energy drainage is applied in each sector. Assigning CH probability P = 0.05 we start clustering process. In every individual round nodes decides to become CH based upon P and threshold T(n) given in[17] as:

Algorithm 1 Setup Phase

1: begin
2: if node "G −→ G =nodes which did not become CHs in current EPOCH then
3: if (NODE BELONGS TO ==′ areaA′) then
4: if (NUMBEROFCHs <= _ NK _) then
5: TEMP=random number (0-1)
6: if (temp <= P
1−P(r,mod1/P)) then
7: node=CH A
8: NUMBER OF CHs = NUMBER OF CHs+1
9: end if
10: else if (NODE BELONGS TO ==′ areaB′) then
11: REPEAT STEP 4: 8
12: else if (NODE BELONGS TO ==′ areaC′) then
13: REPEAT STEP 4: 8
14: else if (NODE BELONGS TO ==′ areaD′) then
15: REPEAT STEP 4: 8
16: end if
17: end if
18: end if

Algorithm 1 defines CHs selection mechanism. Overall network is divided into four areas as: Area A, B, C and D. Initially, each node decides whether or not to become a CH. The node chooses a random number between 0 and 1. If this number is less than certain threshold T (n), and condition for desired number of CHs in a specific area is not met, then the node becomes a CH. Similarly the same process continues for the rest of the sectors and optimum number of clusters are formed. Selection of clusters will depend upon Received Signal Strength Indicator (RSSI) of advertisement. After the decision of clusters, nodes must tell CHs about their association. On the basis of gathered information from attached nodes, guaranteed time slots are allocated to nodes using time division multiple access (TDMA) approach. Moreover, this information is again broadcasted with sensor nodes in the cluster.

Algorithm 2 defines the association of nodes with their appropriate CHs. Non-CHs nodes will locate themselves in specified area they belong to. Then they will search for all possible CHs, and on the basis of RSSI they will start an association. This process will continue until association phase comes to an end. Once a cluster setup phase is complete and nodes are assigned to TDMA slots every node communicates at its allocated time interval. The rest of the time, radio of each non-cluster head node will remain off in order to optimize energy utilization. When all node data are received at the CHs then, the data is compressed and is sent to BS. The round completes and new selection of CHs will be initiated for the next round. In proposing idea, we implement above mentioned concept of localized coordination in each sectored area. We used the same radio model as discussed in[16] for transmission and reception of information from sensor nodes to CHs and then to BS. Packet length K of 2000 bits is used in our simulations. According to the above mentioned, initially all nodes send their location information to BS. BS performs logical partitioning of network on the basis of gathered information. Network is divided into four quadrants and broadcasts information to nodes. On the basis of threshold some nodes are elected as CH in each division. Normal nodes choose their CHs within their own quadrant based on RSSI. For association nodes sends their requests to CHs. TDMA slots are assigned to every node for appropriate communication without congestion. Every node communicates in its allocated slot with its defined CH.

Algorithm 2 Node Association in Q-LEACH

1: N ∈Group of normal nodes
2: GC ∈Group of CHs
3: if N∈(A, a1) then
4: Where
5: A = a1, a2, a3, a4
6: Check all possible ACHs
7: Check RSSI of CHs
8: Associate with ACHs
9: then
10: transfer of data occurs
11: end if
12: if N ∈(A, a2) then
13: Repeat step from 5: 8 for BCHs
14: end if
15: if N ∈(A, a3) then
16: Repeat step from 5: 8 for CCHs
17: end if
18: if N ∈(A, a4) then
19: Repeat step from 5: 8 for DCHs
20: end if

3. PROPOSED MODEL

The Q-LEACH protocol not measure, the prior knowledge of cluster head selection during transmission of data for base stations.The selection of cluster head process done by using the EM estimation technique. The EM technique estimates the energy level and the consumption level during transmission and selection of cluster node in the individual cluster group. The process of individual groups of node for selecting the cluster head depends on minimum energy required for the formation process. Now process of that reduces the energy consumption and increase the lifetime of the network. In each area of cluster head selection using the grouping of nodes using estimation of maximum

entropy for the generation of information during the selection of cluster head and data aggregation for the transmission of data from sensor node to base station. The working algorithm discusses in two phases in first phase discuss the estimation technique of energy and second phase discuss the process of data aggregation of the algorithm.

The process of energy estimation and relation of network estimation function

The selection of cluster head node and network relation define in four quadrature in such a manner is U,Z,V,W. the process of distribution an collection of node information derive the equation such as

$$EM(U,Z,V,W) = \sum_{l=1}^{k}\sum_{i=1}^{n}\sum_{t=1}^{T}\sum_{j\in Gi}^{1} uiwtvjd(xij,zij) - + n\sum_{j=1}^{m} vjlog(vj) + \lambda\sum_{t=1}^{T} wtlog(wt) \quad (1)$$

Subject to the level of energy function realized in the selection area

$$\begin{cases} \sum_{l=1}^{k} ui.l = 1, ui, l \in (0,1), 1 \le i \le n \\ \sum_{t=1}^{T} wt = 1, 0 \le wt \le 1, \\ \sum_{j\in Gi} vj = 1,0 \le vj \le 1, 1 \le t \le T, \end{cases} \quad (2)$$

where *U* is a area of cluster and *I,J* is the location of node.

Z={Z1,Z2,……..,Zk} is a set of optimal set of sensor node whose energy function is minimum.

W={W1,W2,……..Wt} are T weight for T cluster head of minimum energy.

V={v1,v2,……..vm} are sensor power level.

d(xij,zlj) measure the power level of two different cluster head.

$$d(xij, zlj) = (xij - zlj)^2 \quad (3)$$

if the selected node is minimum power consumption then sensor node select form the random fashion

$$d(xij,zlj) = \begin{cases} 0 & (xi.j = zl.j) \\ 1 & (xi.j = /zl.j) \end{cases} \quad (4)$$

Node Association in M-Q-LEACH area = (V, E) ←assigned sensor node //initialize network

NP_area ← EM (U,V,W,X) //estimated sensor node value for h ∪ N P_area do

h.nn ← selection_group (NP_area - {h})

h.sc ← Compute-SC (h,h.nn) //energy coefficient

V←V ∪ {h} //add these nodes

V←V ∪ {h.nn}

if h.sc <th_sc then //relatively closer to the cluster head

E←E ∪ {(h,h.nn)} //add this into cluester head

end if

end for count ← list_area (U,V,W,X) //find all bidirectional area of network

// selection phase

for each group of node (g1,g2) ∈ G(U,V,W,X) do

μ_1←mean-energy (g1), μ_2←mean-energy (g2)

if (μ_1+μ_2)/(2*selection_energy(g1,g2))> 1 then g1←select(g1, g2)

end for

// Now assign the cluster head

NP_area ← EM (U,V,W,X)

for x∈ Emin do

h ← selectof (x)

N_type ← N_type ∪ {(x, h.area)}

end for

4. EXPERIMENTAL PROCESS

Simulation is an experimental process in that process proposed a simulated model for wireless sensor network and put some standard parameter for valuation of result. In our research work perform energy minimization in wireless sensor network. The proposed model of M-Q-LEACH written in C++ script language and scenario of network generated by TCL (tool command language), both C++ and TCL command provided by NS-2.35 simulator[20]. NS-2.35 well knows research software of wireless network. The evaluation of performance of our proposed methodology in two parameter throughput of network and packet dropping of network.

Table 1. Lists the simulation parameters, their values and description of these parameters used in the simulation

Parameter	Value	Description
Environment size	100 * 100 ms	Area of simulation
Base sation location(x,y)	50,170	
Node types	Mobile node	Relative load due to traffic.
Node speed	30m/s,40m/s,50m/s	Mobility time of node
Packet type	TCP/UDP	Application load
Packet size	500 bytes	load
Base node node	2	
Simulation time	200	Total time
Receiver node	one	Single destination

5. CONCLUSION AND FUTURE WORK

M-Q-LEACH is a hybrid model of very famous EM model and LEACH protocol for energy saving in wireless sensor network. Basically M-Q-LEACH work as a power filter, because in modern trend traffic apply by the flooding a power that power is

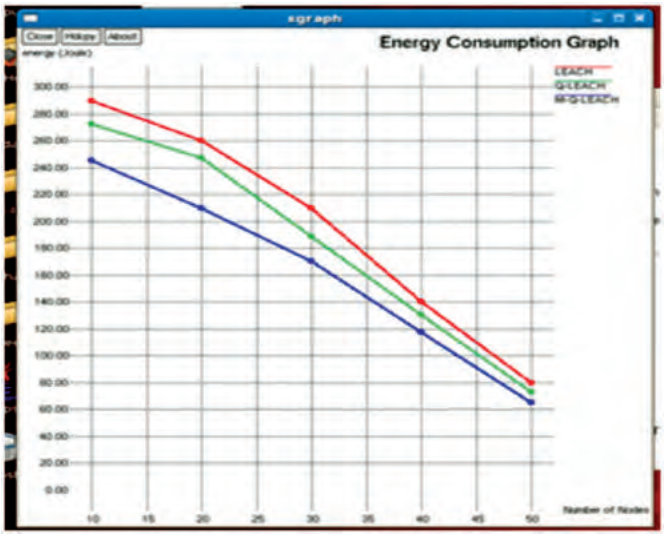

Figure 1. Shows that simulation result of energy consumption between number of node and simulation time find the consumption of energy. The LEACH protocol consumed more time in compression of Q-leach protocol and in case of M-Q-LEACH the energy consumption are reduced and this save almost 45% energy.

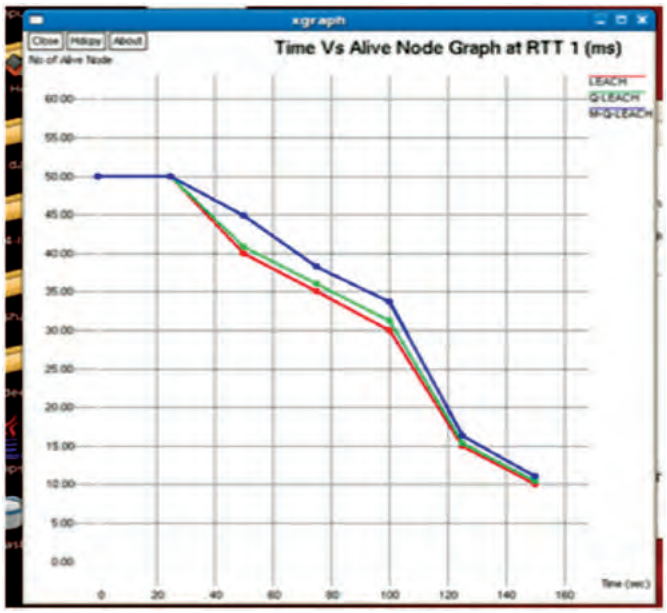

Figure 2. Shows that the simulation result of time with a number of nodes alive. The LEACH protocol consumed more time in the compression of Q-leach protocol and in case of M-Q-LEACH the node alive time period is increases almost 30% in compression of the pervious protocolof this used round trip time is 1.

consumed by sensor node. Flooding blocks a provided bandwidth of communication and our network are jam without generation of any interference attack and jamming attack. So we design a strong filter for unknown control request power at the time of node mobility. In this process our methods generate a link for connecting a mobile node with their respective

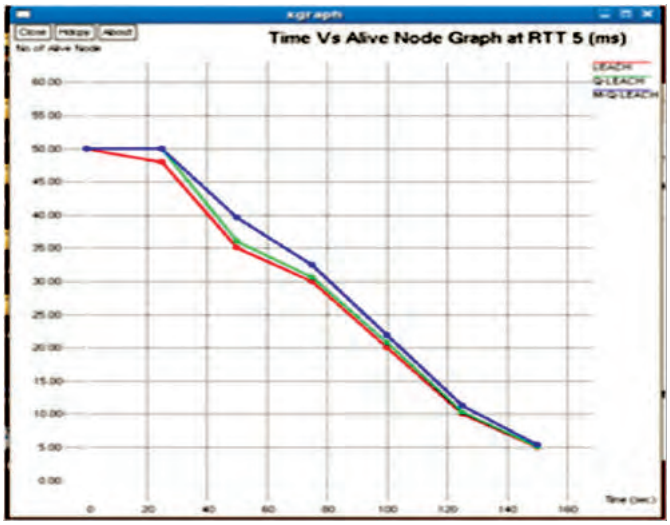

Figure 3. Shows that simulation result of time with number of node alive. The LEACH protocol consumed more time in compression of Q-leach protocol and in case of M-Q-LEACH the node alive time period is increases almost 32% in compression of pervious protocol for this used round trip time is 5.

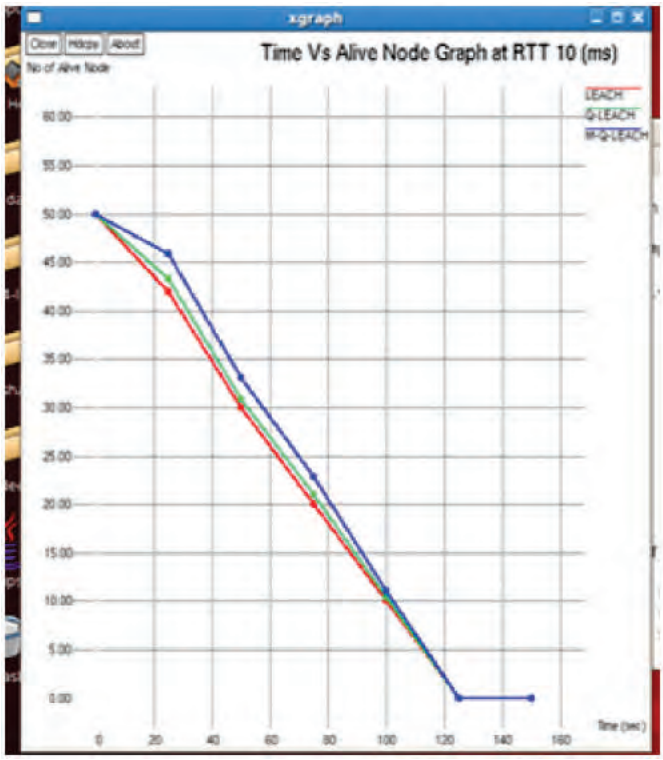

Figure 4. Shows that simulation result of time with number of node alive. The LEACH protocol consumed more time in the compression of Q-leach protocol and in case of M-Q-LEACH the node alive time period is increases almost 30% in compression of the pervious protocolof this used round trip time is 10.

speed and all nodes connect our base node, basically base node is a nothing, this is a central section of M-Q-LEACH and maintains all links from a mobile node. Link of synchronization provided by the clock.

The clock maintains the network's ability for all nodes during communication. If an unknown mobile node sends a request to any node, node not reply, node transfer that message to chock section chock scan their power and find this is normal or abnormal and take action for blocking and generating a security alarm for all nodes.

निष्कर्ष

एम–क्यू–लीच वायरलेस सेंसर नेटवर्क में ऊर्जा बचत के लिए बहुत प्रसिद्ध ईएम मॉडल और लीच प्रोटोकॉल का एक संकरण मॉडल है। मूलतः, एम–क्यू–लीच एक पावर फिल्टर के रूप में कार्य करता है, क्योंकि आधुनिक प्रवृत्ति यह है कि ट्रैफिक एक शक्ति पर बोझ डालते हुए कार्य करता है और वह शक्ति सेंसर नोड द्वारा खपत की जाती है। फ्लडिंग एक दिए गए संचार बैंडविड्थ को जाम कर देती है और हमारा नेटवर्क किसी भी हस्तक्षेप हमले और जैमिंग हमले के उत्पन्न हुए बिना जाम हो जाता है। इसलिए हम नोड मोबिलिटी के समय अज्ञात नियंत्रण अनुरोध शक्ति के लिए एक सशक्त फिल्टर डिजाइन करते हैं। इस प्रक्रिया में एक मोबाइल नोड को उनकी संबंधित गति के साथ जोड़ने के लिए हमारी पद्धतियां एक लिंक सृजित करती हैं और सभी नोड हमारे बेस नोड से जुड़े होते हैं, मूलतः, बेस नोड कुछ नहीं होता, यह एम–क्यू–लीच का एक केन्द्रीय भाग है और यह एक मोबाइल नोड से सारे लिंक का रखरखाव करता है। तुल्यकालन लिंक घड़ी द्वारा प्रदान किया जाता है। संचार के दौरान घड़ी सभी नोडों के लिए नेटवर्क की क्षमता को बनाए रखती है। यदि कोई अज्ञात मोबाइल नोड किसी नोड को अनुरोध भेजता है, नोड जवाब नहीं देता, नोड उस संदेश को चोक सेक्शन को भेज देता है, चोक उनकी शक्ति की जांच करता है और पता लगाता है कि यह सामान्य है या असामान्य और ब्लॉक करने की कार्रवाई करता है और सभी नोडों के लिए एक सुरक्षा अलार्म उत्पन्न करता है।

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स्पाइमी : गुप्त सामाजिक नेटवर्क में महत्वपूर्ण खिलाड़ी के विश्लेषण
SpyMe : Analysis of Crucial Players in Covert Social Network

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सारांश

SpyMe प्रणाली उच्च अभिनेता और रिलेशनल महत्व है कि कुलीन वर्ग का एक सेट टैग। इस तरह के अभिनेता हटाने नेटवर्क के भीतर अभिनेताओं को अलग से सूचना प्रवाह थम जाएगी। अभिनेता महत्व सौंपा भूमिका पर आधारित है और रिलेशनल महत्व है, जो इसे सौंपा है अभिनेताओं की जोड़ी पर निर्भर है। मौजूदा केन्द्रीयता उपायों में, अभिनेताओं के बीच साझा एक विशिष्ट अभिनेता के बारे में जानकारी और संबंधों को आम तौर पर नहीं माना जाता है। इस गुप्त विश्लेषण में महत्वपूर्ण ज्ञान की एक संभावित नुकसान की ओर जाता है। इस लापरवाही के अलावा, मौजूदा तकनीक एक संबंध के महत्व को समझने में मदद नहीं करता है, जो सभी लिंक के लिए एक से एक समान वजन आवंटित। प्रस्तावित SpyMe प्रणाली, संबंध केन्द्रीयता (सीआर) के रूप में बुलाया भोले भारित उपाय परिभाषित करने से, इन पारंपरिक समस्याओं पर काबू। यह भी समय आधारित महत्व विश्लेषण शामिल है। प्रणाली का प्रदर्शन 11 सितंबर 2001 के हमले के आधार पर प्रयोग किया जाता है। इस हमले में शामिल अभिनेताओं एक लुटेरा या इस हमले के लिए एक सहयोगी या तो की भूमिका के आधार पर भार सौंपा है। रिलेषनल भार इस हमले के संबंध के महत्व के आधार पर निर्धारित कर रहे हैं।

ABSTRACT

The SpyMe system tags a set of elites that have high actor and relational significance. Such actor removal will cease the information flow by isolating the actors within the network. The actor significance is based on the role assigned and the relational significance is dependent on the pair of actors to which it is assigned. In the existing centrality measures, the information about a specific actor and the relations shared among the actors is not generally considered. This leads to a possible loss of vital knowledge in covert analysis. In addition to this negligence, the existing techniques assign a uniform weight of 1 for all the links which does not help to understand the importance of a relation. The proposed SpyMe system, overcomes these conventional problems, by defining a naïve weighted measure called as Relationship Centrality (CR). It also incorporates the time-based significance analysis. The performance of the system is experimented based on the September 11, 2001 attack. The actors involved in this attack are assigned the weights based on the roles of either a hijacker or an associate to this attack. The relational weights are determined based on the significance of the relation to this attack..

Keywords: Key player identification, social network analysis, relationship centrality, terrorism, roles, relations

1. INTRODUCTION

Terrorism is considered to be a violent act which, in the name of religion, creates fear among innocent people. This community is seen as a social network with a lot of secrecy and influence. Terrorism is a reprehensible act, that not only influences the impact on the immediate victims, but the pain is felt throughout the world. The plan of action, of such radicals is to commit, acts of violence that catch the attention of all ranges of race, creed, sex and religion to their cause. Terrorism has been described as, defensive and offensive - a justified reaction to oppression and an inexcusable act, a crime military science and a tactic, a holy duty and an evil doing. Realizing the significance and sensitivity of this threat to the homeland security many researchers adhered to a new type of network analysis to understand the structure of these organizations. This helped the crime analyst to study such brutal and well executed attacks so that they could identify the involved critical players. The clandestine network is analyzed to detail on who is related to whom

based on what relation, and it is called as social network analysis.

2. RELATED WORKS

Any organizational structure needs a factor of commitment to achieve the desired objective. These levels of commitment span through many roles assigned to the entities namely, the hardcore leaders, active members, active supporters and passive supporters[1,2]. The entities are assigned unique roles that they perform to accomplish an operation. The leads in the top of a pyramid take maximum responsibilities to successfully complete a mission[3]. These actors plan and execute attacks based on various goals and objectives according to the policies of the organization[4]. The crime network analysis tells us about the structure of the network-based upon the various relations labeled on the links[5]. Knowing actors and their roles, can help to control the information flows within the network. This knowledge about each actor is vital in some application domains[6]. Pivot isolator may help disrupt terrorist activities. But it is not necessary that any player who breaks a social connection is pivot isolator. Although several techniques for identifying key separators have been proposed[7], most of these do not always retain the intended meaning that emphasizes the ability to break the network into fragments as defined.

The measurement of relationships in a terror network requires a supple methodology able to discriminate the influence between father and son, and the influence amongst a group of friends[8]. Unfortunately, almost all of our current mathematical tools are based on data from rigid constructs. For modeling purposes[9] highlights two main problems for rigid constructs. The proposed work shores up the conclusion made by[10,14] that the complexity in collecting data, the means of collecting data, and the type or nature of the data itself are going to play a role in making the data imprecise. This research focuses on the task of modelling terms such as relationship, influence, trust, and belief as there is a clear need for a more flexible construct.

The objective of this research work is to inculcate the significance of an event occurrence and the time order in which the incidents have taken place. The significance can be studied from various frequently occurring events, and with this, the structural equivalence property is understood. The actors and their relationships are represented using multi-rlational network (MRN). The weighted actor MRN analysis, computes actor weight by considering the roles assigned to each actor in an attack. The link weights tend to dynamically change according to the actor weights. The relational weight based centrality does link analysis using the timely occurrence and event significance. This contributes in reducing the space dimension of the graph and includes all possible relations between the actors.

The paper explains the proposed framework of SpyMe- A tagger of pivot isolators.

3. SPYME- A TAGGER OF PIVOT ISOLATORS

The proposed SpyMe system recognizes the pivot isolators which are a set of actors, if removed, could break and paralyze the network. It identifies a set of pivot isolators to enhance the inactiveness of the network. The SpyMe system encompasses two sub-modules, namely, role-based actor weight computation, and relational weight computation. The actor-based weight analysis compares the distance oriented centrality metric with the role-oriented weight computation. The relational weight computation depends on the frequency of a relation occurring in a time period and actor weight assigned. The resulting cutset of CR ranked top N actors are named pivot isolators-actors of high significance. The existing measures to compute this significance is based only on the distance between different actors which are discussed.

3.1 Role-based Actor Weight Computation

The SNA measures individual importance within the network using graph theoretic techniques that have been discussed[11]. One of the relevant social networks measures applied in many ways to find the KPs in the network called the centrality measure. Several centrality measures are described to determine the importance of an actor[12,13]. The degree centrality, betweenness centrality, and closeness centrality are the most widely used measures in SNA for analyzing actor centralities. All the centralities are computed for an unweighted graph and using only the distances among the actors i.e. the path length. Even if weighted graph is considered the edges are assigned with a uniform value of 1 to show the presence of a link between a pair of actors. It is inferred that the importance of the actor and relations labeled in the links is not considered for centrality analysis. The definition is proposed[7] for the Key Player Problem (KPP-Pos/ KPP-Neg) measures have not considered the relationship or actor weights. It is needed to assume that both are unity as it normalizes the measure range between[0, 1]. The Eqn. (1) presents the distance measure DR used by[6] for identifying the KP.

$$D_R = \frac{\sum_j \left(\frac{1}{d_{Kj}} \right)}{n} \quad (1)$$

where d_{Kj} is the minimum distance from all KPs

to actor *j*. This equation assumes that a KP is at a distance of 1 from itself, $d_{ii} = 1$. This violates the graph theory concept which supports that a vertex is at a distance 0 from itself. Hence, instead of n, the normalization is done using *n-k*, where *k* is the size of the KP set with a reasonable assumption, that $n > k$ and leaves $d_{ii} = 0$. Hence Equation (1) is normalized as Eqn (2).

$$D_R = \frac{\sum_j \left(\frac{1}{d_{Kj}} \right)}{n-k} \quad (2)$$

To analyze the KPP problem using the weighted graph, two attributes are considered to be important. The communication gains significance based on the actors among whom the interaction is taking place, and the relationship they share among them. When weights are assigned to the actors and relations involved in the communication to determine the significance, it is called as weighted KPP (WKPP). Hence, the WKPP analysis assigns weights for relations and actors for a corresponding interaction[7] assigned relationship weights to the closest adjacent actors as 1 and for the farthest is any real, positive number greater than 1. In the case of actor weights, it is restricted to the range [1, ∞]. Hence, the weighted distance measure is presented as shown in Eqn. (3).

$$WD_R = \sum_{j \in V-K} h_j d_{Kj} \quad (3)$$

The normalized weighted distance measure WD_R' is shown in Eqn. (4).

$$\text{for } h_i \in [1,\infty], d_j \in [1,\infty] \quad (4)$$

where h_j is the actor weight and d_{Kj} is the minimum distance from all KPs to the actor *j*.

It is inferred that the weights assigned for actors and relations varies, but it is again with respect to the distance and does not consider the attributes of the actor or the semantics of the relationship. This work, contributes in taking the weighted distance measure to the next level, where the additional features related to the network structure is also studied along with the distance measure to resolve the KPP. This paper contributes by introducing the new centrality that includes the social distance measure of actors based on the timing factor and the participation attributes. This centrality varies the participation measure from binary to different levels depending on the significance of involvement.

The actor weight measure determines the significance of how difficult it might be to replace that individual if they were removed from the network. The actors are assigned a weight where it is inversely proportional to the number of individuals in the organization with the same role. For example, there are two managers in the network, so they are both assigned a weight of 0.5, and similarly, if there are 10 workers in the network with the same role, a weight of 0.1 is assigned for all workers. An actor is assigned a weight of 0 for unknown roles. The actor weights computed using distance-oriented measures and the role-based approach are analyzed. In the distance measure, all the actors which are closer and directly connected have higher values than the actors which are located at distant and are indirectly connected. But in the role-based actor analysis, the property of each actor is majorly considered rather than the distance within the actors, and hence, a distant actor with significant role is precisely identified in this measure.

3.2 Relational Weight Computation

The Relational weight computation is performed as a two-step process, namely, relational analysis and weight computation. The relational analysis computes, relational probability, PR_{wt} and weight computation determines the R_{wt} based on which CR is computed.

3.2.1 Relational Analysis

In this analysis, the significance of each relation is studied. Since the network is organized as an MRN, there exist multiple relational links between the actors. These links are used to compute the relational probability, through the following steps:

1. Generate all relational links existing among the two actors
2. To identify the significant occurrence of relation
   a. Determine the time period of relational occurrence
   b. Find the frequency of the same relational occurrence
   c. Identify contextually significant relational occurrence
3. Compute relational probability PR_{wt} as given in Eqn (5)

$$P_{Rwt} = 1 + (Occ_{Sig} / Occ_{Rel}) \quad (5)$$

where Occ_{Sig} is the significant number of relational occurrences and OccRel is the total number of relational occurrences. Here the addition of 1 to the proportion shows the presence of information exchange between the actors.

3.2.2 Weight Computation

The significance of the actor analyzed using its roles is included in the relational weight analysis. The R_{wt} value is higher or lower depending on the significance of the actors in the communication. Based on these weights the R_{wt} computation is done

as shown below.

1. Actor weight comparison: The actor weights in a link are compared, and the link weights are incremented accordingly. If both the actors have high actor weight, then increment the relation weight by 1. If any of the actor weight is low then increment the relation weight by 0.5. If both the actor weights are low then there is no change in relation weight.
2. Compute the relational weight, R_{wt}, as average of the updated relational weights of all the links, existing between the pair of actors

Using the actor weight and the relational weights computed, the SpyMe defines the naïve CR as shown in Eqn (6).

$$C_R = \sum_{j \in n-k} h_j d_{kj} + R_{wt} \quad (6)$$

where h_j is the actor weight, d_{Kj} is the minimum distance from all K_{Ps} and jth actor, R_{wt} is the relation weight between the KP and jth actor. The following algorithm presents the formal description of the CR computation.

Algorithm: Tagging pivot isolators

Input : MRN

Output : Top ordered actors with maximum CR

Procedure

Step 1: /* Compute actor weight, h */
h = 1/num_cl_mem;

Step 2: /* Compute relational probability, P_{Rwt} */
PRwt =1+ (Occ_{Sig}/ Occ_{Rel});

Step 3:/* Compute relational weight, R_{wt} */
if hi && hj = High dependency_act_wt = PRwt +1;
else
if hi =Low && hj = High
dependency_act_wt = P_{Rwt} +0.5;
else
if hi && hj = Low
dependency_act_wt = P_{Rwt} +0.0;
Rwt= avg (dependency_act_wt for all links);

Step 4: Compute CR

Step 5: Rank the top ordered actors based on computed CR

This algorithm initially computes the actor weight h to be inversely proportional to num_cl_mem which is the total number of actors who perform the same role. Then it generates weighted MRN by assigning the relationship weights. Finally, it calculates CR using distance, actor weight and relationship weights. The top N ranked actors based on the computed CR, are recognized as set of pivot isolators. The performance of the proposed algorithm is experimented and evaluated in the following section.

4. RESULTS AND DISCUSSIONS

The experimental analysis for recognizing the pivot isolators is performed on the set of 51 actors and 43 relations involved in September 11, 2001 attack[15]. The sample of the relational adjacency matrix for the MRN representation of the dataset is shown in Table 1. In this Table, the various relations are shown in the form of a corresponding lookup number. For example, the number 1 represents the relation Fights, 2 is for Meeting_attack and so forth. The number of the pivot isolators to be removed from the network is based upon, how long an actor can spread its influence or control the network. It is equivalent to the average path length of 6 which is also the cutset size.

4.1 Analysis of Role-based Actor Weight Computation

The actor centrality is computed for the above described dataset, using the conventional distance based centrality and the enhanced role based metric. The weight analysis shows the improvement in the performance of SpyMe in recognizing the pivot teller based on roles assigned to actors. The state of art centralities, namely, the degree, closeness and betweeness are measured for all the 51 actors. A sample of this computation is presented for only 19 hijackers in Table 2.

Table 1. Relational adjacency matrix for MRN

Names	Nawaf	Kam	Atta	Ziad	Marwan	Waleed	Saleem
Nawaf		1|3|5|26|37|9				26|43	3|5|10|26|43|25
Kam	34|7|2|21|40|17						3|8|12|2|7|17
Atta	28|34	34		21|26|42	14|15|34|10|26|42	6|11|41|8	
Ziad		23	14|6		14		
Marwan	34	34	18|23|39	26|42		6	
Waleed							26|43
Saleem	2|7|17						
Ahmed	4						26|43

Table 2. D_i, B_a, C_a of 19 hijackers

Actor Name	Rank	B_a	Rank	C_a	Rank	Actor ID	Actor Name	D_i	Rank	B_a	Rank	C_a	Rank
Nawaf	1	0.271	1	0.7	2	11	Satam	0.12	11	0.3	9	0.45	10
KAM	4	0.15	13	0.5	7	12	Majed	0.15	10	0.0	0	0.5	7
Atta	2	0.189	2	0.72	1	13	Wail	0.17	8	0.0	0	0.48	9
Ziad	3	0.3	8	0.7	2	14	Abdul Aziz	0.1	14	0.0	0	0.45	10
Marwan	5	0.16	4	0.65	3	15	Fayez	0.11	12	0.026	10	0.4	12
Waleed	6	0.034	7	0.55	5	16	Mohald	0.12	11	0.02	12	0.43	11
Saleem	6	0.0	0	0.54	6	17	Alhaznawi	0.1	13	0.025	11	0.35	13
Ahmed	9	0.0	0	0.51	8	18	Alnami	0.1	14	0.1	14	0.34	14
Hamza	7	0.044	6	0.54	6	19	Hani	0.2	7	0.176	3	0.58	4
Saeed	12	0.057	5	0.48	9								

The degree centrality identifies top 6 well connected actors among the hijackers in the covert network as {Nawaf, Atta, Ziad, KAM, Marwan, Waleed and Saleem}. The actors Saleem and Waleed are both ranked at 6. The degree centrality could not recognize Hani, inspite of him being the most communicated actors in many locations like Hamburg, Arizona, Newark and one of the well trained pilots. The top 6 well communicated actors among the hijackers in the covert network using Ba are {Nawaf, Atta, Marwan, Hani, Hamza and Saeed}. The actors with Ba of 0 are assigned a rank of 0. The betweeness centrality could not recognize KAM, as he is much involved in only a few important communications with the other elite actors. His absence in many shortest paths of communication leads to miss the mastermind of the attack. The closeness centrality could not recognize KAM, inspite of him being the mastermind behind this attack, and one of the elite actors among the hijackers. This analysis shows that the reachability if KAM is restricted to only the pivot actors. In CR the role assigned to an entity is used to study the coalition among them. In the 9/11 dataset the participants are widely categorized into two types, namely, hijackers and other associates (OA). Further, by taking the roles of the actors, seven categories have been defined as shown in Table 3.

The 51 actors are categorized under the above mentioned roles. The actor weight relies on the number of actors in each category. The more the number of actors, the lesser the weight each actor is assigned. The actors are assigned the weights based on their roles as shown in Table 4. The actor Nawaf is assigned the roles of Pilot_Hijackers and actors Saleem, Wail and Waleed are assigned the role of Muscle_Hijackers. In addition to it, they share a very important role of Brother among them. In such cases, the actor weight is a summation of all the weights assigned to each role. For example, actor Ramzi has the actor weight

Table 3. Roles assigned to the participants in the 9/11 covert network

Actor	Hijackers	OA
Role	Pilots	OA_Close (Friend, Blood relation, Wife)
	MUSCLES_ withmilitary training	OA_Aid (Financier, Trainer, Key contact with pilots, Leader in Mosque, Logistics)
	MUSCLES _for mass	OA_Trusted Members
		OA_Other Attacks
		OA_MUSCLES

as the summation of the weights, assigned to the roles OA_Aid, OA_Trusted members and OA_Other attacks. Table 5 summarizes the weights of all actors involved in the attack.

The actors Ramzi and KBA top the actor weight ranks, as they support a lot of hijackers taking the role of OA as a financier, key contact among pilots and helped in other attacks like the USS Cole. It is inferred from the results that, even though the actors like Ramzi and KBA have lower distance based centrality values they are considered most vital pivot OA. The actor Hambali is ranked next, due to his trusted member role in the organization and because of which, he is a member of many important meetings conducted among the top hierarchy leaders. He has also significantly contributed in planning many other attacks. Amir El Aziz and Barak are OA, who are assigned the role of commanders and executers well trained in amours. Nawaf, Waleed and Saleem are hijacker actors, who are ranked as 4 and 5, respectively. Actor Nawaf is a well trained pilot, who has taken pilot training at aviation center. He is also a well trained commander. The actors Waleed and Saleem are well trained military commanders, whereas, their skill set in pilot training is poor. Even though, hijackers were directly involved in the attack, their roles did not have much significance when compared to the executers and planners in the

Table 4. Assigning actor weights based on their roles in the 9/11 covert network

Category_Name	Actors with roles	Weight of category
Pilot_Hijackers	Atta, Marwan, Ziad, Hani, KAM, Nawaf	0.166
Muscle_ Hijackers	[MUSCLES_withmilitary training] Ahmed Alhamdi, Hamza, Majed, Waleed, Saleem,	0.2
	[MUSCLES_for mass] Saeed, Satam, Wail, Abdul Aziz, Fayez, Mohald, Alhaznawi, Alnami	0.14
OA_Close	Friend-Bandar; Father-in-Law-Ahmed Al-Handa Wife- Hanifa, Manal; Brother-Saleem-Nawaf, Wail-Waleed	0.25
OA_Aid	Financier- Omar Al Bayomi, Omar Saeed Sheik; Trainer- KBA, Sakra; Key contact for pilots- Ramzi Leader in Mosque- Rayed Mohammed Abdullah, Marcal, Imam; Residence – Abdussatar Shaikh	0.11
OA_Trusted members	KSM, Ramzi, KBA, Adb, Hambali, Yazid, Fahab, Abu Bara, Al-Khatani	0.14
OA_ Other attacks	USS Cole- KBA, Ramzi Bojinka- Hambali Madrid- Amer, Barakat, Ramzi	0.5
OA	Zakariya, Abdussatar Sheikh, Faisal, Lotfi, Mamoun, Mounir, Said Bahaji, Hayder, Majed Dweket, Shayna, Abu Mohammed	0.09

Table 5. Actor weights for all 51 actors involved in 9/11 attack

ID	Weight	ID	Weight	ID	Weight	ID	Weight	ID	Weight
1	0.41	11	0.2	21	0.09	31	0.11	41	0.14
2	0.16	12	0.2	22	0.09	32	0.25	42	0.64
3	0.16	13	0.39	23	0.09	33	0.11	43	0.14
4	0.16	14	0.14	24	0.09	34	0.14	44	0.14
5	0.16	15	0.14	25	0.75	35	0.09	45	0.14
6	0.39	16	0.14	26	0.11	36	0.75	46	0.14
7	0.39	17	0.14	27	0.09	37	0.11	47	0.09
8	0.2	18	0.14	28	0.09	38	0.25	48	0.11
9	0.2	19	0.16	29	0.11	39	0.09	49	0.5
10	0.2	20	0.25	30	0.09	40	0.25	50	0.5
								51	0.11

category of OA. The actor Atta does not have a high weight, as he communicates with the MUSCLES at large. The actor's interaction with OA is very less. The actor Hamza has less actor weight, as he is involved in many less significant activities. Similarly, for the actor Waleed, even though he has high actor weight his involvement in significant events is less and he shares minimum communications with OA.

4.2 Analysis of Relational Weight Computation

The SpyMe adds the significance to relationship based on the actor weight and time order. It compares the CR metric with other existing centralities and proves the importance of including the network structure for actor centrality computation along with the distance factor.

4.3 Assigning Relationship Weight

The significance of the relation and time order of the event is considered in computing PRwt. The analysis determines the significant occurrence of the same and frequently occurring relations across a timeline. For example, the preparation for the 9/11 attack had started back in 1993. Hence, for computing PRwt the time period is taken between, 1993-2001. The multiple timeslots of the events are split as five folds, from 93-96, 96-98, 98-99, 99-00, 00-01. The Table 6 depicts the links for actor Nawaf during the above period. The relation 1, Fights, has occurred during 93-96, 96-98, 98-99, but has gained significance only by 98-99, when the Al-Qaeda was recognized as a banned terrorist organization. The relational occurrence is computed, as a ratio of the number of significant

occurrences to the total number of occurrences. The relationship weight has a default value of 1 and is incremented based on the significance.

For example, in Table 6, indicates the occurrence of relation and /* indicates the significant occurrence of relation. The link 1-6 existing with the relation 26 occurs only once and is also not significant. In such a case, the PRwt value is just the default weight of 1. Similarly, for the link 1-7, the relation 26 has occurred twice and one of them is significant. The PRwt value for the link 1-7 is a summation of default weight 1 and 1.5 which is the probability ratio (1/2).

Table 6. Sample of relationship analysis for actor Nawaf

Actor _Link	Relation	Time Period (Year)				
		93-96	96-98	98-99	99-00	00-01
1-2	1	/	/	/*		
	3					/*
	5			/*		
	26				/*	
	37			/	/	/*
	9					/
1-6	26			/		
	43					/*
1-7	3				/	
	5			/		
	10					/
	26			/		/*
	43					/*
1-8	26					/*
	43					/*
1-9	26					/*
	43					/*
1-10	4			/*		
1-11	4			/*		
	26					/*
	43					/*

4.4 Analysis of CR measure

The multiple relational weights on the link are computed, and reduced to a simple graph averaging the weights. Thus Rwt reduces the MRN into a simple weighted graph. This reduces the space dimension of the graph, inspite of including all the existing relations among the actors. The CR of the 19 hijackers are computed and ranked in the following Table 7.

The top 6 well communicated actors among the hijackers in the covert network are {Nawaf, KAM, Atta, Ziad, Marwan, Hani and Waleed}. The CR is successful in recognizing all the major pivot actors, who also have the various important features of distance oriented centrality measures. This set of actors is easily reachable and are included in many shortest paths among different actors. The centralities are computed for all 51 actors and the top 6 pivot isolators have been tagged. Table 8 displays their ranking in the different centrality metrics.

Table 7. Relationship centrality computation

Actor ID	CR	Rank	Actor ID	CR	Rank
1	0.27	2	10	0.1	9
2	0.38	1	11	0.1	9
3	0.22	5	12	0.1	9
4	0.25	3	13	0.15	8
5	0.23	4	14	0.1	9
6	0.19	6	15	0.1	9
7	0.1	9	16	0.16	7
8	0.1	9	17	0.16	7
9	0.16	7	18	0.16	7
			19	0.19	6

The actors like Hambali, Amir El Aziz and others even though, had top ranks in the actor weight they did not share significant relations with many other hijackers or OA. The actors KAM, Atta and Hani, had a common role of hijackers and had many important contacts with the OA like Ramzi, Omar-Al-Bayoumi, Yazid and Fahab. The tie strength of these actors is also improved, when they shared strong relations like Caller of Al-Qaeda Summit, Attendee of Summit, Member of USS Cole Attack, Advanced Flight Class and Brother Of with other actors.

Table 8. Ranking of Pivot isolators in different centrality measures

Pivot Isolators	Centrality Measures (Ranking among all 51 actors)			
	C_R	D_i	C_a	B_a
Ramzi	**1**	8	15	14
KBA	**2**	49	37	22
KAM	**3**	10	19	17
Nawaf	**4**	4	2	2
Atta	**5**	1	1	1
Hani	**6**	3	3	3

5. CONCLUSION

This paper has tagged the pivot isolators, by the proposed SpyMe system, as it enumerates on how the various interpersonal relations, among the actors could be used to study the nature of covert organizations. It

extends the problem of KPP to WKPP, by including the actor and relationship weights. The proposed methodology, overcomes the state-of-art distance metric issues. The actor significance is analyzed by the role assigned to them, and the relational significance is based on the time order and the repeatability of its occurrence. The efficiency of the newly defined relationship centrality is compared with the existing centralities. The top N ranked actors could be further used to perform efficient fragmentation of the covert organization.

निष्कर्ष

यह अभिनेताओं के बीच विभिन्न पारस्परिक संबंधों, गुप्त संगठनों की प्रकृति का अध्ययन करने के लिए इस्तेमाल किया जा सकता है पर विश्लेषण के रूप में इस पत्र में प्रस्तावित SpyMe प्रणाली द्वारा, धुरी आइसोलेटरों में चिह्नित किया गया है। यह अभिनेता और रिष्ते भार को शामिल करके, WKPP को केपीपी की समस्या फैली हुई है। प्रस्तावित कार्यप्रणाली, राज्य के कला दूरी मीट्रिक मुद्दों पर काबू। अभिनेता महत्व उन्हें सौंपा भूमिका से विश्लेषण किया है, और संबंधपरक महत्व समय आदेश और इसकी घटना के repeatability पर आधारित है। नव परिभाषित रिष्ता केन्द्रीयता की दक्षता मौजूदा centralities के साथ तुलना में है। शीर्ष एन स्थान पर रहीं अभिनेताओं आगे गुप्त संगठन के कुशल विखंडन प्रदर्शन करने के लिए इस्तेमाल किया जा सकता है।

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स्मार्ट वस्तुओं का निर्माण : आर एफ आई डी
RFID: Creating Smart Objects

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सारांश

आर एफ आई डी तकनीक अब दशकों से प्रयोग में है। हम सब ने इसका नाम कभी न कभी जीवन में सुना है। यह पेपर आर एफ आई डी तकनीक के पीछे के विज्ञान और तकनीक को कुछ गहराई से संझाने का प्रयास है, जिस से हम अपने यह सोच पायेंगे की कैसे इस तकनीक का प्रयोग हम अपने अपने कार्य क्षेत्र में कर सकते हैं। यह तकनीक गत वर्षों में काफी मच्योर हुई है, और अभी भी दिन पर दिन बेहतर और अधिक सक्षम होती जा रही है। इस तकनीक की जो विशेषता इसे अलग बनाती है, वह ये है की ये तकनीक निर्जीव वस्तुओं को स्मार्ट बना देती है। स्मार्ट वस्तुओं में अपनी मेमोरी और कम्प्यूटेशन की क्षमता होती है, जिससे वह आस पास की अन्य वस्तुओं और वातावरण से कम्यूनिकेट कर सकती है। पेपर में हम इस तकनीक के विकास, कार्य प्रणाली, और प्रयोगों पर चर्चा करेंगे।

ABSTRACT

RFID is a technology that has been around for decades. All of us have heard its name at some point of time. This paper tries to give a deeper understanding into the science and working of this technology, and let you imagine one more way in which RFID can be used in your field of work. The RFID technology in all these years, has matured itself and is still evolving technology with lot of potential. Its applications are limited only by one's imagination. What makes this technology so fascinating is the fact, that it can make objects intelligent. It gives objects the memory and gives them intelligence to communicate with other objects around. We will discuss its evolution, functioning and applications.

Keywords: RFID tag, RFID applications

1. INTRODUCTION

RFID is one of the host of technologies used for automatic identification of objects. Automatic identification is often used by companies to identify objects or individuals while manufacturing, on assembly lines or while in stores. The auto-id is aimed at reducing manual identification, data-entry, and thus improving efficiency of the whole business. The basic idea of such technologies is to let machines do the identification of object and individuals, using various sensor technologies. Bar codes, OCRs are some other technologies that have been around for a while now. The later developments are biometrics, voice recognition, and RFID.

2. EVOLUTION

The immediate predecessor of RFID was Barcode, that we are all must have seen, and that has been used excessively. Some of the fixed information about a product like its name, manufacturer, etc can be embedded on a barcode, which can easily read by a barcode reader. For example in case of a book we can embed some fixed information like its name, publisher, subject, edition, no. of pages on a barcode, and paste the barcode as a sticker on every copy of the book. Now in whichever library the book will go, the information stored in the barcode will never have to be entered manually.

RFID does all what a barcode does in a better way. Where a laser based sensor of barcode reader must be in line of sight with the barcode, in order to read it. An RFID has no such requirement. RFID is based on radio waves. An RFID reader can sense an RFID tag even if it is not in line of sight, it just needs to be in distance range of the reader. The following diagram depicts the communication between an RFID tag and a reader.

3. AN RFID SYSTEM & ITS COMPONANTS

An RFID system consists of a reader and an RFID tag. The reader consists of a powerful antenna to sense the tag, a source of power, and a computer

system. The computer system contains the database of the objects being scanned along with other business logics. The computer system may be simple PC or a high end server. RFID tags contain at least two parts. One is an integrated circuit for storing and processing information, modulating and de-modulating a radio-frequency (RF) signal, and other specialized functions. The second is an antenna for receiving and transmitting the signal. The tags may come in different size and shapes. Figs show two common types of RFId tags. The reader and the Tag communicate in radio frequencies emitted through their respective antennas. A reader can sense the presence of a tagged object in its range. The tag responds back to the reader, and marks its presence. This communication forms the basic crux of an RFID system. The tagged objects become smart objects, that can mark their presence, and may even provide the reader other information about the tagged object, at very high speeds, and without any human intervention.

3.1 An RFID Tag

An RFID tag can be applied to or incorporated into a product, animal, or person for the purpose of identification and tracking. Some tags can be read from several meters away and beyond the line of sight of the reader. Most tags carry a plain text inscription and a barcode as complements for direct reading and for cases of any failure of radio frequency electronics.

The chip and the antenna can be noticed in both the types of tags depicted (Fig. 1 and 2). This circuitry of RFID is so compact that it can be sandwiched inside a sheet of paper, without making any noticeable change in the thikness of paper (Fig. 3).

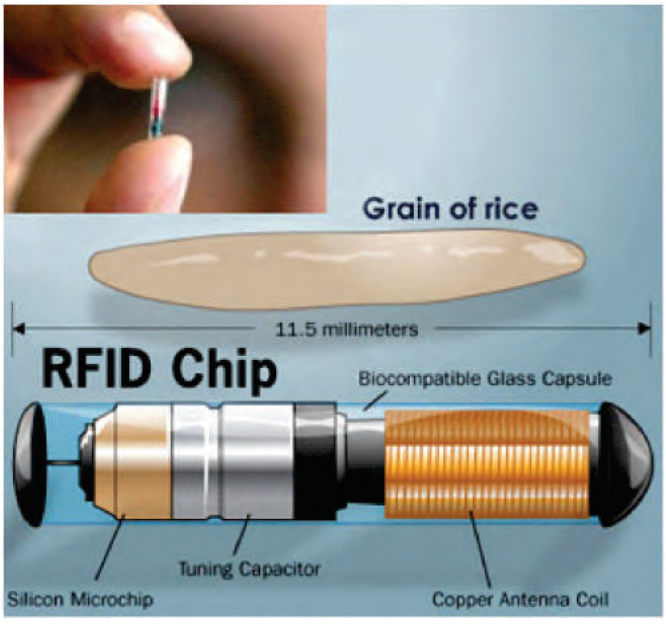

Figure 1. An animal/human implantable RFID tag.

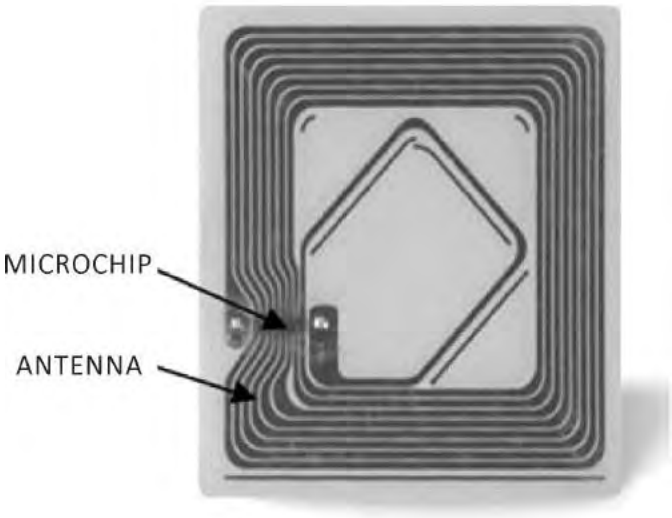

Figure 2. A typical RFID tag installable inside a paper lining.

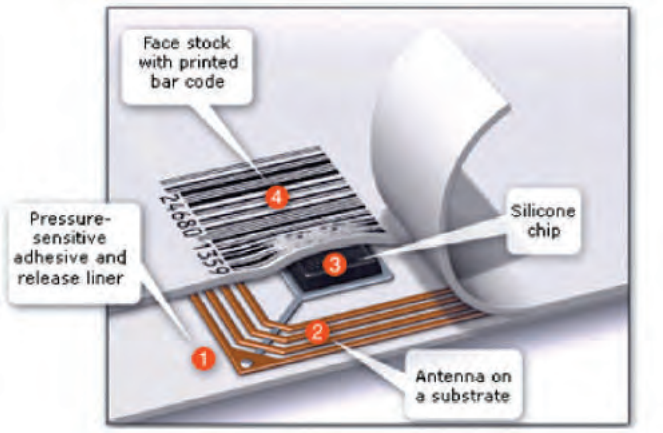

Figure 3. An RFID tag sandwiched inside a paper lining.

4. HOW DOES RFID WORK?: THE TECHNOLOGY BEHIND

Before we discuss applications of the RFID technology, it would be more appropriate to have an understanding of the technology or the science behind the concept of RFID. Fig. 4 shows a basic communication between a reader and a tag.

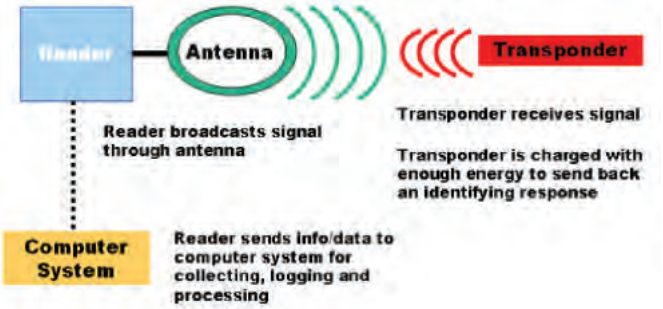

Figure 4. Basic RFID communication.

5. ACTIVE TAGS VS PASSIVE TAGS

There are generally two types of RFID tags: active RFID tags, which contain there own internal

Table 1. Comparison of active and passive RFID tags based on various parameters

	Active RFID	Passive RFID
Tag's Power source	Internal battery source	Energy transferred from the reader
Availability of power	Continouous	Only inside the range of reader
Required signal strength of reader	Very low	Very high
Read range	Large, upto 100 m and even more	Upto few meters or even lesser
Per Tag Cost	High, because of battery	low
Tag Size	Larger, Varies depending on application & battery	Smaller, "Sticker" to credit card size
Data storage	Large data storage, upto 128 Kb	Smaller data storage, 128 bytes
Per Asset Variable Costs	Higher – see tag cost	Lower – see tag cost
Sensor capability	The tag has the capability to record sensor inputs like: date/time samp; temperature, GPS location	Cannot record sensor data; only transfer sensor valueswhile powered by reader
Best Area of Use	Where tagged objects are moving in random systems, and may not necessarily pass through fixed points	High volume assets moving through fixed points where readers can be installed
Industries/Applications	Auto dealerships, Auto Manufacturing, Hospitals – asset tracking, Construction, Mining, Laboratories, Remote monitoring, IT asset management	Supply chain, High volume manufacturing, Libraries/book stores, Pharmaceuticals, Passports, Electronic tolls, Item level tracking

source of power, i.e. a battery, and passive RFID tags, which have no internal source of power. Being with or without an internal source of power, makes the two types of tags suitable for different types of applications. Table compares theses two types of tags on various parameters.

5.1 Working of a Passive tag

Now while we have discussed in most of you would wonder that from where does a passive tag (without an internal source of power) gets power to communicate with the reader? Let us understand the physics behind the working of a passive RFID tag. The tag draws power from the concept of electromagnetic induction. The powerful coil of the reader produces an alternating magnetic field in its near field region. This alternating magnetic field in the near field induces current in the coil of the tag. This induced current is modulated with the data stored in the chip of the tag. Thus the data is sensed back on the reader. The Figure below depicts the three way interaction between the reader and the tag. There are also semi-passive tags that are mid-way between active and passive tags. Such tags use battery just to run the chip's circuitry, and use the induced power from the reader, to communicate with the reader.

6. READ-ONLY AND READ-WRITE TAGS

Also the RFID tags can be categorized based on their capability to read/write or read-only. Both

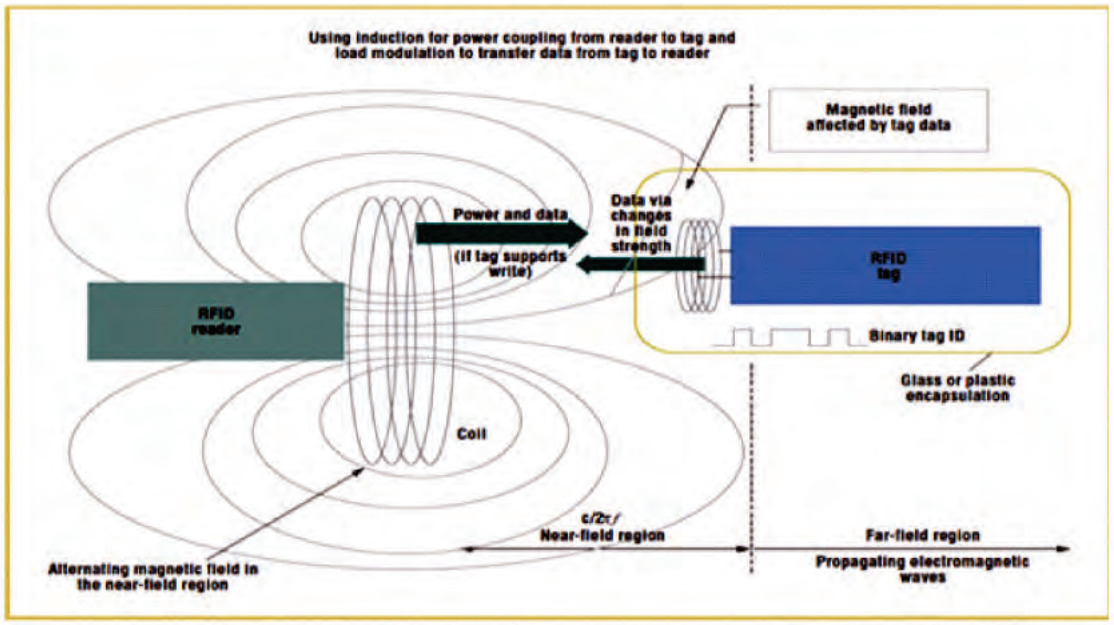

Figure 5. Read process for a passive RFID tag.

types of the tags have a readonly part that contains serial no. or fixed part that cannot be over written. The read-write tags provide additional blocks to store additional data related to the object being tagged.

7. OPERATING RANGES OF RFID TAGS

RFID systems (readers and tags) may operate in different frequencies. Operating frequencies may be categorized broadly in low-, high-, ultra high-frequencies (UHF).Various frequency ranges have their own merits and demerits. A good consultant/vendor may help you choose the best frequency range suitable for your application. Table 2 compares the properties of the radio waves based on their frequencies.

8. APPLICATIONS OF RFID

Now when we have got a good understanding of the RFID technology, we will be better able to appreciate the applications of RFID. Putting an RFID tag on any object makes it smart. It makes the object identifiable throughout the system. Any reader in the system can identify the object from millions. The computer system attached with the reader stores in its database all the times and places where this object has been detected in the system. Let us discuss the concept in various applications.

Table 2. Comparison of properties of low-frequency based and high frequency based RFID systems

Frequency	Lower	Higher
Cost	Cheaper	expensive
Power needs	Require less power	Require more power
Penetration	Better penetrate non-metallic objects, and objects with water content	Less penetrable, require clear path between reader and tag
Workable range (distance)	lower range	higher range
Data transfer rates	slower	Faster

8.1 RFID in a Library

The Figure demonstrates the use of RFID based library management system in a library. Once all the books in the library are tagged, the check-in/check-out, stock taking, shelf management, theft control becomes very easy, and requires no labour-intensive work. The check-in/check-out can be done without typing, thefts can detected by a reader on the exit door. Shelf-management and stock taking can be done by single person carrying an RFID reader through all the racks.(Fig. 6)

8.2 RFID in a mall/ retail store

RFID is really helpful in a retail store, almost in a similar way as we have seen in case of library in the last section. It makes the billing process very fast. The sold out stocks can be replenished from the warehouse, so that there is always all varieties available at display.

8.3 Access Control at Entries for Vehicles or Individuals

An RFID reader installed on a barrier gate can recognize an RFID based sticker on the windshield of an approaching vehicle, and open the barrier for entry,

Fig. 6: RFID in Library

if the identity is authorized (Fig. 7). There is no need even to stop the authorized vehicle. It can also record all the entry/exit details of a particular vehicle in the RFID server database. In a similar way an RFID-based ID card kept in the pocket of an employee can be used to allow an employee in through the entry gate, and to keep the attendance record. RFID based door locks are also becoming very popular these days for locking of home/commercial premises.

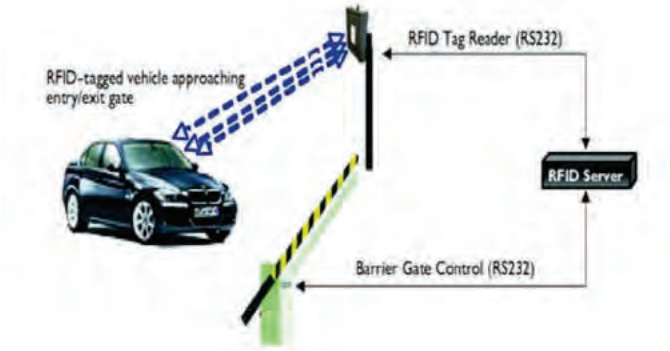

Figure 7. An RFID based Access control/ barrier gate control.

8.4 Transportation payments in a public transport system

The tokens that we use while travelling in the Delhi metro, are nothing but RFID tags. When we touch the card at the entry, the system marks our entry from that particular station. When we touch it again at the exit of the destination station, it checks whether the distance travelled is within the amount paid for the token. If so it opens the exit door, otherwise it asks the user to go to the ticket counter to pay penalty.

8.5 Museums

Museums have devised a very innovative way of using the RFID technology. Not only the exhibits inside a museum can be tagged of stock taking and theft control, but even a step further. A visitor at the entry of the museum is handed over a RFID based card, his mobile numbers is fed into the computer system. Until the visitor surrenders the card at the exit, he keeps receiving information about the exhibits he is around, on his mobile number.

8.6 Sports

RFID technology has also been used in marathon races. All the participants at the beginning of the race are issued an RFID tag, which they have to tie near their shoes. Now various RFID reader-based mats (Fig.8) are kept in the path of marathon at short distances. Every athlete, during the race, has to pass over these mats. Thus, time-stamps of each athelete passing over all the mats on the path get recorded in the system. This ensures fairness in the marathon results.

8.7 Passports

RFID based passports were first issued in 1998 by Malaysia. Since then many countries of the world have implemented the same. RFID based passports digitally contain all the information otherwise printed on the passport, along with the digital photograph of the owner.

Figure 8. An RFID-based mat to sense the tags installed on the athletes passing over it.

9. ADVANCES IN RFID TECHNOLOGY

RFID is quite a matured technology now, since it has been in use for a long time now. As we have discussed in the earlier section, it has been implemented in a wide gamut of applications. It is still getting adopted for newer and newer applications. With more and more research being done in RFID, the tags are getting more miniaturized, and are becoming more inexpensive. Cost of tags has got reduced to an extent that now it is becoming feasible for companies to tag even millions of products.

10. CONCLUSION

Now with the greater understanding and appreciation of the RFID technology, we can think of ways in which it can be implemented in our respective fields of work, to make the business process more efficient.

निष्कर्ष

अब जब हम आर एफ आई डी तकनीक को गहराई से समझ चुके है, तो अब हम ज्यादा बेहतर सोच सकते हैं की कैसे हम इस तकनीक का क्लार्यानवयं अपने कार्य क्षेत्र में कर सकते हैं, जिससे कि हमारा व्यवसाय और अधिक एफ्फिशिएन्ट हो जाये।

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वायरलेस सेंसर नेटवर्कों में एंट कॉलोनी इष्टतमीकरण और स्वार्म इंटेलिजेन्स का विकास
Evolution of Ant Colony Optimization and Swarm Intelligence in Wireless Sensor Networks

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सारांश

अनेक एल्गोरिथ्म और प्रोटोकॉल बैटरी लाइफ, पीडीआर, विश्वसनीयता, थ्रोपुट, त्रुटि सहन–क्षमता, नेटवर्क लैटन्सी, नेटवर्क लाइफ स्पैन, डेटा असेम्बली, ओओएस, डेटा डिलीवरी मॉडल और प्रचालन अवसंरचना में सुधार कर इष्टतम पाथ राउटिंग के साथ वायरलेस सेंसर नेटवर्क के निष्पादन को बढ़ाने पर ध्यान केन्द्रित कर रहे हैं। यह पत्र एंट कॉलोनी इष्टतमीकरण राउटिंग पर आधारित एंट कॉलोनी तकनीकों और स्वार्म इंटेलिजेन्स के विकास को दर्शाता है, जो एसीओ के लिए एंट और बी सेंसर के लिए बी से प्रेरित है।

ABSTRACT

Several algorithms and protocols are focusing on enhancing the performance of wireless sensor network with optimum path routing by improving battery life, PDR, reliability, throughput, fault tolerance, network latency, network life span, data assembly, QoS, data delivery models, and operating infrastructure. Paper shows the evolution of ant colony techniques and swarm intelligence based on ant colony optimization routing, which is inspired by ant for ant colony optimization, and bee for bee sensor.

Keywords: Ant colony optimization, swarm intelligence, wireless sensor networks

1. INTRODUCTION

Wireless sensor network comprise tinny sensors which can exchange data via wireless channels[1]. Improvement in WSN makes the sensor very small, better battery life, low range, and consumes less power. Base station, sensor unit, region and task allocator are the parts of sensor network. Small sensor units are spread in the sensor network which make tough to find the accurate sensor location[2]. Adaptive collaboration and self-organization is necessary to survive in such sensor network[3]. Location information is transferred to base station via multi-hop routing as feature of organizing itself. WSN most popular with wide application areas in different fields like science, technology and education. Performance improvement is a major issue, which can be achieved by reducing congestion and enhance network life[4].

Various protocols and routing schemes are designed to improve sensor network performance, from which swarm intelligence is the most renowned scheme[5]. Swarm intelligence is based on insects like honey bees and ants, their decentralized management and collective behaviour[6]. Their behaviour is similar to networking in dynamic, parallel, and distributed systems. Evolution of swarm intelligence improved the performance of wireless sensor networks in terms of packet delivery ratio, network lifetime, scalability, reliability with better QoS. Extensive range can be achieved using sensor of low cost with long battery life, and free of maintenance.

2. SWARM INTELLIGENCE ROUTING PROTOCOLS

Swarm intelligence routing protocols are of three types: bee-based, slime-based and ACO (ant colony optimization)-based.

2.1 Bee Colony-Based Routing Protocols

Bee colony protocols based on for aging behaviour of honey bees, which is the same as routing in sensor networks. Self-organizing nature and dividing labour is the principle which is used by honey bees.

2.1.1 Bee-Sensor

Routing protocol based on beehive is developed with wired networks[5]. The principle is scoutrecruit system used with the help of bees. For aging is used

by on-demand route discovery AODV. Agents used for this are of three types:

- Packers locate proper for agers for data packets at source node.
- Scouts find paths with the new destination.
- Foragers forward packets of data to sink node.

2.2 Slime Based Routing Protocols

Slime mold is term defined for heterotrophic organism like fungus. They can cluster themselves and pheromone are generated for self-organization Wireless sensor network is self-organized sensor colony with is same as ant colonies, and unicellular organisms.

2.2.1 Multi-sink Swarm-based Routing Protocol

WSN protocols are based on properties like environment adjustment, fault easiness, and organizing themselves, which is the same as social insect colonies. Protocol is based on cluster organize behaviour of slime mold organism, in which they cluster with the help of evaporation and pheromone generation, to organize themselves[6]. Multi-sink swarm-based routing protocol use gradient concept for organizing the data traffic in direction of different sink nodes, it is inspired by slim mold organism.

2.3 ACO-Based Routing Protocols

ACO ant colony optimization-based routing protocols are based on for aging principle of ants, by which ant can build nest and perform complex tasks.

2.3.1 T-Ant

It follow two-phase clustering process and involve setup to cluster and phases of stable state. Gathering and alteration approximation are the two methods used by T-Ant[5]. Election ant is allotted for gathering. If node is to initialize then sink appoints multiple ants for messages control. After TTL time-to-live, network is invasion by ants. Ant apply prospect to choice any uninformed node, when it reaches the node.

2.3.2 Ant-chain

Node life time, data integrity, and energy efficiency are the main parameters over here. A specific chain is prepared in it, to broadcast data to all nodes in wireless sensor network[6]. Node can run independently after knowing chain kind data. For data collection, three chains are selected:

- Bi-direction ant-chain is auto-adaptive with little modification in topology.
- Uni-direction ant-chain gathers limited data.
- Query chain collects data from node in focus.

2.3.3 QAAB

GPS is used to locate position of nodes to form a rational simulated grid, and here data is transferred by recognized locations[4]. To survive in region with self-organization, nodes follow rules. Nodes are of different types:

- Source Node also called Event node.
- Sink Node also known as Destination node.

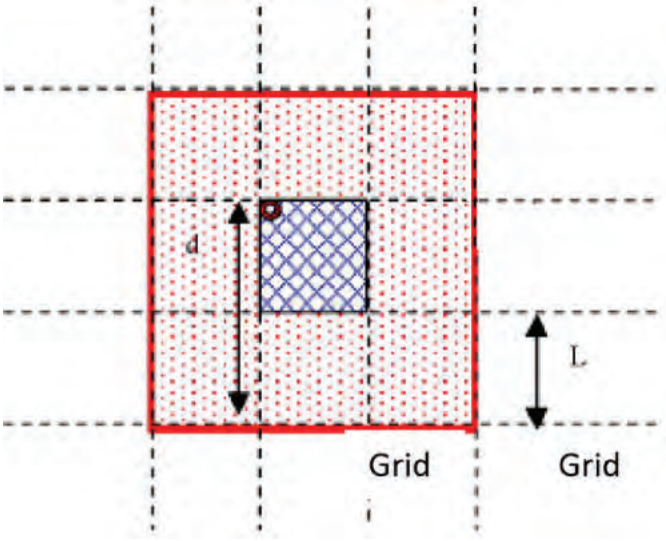

Figure 1. Splitting region into several grids.

- Queen Node provide interface with Internet.
- Principal Node acts as monitor of group.
- Member Node are the normal members.

2.3.4 ACLR

Ant-colony optimization-based location-aware routing protocol based on principle in which ant picks next hop neighbour node from selected set of neighbour nodes, to avoid loops during data transmission towards sink. Route is made by determining pheromone quantity dropped by ant and evaporation of pheromone based on residual energy and location of node.

2.3.5 MADFT

It allocate ants to Source node, then one of the selected ant form a path by searching another ant close to last found path[5]. MADF is based on probabilistic routing technique to form least cost path by calculating pheromone amount and cost.

2.3.6 Ant-0, Ant-1 and Ant-2

Energy constraint is improved by stresses data aggregation and reducing number of message exchange between nodes in wireless sensor networks. Data aggregation tree of wireless sensor network is constructed, where multiple source nodes sense data and send to single destination node. Ants find all possible paths from source node-to-sink node, out of which little potential track is trailed. Search space is explored for data accretion, with support from swarm intelligence.

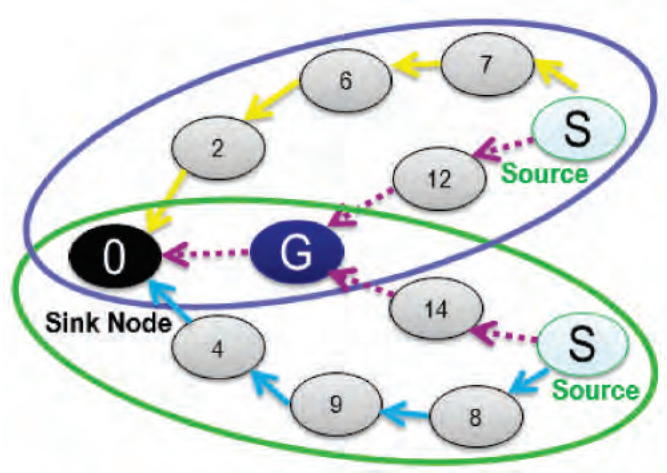

Figure 2. Aggregation node identification.

Pheromone is gathered to build data aggregation tree[6]. Figure 2 shows that there is no aggregation between Source 1, Source 2 and Sink, so an aggregation node G is used and two paths are modified.

2.3.7 FF-Ant

Flooded Forward Ant routing is based on broadcasting technique, so ants are flooded to all the routes and to explore all areas[4]. This technique is used where destination is not known or cost is not determined.

2.3.8 FP-Ant

Flooded Piggybacked Ant routing is used because flooding is dynamic, complex, and extremely dispersed[3]. FP-Ant deliver novel ant to forward ant or to data ant, they also contain forward list.

2.3.9 SC-Ant

Sensor-driven Cost-aware Ant routing is used to sense the best initial direction for ants, with the help of sensors, so that forward ant performance is maximized[5]. Each node retains probability distribution and the cost to reach destination from its neighbours.

2.3.10 E and D Ants

It is Energy X Delay model, which is used to reduce time delay and consumption of energy to send packets of data[4]. Real-time data transmission, improved battery life and optimum network lifetime is achieved by E and D ants, which is seven-times better than AntNet and Ant-chain algorithms[7].

2.3.11 Ant colony

This technique is dedicated to energy balance, network lifetime, battery life, and end-to-end latency by selecting nodes with less hops and pheromone[6]. It aggregate the battery life, network lifetime, and global energy consumption[10]. This technique outperforms direct diffusion routing protocol.

Table 1. Comparison of routing algorithms

Routing Protocol	Energy Efficiency	Data Gathering	Network Lifetime	Fault Tolerance	Packet Delivery Latency	Success Rate
T-Ant	Strong	Very Strong	Strong	Weak	Weak	Weak
Ant-chain	Strong	Strong	Very Strong	Weak	Weak	Weak
QAABR	Very Strong	Weak	Strong	Weak	Weak	Weak
ACLR	Very Strong	Weak	Weak	Very Strong	Weak	Weak
MADFT	Strong	Weak	Weak	Weak	Weak	Weak
Ant 0, 1 & 2	Very Strong	Weak	Very Strong	Weak	Weak	Weak
E & D Ant	Strong	Weak	Weak	Weak	Strong	Weak
SC-Ant	Very Strong	Weak	Weak	Weak	Weak	Weak
FF-Ant	Weak	Weak	Weak	Weak	Very Strong	Weak
FP-Ant	Weak	Weak	Weak	Weak	Weak	Very Strong
Ant-colony	Strong	Weak	Strong	Weak	Strong	Weak
AR, IAR	Strong	Weak	Weak	Weak	Very Strong	Very Strong
EEABR	Very Strong	Weak	Strong	Weak	Weak	Weak
Bee Sensor	Very Strong	Weak	Strong	Weak	Very Strong	Weak

2.3.12 AR and IAR

It is swarm intelligence based routing, it is established to increase the enactment by improving parameters like success rate, packet delivery ratio, energy consumption and time delay in wireless sensor networks.

2.3.13 EEABR

Energy-efficient ant-based routing is based on swarm intelligence in which every node contains data structure which stores ant information and routing table stores value of time out, ant id, forward node and previous node[2]. When forward ant is received, then node check routing table and find ant identification for loop. If found, then ant is removed; otherwise node stores required data, restarts timer and forwards ant to following node[9]. When backward ant is acknowledged, then node form routing table for next node to propel ant. If ant not reach node within assigned time, then timer delete record which finds backward ant.

3. COMPARISON OF ROUTING ALGORITHMS

Swarm intelligence-based algorithms and protocols like bee sensor and ant colony optimization, have different aspects and benefit areas. A brief comparison is made and represented in Table 1.

4. PROPOSED ANT COLONY ROUTING ALGORITHM

Enhanced clustering ant colony routing algorithm is proposed, which finds less congested and shortest path in wireless sensor network[8]. Improved clustering ant colony algorithm is not of use when sink node is near to source node and no benefit of reporting cluster head[9]. Proposed algorithm sink node directly report to nearby sink node, which results in less congested shortest path with minimum hop count[10].

Figure 3 shows that the source node is near sink node and both are in same cluster 1, so source node directly report to sink node and not follow path via cluster head.

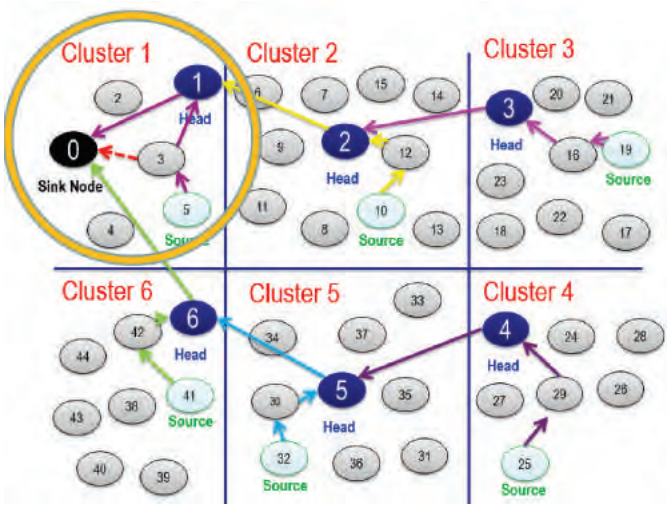

Figure 3. Source node report directly to sink node.

Table 2 shows that source node will directly report to sink node if both are near to each other, otherwise follow improved clustering ant colony routing algorithm, which states indirect path from source-to-sink via cluster head.

Table 2. Routig table

Source → Head → Sink Source → Sink	X <=X	Y <Y	Source → Sink (Direct Path)
Source → Head → Sink Source → Sink	X >X	Y <Y	Follow ICACR
Source → Head → Sink Source → Sink	X >X	Y >Y	Follow ICACR

5. CONCLUSION

Several algorithms are proposed in fast growing wireless sensor network, as network is distributed and dynamic. Evolution of ant colony optimization and swarm intelligence provides wide applications in field of wireless sensor networks, which mainly focuses on issues like scalability, adaptability, survivability, battery life, and maintainability.

6. FUTURE WORK

Enhanced cluster-based ant colony routing algorithm is in developing stage, which will use optimum path routing to improve performance of wireless network.

निष्कर्ष

तेजी से प्रगति कर रहे वायरलेस सेंसर नेटवर्क में अनके एल्गोरिथम प्रस्तावित किए गए हैं क्योंकि नेटवर्क वितरित और गत्यात्मक है। एंट कॉलोनी इष्टतमीकरण और स्वार्म इंटेलिजेन्स का विकास वायरलेस सेंसर नेटवर्क के क्षेत्र में व्यापक अनुप्रयोग प्रदान करता है, जो मुख्यतया मापनीयता, अनुकूलनीयता, जीवनक्षमता, बैटरी लाइफ और रखरखाव जैसे मुद्दों पर ध्यान केन्द्रित करता है।

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