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A New Approach for Handling Null Values in Web Server Log

Pradeep Ahirwar [1]
Department of CSE
MANIT, BHOPAL, INDIA
[1]pradeepgec@yahoo.com

Deepak Singh Tomar[2]
Department of CSE
MANIT, BHOPAL, INDIA
[2]deepaktomar@manit.ac.in

Rajesh Wadhvani[3]
Department of IT
MANIT, BHOPAL, INDIA
[3]wadhvani_rajesh@rediffmail.com

***Abstract*— The web log data embed much of the user's browsing behavior and the operational data generated through Internet end user interaction may contain noise. Which affect the knowledge based decision. Handling these noisy data is a major challenge. Null value handling is an important noise handling technique in relational data base system. In this work the issues related to null value are discussed and null value handling concept based on train data set is applied to real MANIT web server log. A prototype system based on Fuzzy C-means clustering techniques with trained data set is also proposed in this work. The proposed method integrates advantages of fuzzy system and also introduces a new criterion, which enhances the estimated accuracy of the approximation. The comparisons between different methods for handling null values are depicted. The result shows the effectiveness of the methods empirically on realistic web logs and explores the accuracy, coverage and performance of the proposed Models.**

Keywords- Null value, web mining, k-means clustering, fuzzy C-means clustering, log records, log parser.

I. INTRODUCTION

Web mining involves a wide range of applications that aims at discovering and extracting hidden information in data stored on the Web. It is also provide a mechanism to make the data access more efficiently and adequately and discover the information which can be derived from the activities of users, which are stored in log files, by the log records, investigator can vigil on the client's activities but most of the time connection fails due to which it is not possible store entire log record entry in the database, this creates many discrepancies for investigation of the client activities, to enhance the investigation one of the significant process is estimate the null values.

The mining process will be ineffective if the input data represent the raw content. Database systems have much more operational inefficiencies, therefore, for many applications in the area of data analysis, data pre-processing is an essential step. In addition, the handling of null values is the major task of the data quality. The poor data quality can cause negative results, including lost information. Inaccurate, inconsistent or the null data in the database can hamper research's ability to ascertain useful knowledge. An effective data quality strategy can help researchers to find knowledge in database, allowing them to make right decision and reduce costly operational inefficiencies. This paper included a trained data set method, which operated on web mining for processing relational database. Instead of directly taking the database we take live log record and ascertain the relational database we parse these log record by the assistance of Web log Analyser [7]. The structure of the proposed method can be composed of four phases, comprising log records and parsing these log records, applying clustering algorithm with trained data set method to form clusters, estimating null values through these clusters and comparing our possible techniques with other existing methods.

II. PRELIMINARIES

In present, one of the leading research areas in web mining is estimating null values using different techniques [1,2,3]. In this section, we describe briefly about the null value, web mining, k-means clustering, fuzzy c-means clustering, log records and log parser.

A. Null Values

A null value shows the dearth of information or the value is unknown. A value of null is apart from zero or empty. Operation among the null values or any other values, return null results and the value of each null is unknown or unavailable, so it is one of the tedious task to get the knowledge from such type of data record also the mining process will be ineffective if the samples are not a good representation of the data.

Database systems have much more operational discrepancies, therefore, for many applications in the area of data analysis, data pre-processing is an essential step. The availability of null value may be due to the data was not captured, due to faulty equipments, inconsistencies with other recorded data, the application program might have deleted the data, the data were not entered due to confusion, certain data may not have been considered important enough at the time of entry and the data was not registered in the database.

Sometimes null values represent significant and crucial data, and may need to be inferred and approximated. In recent years many researchers pay heed to the estimating null values in relational database systems. There are a number of approaches to deal with this problem; overlook objects containing null values, fill the gaps physically, substitute the missing values with a continuous, use the mean of the objects and use the most probable value to fill in the missing values, but these methods are not completely sufficient to handle Null value problems [2]. Therefore it is one of the primary research areas in the analysis of the data.

B. Web Mining

Web mining is the branch of the data mining used for discovering the patterns from the web, due to the heterogeneous and devoid of structure of the web; data mining is a challenging task. Through the web server many kinds of data are generated, one of them is log records. Due to many security reasons it is necessary to analyze web log record but many times by the failure in the networks some field of these log records are unknown but this unknown information is very important in the field of investigation, so we propose some possible methods to estimate this unknown value in log records with high accuracy. With the huge amount of information available online the World Wide Web is the fertile area for data mining research. The web mining research is at the cross road of research from several research communities, such as database, information retrieval, and with in AI, specially the sub-areas of machine learning and natural language processing.

C. Log Records and Log Analyzer

Log files formed by web or proxy servers are text files with a row for each http transaction on the network. Web log files contain a large amount of incorrect, ambiguous, and deficient information. The web log gives information about the site's visitors, activity statistics, accessed files, paths through the site, information about referring pages, search engines, browsers, operating systems, and more. Here we describe a log entry.

```
61.2.55.81 - - [04/May/2009:22:53:32 -
0700] "GET
/templates/ja_pollux/ja_transmenu/ja-
transmenuh.css HTTP/1.1" 200 5413
"http://manit.ac.in/content/view/297/123/"
"Mozilla/5.0 (Windows; U; Windows NT 5.1;
en-US; rv: 1.9) Gecko/2008052906
Firefox/3.0"
```

Here "61.2.55.81" is the IP address of the client (the system which is initializing the request). "04/May/2009:22:53:32" is the date time of the transaction, GET is the method of the transaction (GET and POST are the methods which are used to interact with the server), "/templates/ja_pollux/ja_transmenu/ja-transmenuh.css" is the URL requested by the client, "HTTP/1.1" is the http protocol, "200" is the http return code it means ok, "5423" is the size in bytes of the response sent to the client, "http://manit.ac.in/content/view/297/123/" is the cookie at the client browser, "Mozilla/5.0 (Windows; U; Windows NT 5.1; en-US; rv:1.9) Gecko/2008052906 Firefox/3.0" is the client environment specification on provided by the client browser.

A colossal amount of transactions occur day by day on every server. This generates log records endlessly on the server, it is not a simple task to examine these log records by these simply reading text files because these log files are not in well formed so we need a log analyser or a log parser to parse these log records, this makes simple task to analyse these tabular or well structured form of the logs which is generated by the log parsers. The log analyser also supports creating click overlay reports. These interactive reports allow you to navigate your site and view links marked according to the frequency they were clicked, as well as get additional statistics for site pages.

D. Clustering Techniques

Clustering is the process of organizing data items into groups where members are possess posses some similarity among them. A cluster is therefore a collection of similar data items or a collection of dissimilar data items belonging to different clusters.

1) K-means Clustering: The K-means clustering is one of the initials clustering algorithms proposed, it is one of the easiest type of unsupervised learning techniques that solve the clustering problem. It allows the partition of the given data into the k-clusters, the number of clusters is previously decided, after that each cluster randomly guesses centre locations and each data item finds out which centre it is closest to, thus each centre owns a set of data items, now each centre finds its centroid and jumps there, this process is repeated until terminates.

Although it has the advantage that it is easy to implement, it has two drawbacks. First, it is really slow as in each step the distance between each point to each cluster has to be calculated due to this phenomenon it is expensive in a large dataset. Secondly, this method is very susceptible because we provide the initial value of the clusters.

2) Fuzzy C-Means Clustering: In Fuzzy C-Means a data is formed into c-clusters with every data value in the dataset belongs to all clusters with certain degree. It lies under the unsupervised method and is inherited from fuzzy logic; it is capable of solving the multiclass and ambiguous clustering problems. Fuzziness measures the degree to which an event occurs due to this we are able to increase the probability as respective to the normal probability calculation. In the traditional clustering we assign the each data item to only one cluster. In this clustering we assign different degrees of membership to each point. The membership of a particular data item is shared between various clusters. This creates the concept of fuzzy boundaries, which differs from the traditional concept of well-defined boundaries. The well-defined boundary model does not reflect the description of real datasets. This contention led a new field of clustering algorithms based on a fuzzy extension of the least-square error criterion.

III. Problem Description

Including unknown values within your database can have an undesirable effect when using this data within any calculative operations. Any operation that includes a unknown value will result is a null; this being logical as if a value is unknown then the result of the operation will also be unknown [6]. The result below shows how using a null in a Boolean will alter the outcome, this is also known as three-value logic.
The data below shows how using a null in a calculation will alter the outcome:

(40 x 3) + 10 = 130	(Null x 4) + 8 = Null
(7 x Null) + 4 = Null	(8 x 9) + Null = Null

The problem of providing a formal treatment for incomplete database information and null values represents one of the thorniest research issues in database theory. A particular source of difficulties has been the generalization of the relational model to include null values. At present some methods exist to estimate null values [4] from relational database and data mining systems.

IV. Proposed Approach

As described in the introduction, the method is structured on a trained data set methodology, including fuzzy c-means clustering and relational database estimation. Assume that there is a null value in the log record; due to the presence of these null values it is not possible to investigate the client activities on the servers or the web, so we estimate these null values. The purpose of the possible proposed algorithm is to process the relational database estimation with a highly estimated accuracy rate by integrating the advantages of the fuzzy c-means clustering algorithm with the trained data set and relational database estimation simultaneously. In the phase of fuzzy c-means with trained data set we already trained some data point which gives surety that, they will always produce some optimal output than the core fuzzy c-means clustering algorithm. When we implement our proposed method and compare it with the previously implemented K-means and C-means algorithm, [3,5] we find that this method gives better results than others.

To show this procedure we take live web log records of Maulana Azad National Institute of Technology, Bhopal, India, for processing our possible approach, first we parse these log records by the tool WebLogExpert [7], in Fig-2(A), Fig-2(B) we show daily search phrases for the Maulana Azad National Institute of Technology, Bhopal, server, in Fig-3(A), Fig-3(B) we show some possible errors on the web log, these possible errors may create a null entry in the web log. For measuring performance, accuracy of the proposed method, we perform our operation on the 500 records of the MANIT, Bhopal, India log records. Finally Fig-1 shows that how we resolve this null value by our proposed possible approach.

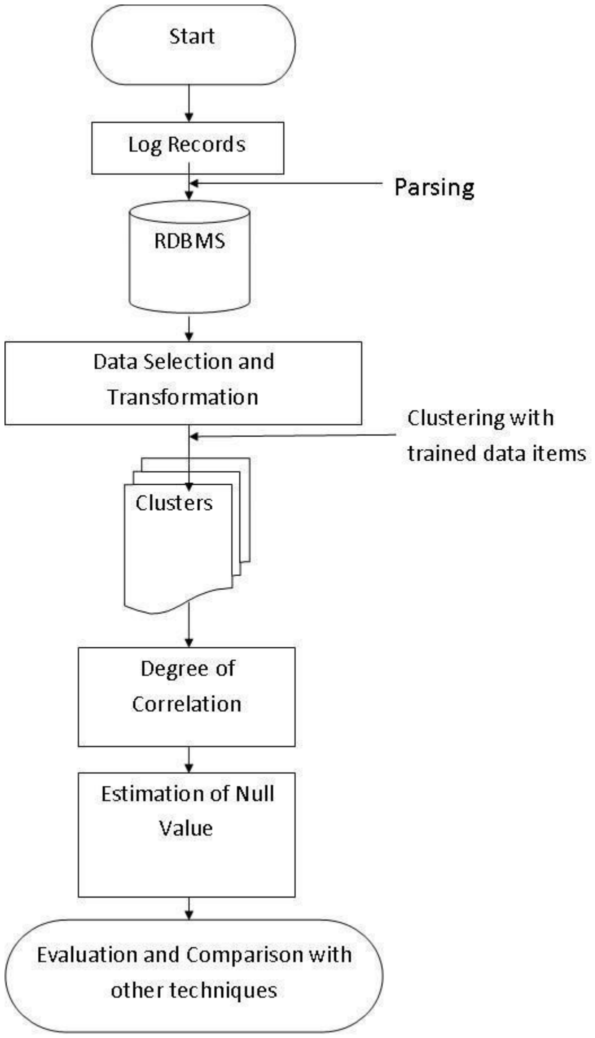

Fig. 1. Proposed possible approach for null value estimation.

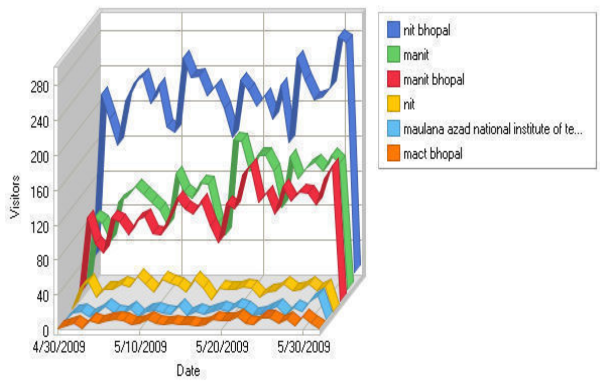

Fig. 2(A). Daily Search Phrases in MANIT Log Records.

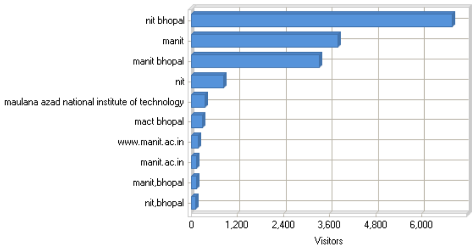

Fig. 2(B). Top Search Phrases in MANIT Log Records.

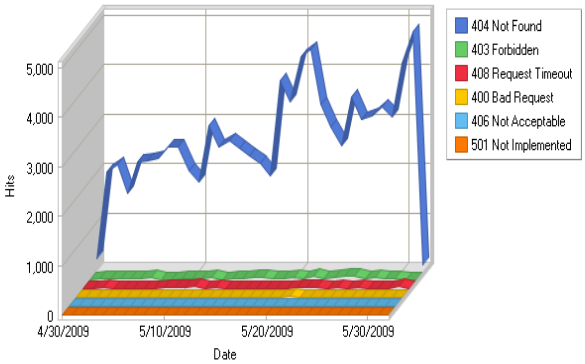

Fig. 3(A). Daily Error Types in MANIT Log Records.

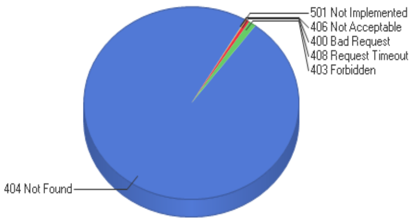

Fig. 3(B). Error Types in MANIT Log Records.

V. RESULTS AND COMPARISION

The results of proposed method compared with the other Implemented methods, the K-means Clustering (where the user need to enter the Cluster value and Seed value) another hands our proposed trained Data Clustering methodology where no need of giving the Seed and Cluster value instead of only generating point needed. In Table 5.1 clearly shown that our proposed method has better results than the implemented methods.

The resultant Iteration and Error rate are generated by our proposed architecture, which identifies most accurate results than the respective and previous implemented method. For measuring performance, accuracy of our proposed method, the Operation performed on 500 records of the MANIT, Bhopal, India log records.

Methods	No. of Iteration	Error Rate
Implemented Method (K-means Clustering)	10	4.93
	09	5.70
Proposed Method (Trained Data based Method)	Ini. Val .45 7	2.73
	.24 5	2.68
	.53 6	2.93

Table 5.1 Performance Comparisons for Implemented and Proposed Method.

VI. CONCLUSION

In this paper, the proposed method is based on trained data set to estimate null value in relational database systems by constructing fuzzy c-means clustering algorithm, and which integrates advantages of fuzzy system. Due to this trained data set, the proposed method can effectively achieve better performance on relational database estimation. Now we are able to get the unknown values present in the log records, which were the biggest hurdle in the field of analyzing the log record.

ACKNOWLEDGMENT

The work presented in this paper would not have been possible without our college, at MANIT, Bhopal. We wish to express our thankfulness to all the people who helped turn the World-Wide Web into the useful and popular distributed hypertext it is. We also wish to thank the anonymous reviewers for their valuable suggestions.

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AUTHORS PROFILE

[1]**Mr. Pradeep Ahirwar** is a student of MTech Computer Science, MANIT, Bhopal, MP, INDIA. His Research activities are based on web log mining, digital forensics.

[2]**Mr. Deepak Singh Tomar**, working as Assistant Professor in Department of Computer Science at MANIT Bhopal, MP, INDIA. His Research activities are based on digital forensics, data mining and network security.

[3]**Mr. Rajesh Wadhvani, working as** Assistant Professor in Department of Information Technology at MANIT Bhopal, MP, INDIA. His Research activities are based on database, data mining, and network security.

Traffic Classification – Packet-, Flow-, and Application-based Approaches

Sasan Adibi

ECE Department, University of Waterloo, Waterloo, Ontario, N2L 3G1, Canada

***Abstract* — Traffic classification is a very important mathematical and statistical tool in communications and computer networking, which is used to find average and statistical information of the traffic passing through certain pipe or hub. The results achieved from a proper deployment of a traffic analysis method provide valuable insights, including: how busy a link is, the average end-to-end delays, and the average packet size. These valuable information bits will help engineers to design robust networks, avoid possible congestions, and foresee future growth.**

This paper is designed to capture the essence of traffic classification methods and consider them in packet-, flow-, and application-based contexts.

***Keywords* — Traffic Classification, Packet, Flow, Applications, Delay, Payload Size.**

I. Introduction

Traffic classification techniques are used to categorize traffic flows into tangible selections. These selections may be in two major forms; packet information (e.g., packet size, flow duration, etc) and packet representing the application in use.

There are numerous selections of packet classifications, which are based on how they are observed and analyzed. An observation can be at the packet level, including the consideration of; packet size, duration, burstiness and patterns of transmission. Another observation is to consider the context of which the packets are used in. This can include the application by which the packets are created for, performance measures, and different underlying protocols stacks in use. These will be discussed in later sections.

The management of this paper is as followed: Section II will discuss traffic classification parameters. Sections III and IV are dedicated to flow-based and Quality of Service (QoS)-application-specific traffic classifications respectively, followed by conclusion and references.

A. Traffic analysis in the literature

In the traffic classification literature, the classical method of identifying flows is based on various parameters observations, such as IP addresses, ports, etc. Reference [1] proposes a method for relying on the first five TCP packets observation to identify the application in use. The proposed classification technique works around two phases: an online traffic classification phase and an offline learning phase. The learning phase uses the training data, which checks the TCP flows to extract common behaviors. The traffic classification phase is used to extract the applications running above the TCP layer.

BLINC [2] discusses a new approach in traffic classification where applications and devices hosting the applications are associated. BLINC considers flow activities of hosts instead of considering every individual TCP/UDP flows. The limitation about BLINC is that it is capable of analyzing the statistics only after the connection is terminated. Therefore BLINC is incapable of analyzing the flows on the fly.

Reference [3] presents a framework for traffic classification while packet payload is present. The scheme utilizes several building blocks that are used to create sufficient confidence for application identity. This is done by collecting packets with payloads on the Internet backbone and sorting the TCP/UDP flows based on their port numbers. The results show that a classification based on simple port numbers will provide approximately 70% accuracy for the traffic classification.

Reference [4] is based on NBAR (Network-Based Application Recognition), which is counted as a traffic classification based on Internet applications (e.g., web-based), TCP/UDP port assignments, and other difficult-to-classify applications.

A few studies [5,6] have shown that there are orthogonal correlations between four main traffic classification dimensions; rate, duration, burstiness, and size. These correlations are more accurate for heavy-hitters (e.g., long lasting connections), which contain DNS (Domain Name System) traffic.

Reference [7] presents a security-based application classification technology called App-ID, which operates by establishing application sessions. App-ID identifies different traffic using one of the following approaches: a). Protocol and Port Numbers, b). SSL (Secure Socket Layer) Decryption, c). Application Decoders, and d). Application Signatures.

In the study of traffic classifications, Peer-to-Peer (P2P) networks are also important to consider where both TCP and UDP on top of IPv4 are used to convey file sharing data between individual users [8,9,10,11]. Reference [8] emphasizes on two main issues, first is P2P applications have matured over the past few years and their usage will be on the rise. The other issue mentioned is that since P2P applications use non-standard and random port numbers, the conventional flow classification techniques are not adequate for proper classifications. Reference [9] demonstrates the accuracy, feasibility and robustness of high speed P2P application signature-based traffic. It discusses a number of P2P application protocols, such as eDonkey, BitTorrent, DirectConnet, Gnutella, and Kazaa protocols. The measurements show that using application-level signature technique, less than 5% false position/negative ratios can be achieved.

A few studies [10,11] offer comparative approaches for studying P2P traffic behaviors. Reference [11] offers three such approaches for P2P application classifications; port-based, application-layer signature, and transport-layer longitudinal approaches using empirical network traces over a two-year period. The results show that classic port-based analysis is not accurate, which is inline with the results achieved in reference [8]. Application-layer signature approach, on the other hand, yield more accurate results, agreeing on the results achieved in reference [9].

Reference [12] uses Naïve Bayesian estimator for Internet traffic classification analysis. With fine-tuning this estimator's variants, the results show 65% accuracy on per-flow traffic classification. The accuracy was increased to 95% when data from the same period was analyzed in addition to the usage of techniques, such as Bayes based kernel-estimator was combined with FCBF (Fast Correlation-Based Filter).

Reference [13] uses a supervised Naïve Bayesian estimator algorithm, which features building statistical models, which described the classes based on training data (machine learned classification). The results show an accuracy of better than 83 % on both per-byte and per-packet classifications.

Reference [14] provides an accuracy of 82-100% based on an empirical evaluation technique, which models both host-specific- and aggregate-protocol behaviors. Such an accurate classification is independent of port label, which opposes the traditional classification methods.

If certain traffic attributes are not considered effectively, the performance of a traffic classifier can be greatly affected. An example of such traffic attributes include flow sizes (mice/elephant), which will contribute to degradation of traffic classification accuracy. [15]. Another attribute is the QoS measures and identifiers, which requires CoS (Class of Service) measurement classifications [16].

Certain protocols have certain attributes, which can be measured for traffic classifications. One series of protocols that are often noticed on the Internet backbone are routing protocols. There are two types of routing protocols; internetwork and intranetwork routing protocols. Internetwork (aka Internet Autonomic System "AS") routing schemes operate on larger scales, such as BGP (Border Gateway Protocol), whereas interanetwork routing schemes work inside one network's boundaries, such as OSPF (Open Shortest Path First). It is obvious that only internetworking routing schemes are observed on the Internet backbone. Flow classifications based on classifying BGP level prefix flows are one example of routing traffic classifications [17,18]. Reference [17] uses a method based on Dirichlet Mixture Processes, modeling flow histograms with a capability of examining macroscopic flows while distinguishing between various classes of traffic.

An empirical approach to Inter-AS traffic classification [18,19] includes extensive Internet-wide measurements and classifying and ranking them into individual ASs based on the utilities they derive (e.g., residential, business). The scatterplots show that there are correlations between various pairs of utilities.

Machine Learning (ML) methods have also been widely used in traffic classification [20,21], where traffic clusters are created based of various traffic characteristic. Early ML techniques mostly relied on offline and static analysis of traffic batch traces. However recent work is mostly towards real-time ML-based IP traffic classifications.

Traffic classifications with various security measures in mind; have been considered in various literatures [22,23,24]. It is shown [22] that it is possible to classify and categorize Internet traffic flows without proper content analysis. Using statistical signatures, it is possible to classify services even when they are running on non-conventional port numbers [23]. Reference [24] argues that the application of SSL is on the rise and characterization of SSL and a method, which recognizes applications running on encrypted SSL connections based on the first packet size, provide an accurate traffic classification technique with more than 85% accuracy.

Many of the parameters used in the traffic classifications study, exist at the network layer. Therefore several studies [25,26] included deeper attention on the IP protocol, which operates at the network layer in the TCP/IP suite.

II. Traffic Classification Parameters

In this section we introduce a number of network traffic parameters. These parameters are mostly considered in the study of packet and traffic classification techniques.

A. Packet Size

Packet size is one form of traffic classification. Most of the traffic volumes on the Internet can be categorized into either very small (mouse) packets or very large (elephant or heavy tailed) packet sizes. The large packet size is usually associated with higher link usage. Basically 20% of the connections on the Internet are responsible for 80% of the traffic [27,28,29], mostly containing elephant packets.

Zipf's law is a more generalized form of this context. In the packet size scenario, Zipf's law characterizes the frequency of occurrence of certain packet sizes as a function of its rank in the frequency table [30]. This means that there exists an imbalance in the network due to the fact that 20% of the connections carry 80% of the traffic and the rest of the 80% of the connections are for small packet traffic.

Traffic Engineering (TE) [31] is a term applied to a systematic process in which traffic flows are arranged in "classified" groups to simplify their transmission throughout networks and decrease the chance of congestions. TE, by nature, is well positioned to deal with very large volumes through the aggregation of traffics. However TE tends not to perform as efficiently when dealing with mice flows. The drawback of TE in regards to traffic classification is the fact that traffic in a large and random environment (e.g., the Internet) would exhibit volatility in several flow specifications, namely; volume and bandwidth [31]. Fluctuations in these network parameters reduce the efficiency of TE in the process of traffic classifications.

In many cases, flows exhibit inherent bandwidth fluctuations. As mentioned, this creates complications in the traffic classification criteria, leading to frequent reclassification, thus reduction in the classification performance. These fluctuations are due to the following factors [31]:

Connection termination following the link exhaustion - The duration of a connection can be modeled as a stochastic variable dependant on the following parameters [32,33]: The protocol in use, the current (kth) connection arrival time, the current connection (kth) time duration, and client/server performance metrics (e.g., round-trip delay, client delay, server delay, etc) for client/server based applications such as FTP.

The effect of these parameters contributes to the creation of a median time for the flow. This median time for elephant flows (aka heavy-hitters) will be higher since according to reference [34], the longer the connection duration (heavy-hitters), the higher the probability for the link to continue its connection.

Burstiness Effect - Multimedia traffic, especially video data, can be affected by the burstiness of traffic flows, reflected by a number of parameters, such as [34]: Peak-to-average ratio (PAR) and the temporal auto-covariance function (ACF).

Burstiness is a time sensitive parameter and probability-wise, burstiness is more probable to be an issue in heavy-hitter connections compared to mouse flows.

Bandwidth Fluctuations - Bandwidth fluctuations occur relatively frequently in wireless networks compared to wired networks. In wired networks, bandwidth fluctuations may happen due to various reasons, such as, a sudden increase of user demands or a congestion period.

Reasons behind bandwidth fluctuations in wireless networks, mostly related to PHY and MAC layers, include: handoff and handover between Access Points (APs), limitations of available bandwidth in multi-user environments, physical limitations (e.g., reflections, refractions, multipath, etc), vulnerability to various interferences, and dependency of performance to the distance of the client (wireless user) to the server (AP).

A.1 Heavy Hitters (Elephants) versus Mice packets

Heavy hitters can be identified by both their large packet sizes and long duration connections. It has been presented in the literature [35,36] that there's a strong correlation between the rate of a stream and its packet sizes mainly based on the protocol in use.

In wired connections, from a packet size point of view, packets are usually between a few tens of bytes up to 1514 bytes. Depending on the Maximum Transmission Unit (MTU), large files being transmitted are usually broken down into various fragments. Based on captured real traffic, we notice that control packets (packets containing control commands), which do not usually have any data payloads, are less than 200 bytes. Data packets are usually above 200 bytes. Heavy hitter packets, according to the data we have gathered, from packet size point of view, are packets with payloads of 300 to 1514 bytes.

Wireless traffic starts from 14 bytes (e.g., ACKs, CTS, etc) with no data payloads, up to 1530 bytes, which is a limit by which fragmentation occurs. Based on our real traffic analysis, we label packets with over 400 bytes in lengths as heavy hitters.

B. Duration

Duration of packet streams is another form of packet classification. Depending on the application, a short lived packet can last from a few milliseconds up to a few minutes. Long-lived packets, on the other hand, can last from a few minutes up to several hours. Statistics [35,36] show that there are direct links between larger packet sizes and longer durations. Based on captured real traffic from multimedia-rich connections, most control packets, such as beacons, ACKs, CTSs, etc, are light connections (tortoises) and other packets forming connections (connection requests, confirmations, data transmission, acknowledgement transmission, teardowns, etc), are considered heavy hitters (dragonflies).

C. Confidence Interval (CI)

CI is a population-related parameter, which is an interval estimator [38,43,46]. Confidence intervals are used give an estimate on how reliable a sample is. For an extreme diverse sample space, such as the traffic patterns on the Internet backbone, either one has to monitor the lines for a long period of time (e.g., months or years) and then run traffic classification techniques over the saved traces, or use small sample space with an aid of a confidence interval estimator. A confidence interval of higher than 95% is a relatively good estimation. Bayesian and Gaussian interval estimations are examples, by which confidence intervals can be estimated.

III. Flow-based Traffic Classification

A flow is defined as a unidirectional series of IP packets with unique source/destination addresses, port numbers (assuming TCP or UDP to be the transport layer protocol) and protocol number [40,41,42].

The main focus of this section is to discuss application specific classes of traffic. However it is important to talk about a few basic and fundamental definitions first.

Four main parameters associated to every flow are: size, duration, rate, and burstiness. Correlation between size and rate is protocol-based. In regards to small/medium flow sizes, due to different timeout mechanisms, the strong correlation between size and rate is more likely a pervasive artifact. Such an argument might require the use of a larger packet size or the deployment of a larger initial window to improve TCP performance. This will increase the chance that more data is sent in one round trip time "RTT" before the timeout occurs. There is a strong correlation among flow size and rate. Size can be chosen based on bandwidth availability [42].

A. Flow-Level Metrics

Reference [40] classifies flows according to their *sizes, durations,* and *inter-arrival times*. These are defined as followed [40]:

A.1 Flow Size

Flow size is the total number of bytes transferred between a server and a wireless client during a connection. From the client point of view, it does not matter if a new server giving service (handover happens with a new IP address) while the connection is still ongoing. However this measurement is usually done per server/client pair [42,43,45,46].

Mice Flows - Mice flows are those with relatively low sizes transmitting for a short duration. The duration limit is less than the time required for the accumulation of 10 KB data and the packet sizes are usually less than 500 Bytes each.

P *Elephant Flows* - Elephant flows on the other hand are flows, which usually last more than an hour carrying relatively large packet sizes (often larger than 1 KB each). Therefore for a typically elephant flow (on average) more than 3 MB of data is accumulated compared to 10 KB in the mice flow case.

Peer-to-Peer (P2P) networking has gained much popularity in the recent years. The statistical flows for both P2P and Internet have been well modeled and bounded between Pareto and Weibull distributions [40] and their probability density functions (pdf) can be derived from the following two Equations (f_{WEB} and f_{P2P}):

$$f_{WEB}(S) = \begin{cases} 0.26S^{-0.62}e^{-\left(\frac{S}{2.7}\right)^{0.38}} & : S \le 30KB \\ \dfrac{3.33}{S^{2.05}} & : 30KB \le S \le 5MB \\ \dfrac{600466}{S^{3.35}} & : S \ge 5MB \end{cases}$$

$$f_{P2P}(S) = \begin{cases} 0.63S^{-0.19}e^{-\left(\frac{S}{1.36}\right)^{0.81}} & : S \le 4KB \\ \dfrac{0.0548}{S^{0.35}} & : 4KB \le S \le 10MB \\ \dfrac{7034}{S^{2.42}} & : S \ge 10MB \end{cases}$$

Fig. 1 shows the comparison between web and P2P distribution functions across the 4 kB flow size space.

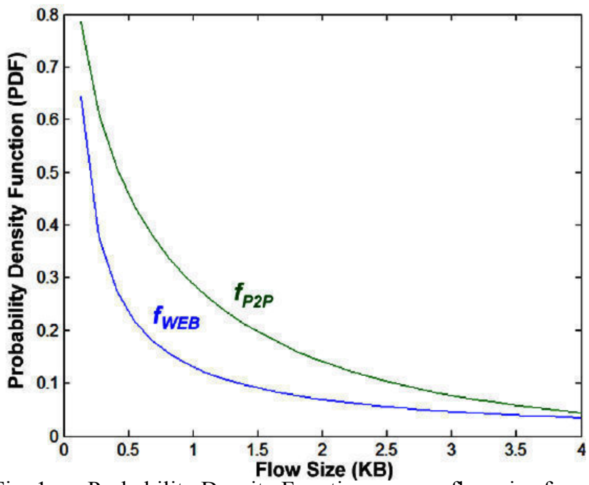

Fig. 1. Probability Density Functions versus flow size for WEB versus P2P activities

The distribution for the web-flow size includes a long-tailed distribution. A probability distribution is called long-tailed (aka heavy-tailed) when high probability regions are far from the median or mean.

A.2 Inter-Arrival Time between Flows

This is the time between any two consecutive flow arrivals. Inter-arrival times in flows are practically independent from each other and are distributed exponentially according to Poisson process. IP traffic on top of TCP and UDP, also has uncorrelated inter-arrival flow times (also true in regards to the flow lengths), therefore it can be modeled by a combination of algorithmic scaled normal distributions [47].

A.3 Flow Duration

This is calculated from the start of the initial handshake of the flow until the last data packet and tear-down of the link related to the flow. At this level we also have mice flow and elephant flow concepts.

To quantify these two concepts, Internet traffic measurements have shown that 80% of total traffic on the backbone is caused by 20% of the traffic flows with relatively long flow durations.

In the Flow Size section a simple math was carried out to calculate a time range for both mouse and elephant flows. According to the definition a typical mouse flow can be as short as a few micro-seconds (based on current 802.11 bandwidth limit of 54 Mbps) up to several minutes. A typical elephant flow lasts from an hour to several days and could transmit up to several thousand terabits of data in a single flow.

A.4 Flow Fluctuation Patterns

In general, one can categorize flow fluctuation patterns as: *Slowly varying continuous data flow, a fast varying continuous data flow, traffic with common periodic trends, short-lived bursts,* and *noise*.

Slowly varying continuous data flows are long-lived connections generated from a steady source with relatively high correlation among successive data. Therefore, only small variations are observed in a short period of time. An example would be the data transmitted from thermal sensors.

Fast varying data flows are long-lived flows where the volume of data generates fluctuates rapidly over a relatively short period of time. In these types of flows, high variations are observed with low correlation indexes among successive data. An example of this would be data transmission across a busy LAN.

Common periodic trends are long-lived traffic patterns which are observed to be periodic in nature, such as web server traffic and scheduled backup data.

Short-lived bursts are also part of most data network traffic. As mentioned before, a long established busy LAN connection may exhibit fast varying data flow, however over a short period of time, such a connection may include short-lived bursts resulting from rapidly fluctuating traffic levels. A burst can be characterized as a fluctuating data stream over a relatively short period of time.

Background noise is an inevitable part of any network traffic. A high SNR (Signal-to-Noise Ration) value ensures relatively high level of signal and low level of noise.

The network traffic categories mentioned can be applied to almost all aggregated network traffic. Thus, proper analysis of these flow types is of great importance.

B. Traffic Control

Depending on the nature of the flows, either majority being mice, elephant, or a combination of both, network will deal with various conditions differently. For instance if the majority of the flows are mice and the network has undergone congestion periods, dropping packets will do little in dealing with congestion control. In general, such a network will pose random behavior with high adaptability to sudden changes, which can be a favorable issue for time-sensitive applications. Telnet and HTTP transfer streams tend to be of mice flow type [41].

For a network where majority of the flows are elephant, depending on the protocol in use, it can be tolerant against congestion, in particular if the majority of the traffic is based on TCP, as TCP features a built in congestion avoidance mechanism. TCP (FTP applications) and UDP (video applications) flows are examples of elephant flows [41].

Flow duration increase may increase the Long Range Dependence (LRD) (aka long memory, measured by Hurst parameter) as well. LRD is an autocorrelation value of a data stream, which approaches a constant value (normalized to 1) as the number of data bits increases. If the limit in equation 3.1 exists for a real number of r, then α (s) is the autocorrelation function and X_t is the LRD stationary process (Fig. 2 [adapted from [48], Equation 3).

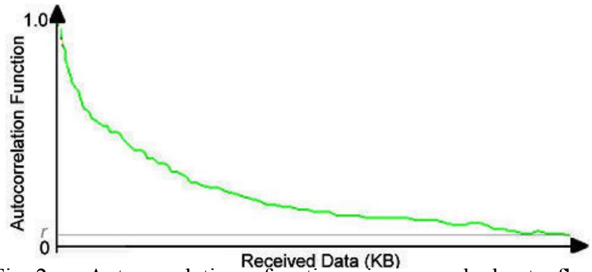

Fig. 2. Autocorrelation function in an elephant flow merging to the value r

Thus for a typical elephant flow, equation 1 should hold. The following definitions are related to LRD:

Hurst parameter **-** is an indicator parameter, which increases when traffic volume and burstiness increase.

Self similarity - is a statistical property, fractal-like, to examine produced data for similar patterns over a scale of time. A few of its properties are: slow decaying variance, long-range dependence, and Hurst effect.

IV. QOS-APPLICATION-SPECIFIC TRAFFIC CLASSIFICATION

The purpose of this section is to study traffic classifications from different QoS requirement perspectives. These types of classifications can be layered-based, such as: application, network, and lower layers (MAC and PHY), which makes it a fairly complex task to configure. Therefore in this section we try to break down different aspects of QoS from traffic classification point of views and discuss the details for each part.

A. QoS Traffic Classes

QoS is an essential part of a non-best-effort traffic classification, which is important to ensure priority data, in particular; multimedia applications running on stringent wireless links are handled with proper priority in a timely manner (upper limits on delay values). These multimedia applications (data containing both audio and video), based on the delay tolerability, can be grouped in the following categories [49,50]:

Streaming - Clients request audio/video files from servers and pipeline reception over the network and display. Streaming data can be interactive, that is the user can control some operations (e.g., pause, resume, fast forward, rewind, etc.).

Unidirectional Real-Time (Half-Duplex): Functioning similar to existing TV and radio devices (e.g., mobile-TV), however data delivery direction is from the network to the device. It is a non-interactive service, only listen and/or view.

Interactive Real-Time (Full-Duplex) - Two-way traffic, similar to a phone conversation and videoconferencing (e.g.., talking/listening broadcasting/ viewing at the same time). This class has a more stringent delay requirement compared to real-time streaming and unidirectional, requires normally less than 150 msec of delay for both audio and video applications (in each direction).

B. Wireless QoS Requirements

QoS in general falls into two categories; user perspective (application interaction) and network perspective. Application perspective QoS refers to the quality of the high-level applications as perceived by the user, including multimedia (e.g., video, audio, streaming, text, file transfer, etc) presentation subjective quality. We already discussed delay, bandwidth, round-trip (end-to-end) delay, and jitter as part of the QoS-related parameters. Other user perspective parameters in regards to QoS include:

Connection Drop – When the delay or jitter figures increase passed certain limits, the link quality either becomes unbearable to the user or the underlying application drops the connection, causing a link failure. In either case, it will affect the user profoundly.

Depending on the application in use (e.g., audio, video, voice messaging, audio streaming, etc), the requirements for the subjective QoS (user perception) figures may change. For instance, if the end-to-end audio delay becomes more than 150 msec, the user level of discomfort starts to increase dramatically.

In regards to network perspective QoS, the QoS-related parameters for multimedia applications include: Bandwidth or Throughput, Round-Trip Time (RTT), End-to-End Delay (E2ED), Bite error rate (BER), Packet Loss Ratio (PLR), Packet drop ratio (PDR), and Jitter [51,52,53,54]. A few of these parameters were introduced earlier in this section and the rest are defined as followed:

Bit Error Rate – BER is the measure of the number of errors bit-wise; 1 is sent, however 0 is received, or 0 is sent and 1 is received. Channel conditions contribute to the value of BER, so when noise and/or interference levels rise, BER value rises too.

Packet Loss Ratio – PLR is a parameter that represents the ratio of the number of lost packets to the total number of packets sent. The performance of the link and the intermediate nodes has direct impacts on PLR. The higher the PLR value, the less efficient the communication path between the source and the receiver is.

Packet Drop Ratio – PDR is a performance measure that is mostly affected by the receiver's input buffer. When the input buffer starts to get full, a mechanism starts discarding (dropping) the packets. The lower the PDR value, the better the quality of these buffers.

B.1 Bandwidth Requirements

Based on the multimedia application in use, bandwidth constraints are different. Table I (adapted from [52,59,60,61]) shows bandwidth requirements for various MPEG formats (combination of video and audio).

B.2 Voice over IP (VoIP) Bandwidth Requirements

Voice over IP is an important multimedia application, which has become a dominant engine of transporting voice across IP networks (Internet).

TABLE I
DIFFERENT DATA RATES FOR DIFFERENT VIDEO APPLICATIONS

Algorithm	Format	Format Specific Properties	Data Rate (kbps)
DPCM	H.120	625-line-50 field, 525-line-60 field	1544 (NTSC) 2048 (PAL)
DPCM, DCT, MC	H.261	88x72, 176x144, 352x288, 704x576 Comparable to MPEG-1	20, 2048
8x8 DCT, CIF, SIF	MPEG-1	352x288, 352x240, 25 fps (PAL), CBR, MPEG-1, Audio, Layer 2 VCD	32 (audio) – 1,536 (video)
8x8 DCTVLC	H.262	Similar to MPEG-2	60-2,048
8x8 DCT, CIF, SIF	MPEG-2	MPEG-1, Low (352x288), Main (720x476), SD (1440x1152), HD (1920x1152), SVCD, DVD	32-80,920
OBMC, DCT, SQCIF, QCIF, CIF, 4CIF, 16CIF	H.263	12bx96, 176x144, 352x288, 704x576, 1408x1152 – up to 72 fps	10-64 (audio) 1,024-20,480
4x4 DCT, 8x8 DCT	H.264	Similar to MPEG-4	64-983,040
DCT, VBSMC	MPEG-4	Level 4, 720x1280 progressive 1080x1920 interlace	24-24,5760

VoIP systems deploy specific codec to packetize voice messages. Each of these codecs has specific characteristics with unique bandwidth and delay requirements. The bandwidth requirements of a number of codecs are mentioned in Table II (adapted from [55,56,57,58]). The qualities of these codecs have direct effects on both user-perception (voice/video), as well as network perspective QoS (e.g., overall delays).

B.3 End-to-End Delay

In a VoIP system, the transmission of voice data packets is not instantaneous and latency is the term used to describe the time durations for the needed time that a packet of voice data to be packetized, encoded, moved across the network to an endpoint, decoded and de-packetized, de-jittered, and decoded at the receiving end.

As mentioned, the end-to-end delay has to be minimized for real-time and interactive applications. End-to-end delay reduction directly improves throughput figures. A thorough end-to-end delay analysis is needed for precise throughput calculations.

Total latency is so-called end-to-end latency, mouth-to-ear latency, round-trip-delay (RTD), or round-trip time (RTT) [56].

In VoIP, real conversations usually involve “turn-taking” with 200 msec breaks. When the latency of a network approaches the 200 msec limit, the conversation flow becomes distorted. The two end parties may interrupt each other by starting to talk simultaneously or remain silent at the same time. Degradations for delays over 150 msec (300 msec two-ways) will affect any signal greatly [62]. For video codecs there are also limits for the delay, for instance H.261 and H.263 are typically within the 200 msec to 400 msec limit.

Multimedia applications often require bounded delay figures to offer seamless QoS. An end-to-end delay is comprised of the following delay figure combinations [63]: Packet loss, packet processing delay (codec, serialization, queuing, and propagation delays), and network jitter.

Codec delay is the combination of frame processing and lookahead delays, which are defined as:

- Frame processing delay is a delay of processing a single voice data frame.
- Lookahead delay is the next frame processing delay, which is needed for algorithms with correlation schemes (e.g., ADPC)

The rest of the delays are from: BER, PLR, PDR, PRDeR, echo, and Jitter. Jitter is one of the most important phenomena affecting the quality of a VoIP system.

Jitter happens due to the fact that there is not delivery guarantees for the voice packets across IP networks, therefore there are possibilities that not all voice data packets travel the same path, causing variation in the packet arrival times. This may happen because some packets may chose paths with more hops than other packets. Therefore packets arrive at the destination node with variable delays causing much higher latency effect, called *jitter*, which is calculated per seconds. Table III (adapted from [64,65,66] shows a few audio codecs delay figures.

Too many packets being processed at the intermediate gateways/routers may overwhelm the processing duties momentarily. Both of these circumstances cause latency to become irregular and this irregular delay, as mentioned, is called jitter. To lessen the effects of jitter, packets are gathered in a jitter buffers in the intermediate transmission devices and at the receiving-end device. Table IV (adapted from [52]) shows the acceptable VoIP jitter figures for Cisco-based systems, which should be below the 70 msec level and for inter-frame delay (frame delay jitter) in video, it should be less than 0.15 msec (for H.261).

The combination of end-to-end delay, jitter, noise-levels, and other factors are used to calculate a subjective measure for VoIP system, which is called; the Means Square Opinion (MOS) value. MOS values vary from 5 (highest) to 1 (lowest).

TABLE II
VOIP CODEC BANDWIDTH REQUIREMENTS

Codec	Data Rate (kbps)	Coding Technique	Bandwidth (kbps)
G.711 (A-, μ-law)	64	PCM	68-96
G.722	48, 56, 64	ADPCM	88
G.722.1	24, 32	ACELP	42, 52
G.723.1	5.3, 6.4	ACELP/MPC-MLQ	26, 27
G.726	24, 32	ADPCM	48, 64
G.728	16	LD-CELP	78
G.729	6. 4, 8, 11.8	CS-ACELP	31.2
G.729a	8	CS-CELP	40
AMR-WB (G.722.2)	6.6-23.85	ACELP	36-49
AMR-WB+	5.2-48	ACELP	7.2-50
AMR-NB	4.75-12.2	ACELP	36-44
GSM EFR	12.2	ACLEP	30
GSM FR	13.3	RPE-LTP	31
iLBC	13.3, 15.2	FB-LPC	24, 32

The quality of the audio codec has a direct impact on the MOS score (Table V). Table VI (adapted from [67]) shows a few codecs and their upper MOS limits.

TABLE III
AUDIO CODEC DELAYS

Codec	Codec Delays
G.711	0.25 msec
G.722	1.25 msec
G.722.1	60 msec
G.723.1	97.5 msec
G.726	0.25 msec
G.728	1.25 msec
G.729	25 msec
G.729a	35 msec
AMR	45 msec
GSM EFR	40 msec
iLBC	45 / 70 msec

TABLE IV
JITTER FIGURES IN VOIP (CISCO-BASED) SYSTEMS

Jitter	Quality
Less than 40 ms	Excellent *(unnoticeable jitter)*
40-75 ms	Acceptable *(noticeable jitter)*
Larger than 75 ms	Unacceptable

TABLE V
COMPARISON OF R-VALUES AND MOS SCORES

Characterization	MOS Value
Very Satisfied	4.3+
Satisfied	4.0-4.3
Some Users Dissatisfied	3.6-4.0
Many Users Dissatisfied	3.1-3.6
Nearly All Users Dissatisfied	2.6-3.1
Not Recommended	1.0-2.6

TABLE VI
UPPER LIMITS OF CODEC'S MOS VALUES

Codecs	MOS
G.711	4.3
iLBC	4.14
AMR (12.2 kbps)	4.14
G.729 (8 kbps)	3.92
G.723.1 (6.3 kbps)	3.9
GSM EFR (12.2 kbps)	3.8
G.726 ADPCM (32 kbps)	3.8
G.729a (8 kbps)	3.7
G.723.1 (5.3 kbps)	3.65
GSM FR (12.2 kbps)	3.5

III. CONCLUSIONS

This paper summarizes various criteria for traffic classification purposes, including packet-, flow-, and application-based aspects. We studied different parameters under each category, numerated the parameters considered for each section, and identified the QoS measures and parameters.

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Algebraic Specifications:Organised and focussed approach in software development

Rakesh.L
Research Scholar
Magadh University, Bodhgaya
Gaya, Bihar, India-824234
rakeshsct@yahoo.co.in

Dr. Manoranjan Kumar singh
PG Department of Mathematics
Magadh University, Bodhgaya
Gaya, Bihar, India-824234
drmksingh_gaya@yahoo.com

***Abstract* — Algebraic specification is a formal specification approach to deal with data structures in an implementation independent way. Algebraic specification is a technique whereby an object is specified in terms of the relationships between the operations that act on that object. In this paper we are interested in proving facts about specifications, in general, equations of the form t1 = t2 , where t1 and t2 are members of term (∑), being the signature of the specification. One way of executing the specification would be to compute the first algebra for the specification and then to check whether t1 and t2 belong in the same equivalence class. The use of formal specification techniques for software engineering has the advantage that we can reason about the correctness of the software before its construction. Algebraic specification methods can be used for software development to support verifiability, reliability, and usability. The main aim of this research work is to put such intuitive ideas into concrete setting in order for better quality product.**

Keywords- *Abstract data types (ADTs), Formal-Methods, Abstraction, Equational reasoning, Symbolic computation.*

I. INTRODUCTION

A specification can be considered as a kind of contract between the designers of the software and its customers. It describes the obligations and rights of both parties. A specification binds customers and designers by expressing the conditions under which services of a product are legitimate and by defining the results when calling these services. Specifications serve as a mechanism for generating questions. The construction of specifications forces the designers to think about the requirements definition and the intrinsic properties and functionalities of the software system to be designed. In this way the development of specifications helps the designers to better understand these requirements and to detect design inconsistencies, incompleteness and ambiguities in an early stage of software development. Specifications are obviously used for software documentation they describe the abstractions being made. Specifications are a powerful tool in the development of a program module during its software lifecycle. The presence of a good specification helps not only designers but also developers and maintainers. The modularity of the specification serves as a blueprint for the implementation phase, where a program is written in some executable language. In most software projects, the language used is an imperative nature. Unlike specifications, programs deal with implementational details as memory representation, memory management and coding of the system services. Writing a specification must not be seen as a separate phase in the development of software. Also, specification must be adapted each time modifications are introduced in any other phases of the software life cycle. Especially, specifications have to be adapted each time modifications are introduced in any of the other phases of the software life cycle. Especially, specifications have to be updated during the maintenance phase taking into account the evolution of the software system. With regard to the program validation, specifications may be very helpful to collect test cases to form a validation suite for the software system.

Specification must be at the same time compact, complete, consistent, precise and unambiguous. It has turned out that a natural language is not a good candidate as a specification language. In industry a lot of effort has been devoted to writing informal specifications for software systems, but little or no attention is paid to these specifications when they are badly needed during maintenance phase of the software life cycle [1].Specification in natural language rapidly become bulky, even to such extent that nobody has the courage to dig into them. Moreover, such specifications are at many places inaccurate, incomplete and ambiguous. It is very discouraging to discover after a long search that the answer can only be obtained by running the system with the appropriate input data. The tragedy in software development is that once a program modification is made without adapting the corresponding specification, the whole specification effort is lost. Having a non-existent or an obsolete specification is the reason why there exist so many software systems the behavior of which nobody can exactly derive in a reasonable lapse of time. Notice that running the program with the appropriate input can only give partial answers to questions about the system behavior. The entire idea is not to prove informal specification is useless. They are very useful as first hand information about the software product and as a comment to enhance the readability of the formal specifications.

II. RELATED WORK

Formal specifications, unlike the informal ones, enable designer to use rigorous mathematical reasoning. Properties of the specification can be proved to be true just as theorems can be proved in mathematics. In this way design errors, inconsistencies and incompleteness can be detected in an early stage of the software development [2]. Algebraic specification enables the designer to prove certain properties of the design and to prove that implementation meets its specification. Hence algebraic specification is used in a process called rapid prototyping. In a design strategy algebraic specification can be used as top down approach. The notion of top-down means here that specification is treated before any instruction of the implementation is written. The benefit of making constructive formal specification will certainly interest the practitioner, by rapid prototyping designers and customers will get user feedback and hands on experience with the software system before the implementation already gets started. In this way design errors due to misunderstandings between developers and customers, and lack of understanding of the services provided the product can be detected and corrected at an early stage. With the concept of constructive formal specifications and direct implementation, the boundaries between specifications and implementation are not very sharp. Both specifications and implementation are in fact programs, but the former are of a more abstract level than the latter. More over in the life cycle of a software product there may be more than two levels of abstraction [3]. A module may serve as a specification for the lower level and at the same time as an implementation for the higher one.

The following literature reveals the historical review on Algebraic specifications development and its significance.

In the Axiomatic method the behavior of the program is characterized by pre and post conditions. Its pioneers are Floyd, Hoare and Dijkstra.

Another well-known formalism is denotational semantics, especially the use of high order functions is very useful to describe the powerful control structures of programming languages its pioneers are Stoy and Gordon.

The new formalism based on the concept abstract data types has been developed as many sorted algebras and underlying mathematical model, such specifications are called algebraic specifications.

The pioneers of algebraic specifications are Zilles, Guttag, and the ADJ group consisting of Gougen, Thatcher, Wagner and Wright. They all consider a software module representing an ADT as many sorted algebra. The basic argument for the algebraic approach is that software module has exactly the same structure as algebra. The various sorts of data involved form sets and the operations of interest are functions among these sets.

The idea of behavioral equivalence was introduced by Giarratana.Gougen of ADJ research group presented the theory of many sorted algebra. Final algebra semantics were discovered by Wand.

The central idea of Sannella and Tarlecki is based on the fact that much work on algebraic specifications can be done independently of the particular logical system on which the specification formalism is based. The Munich CIP- group represented by Partsch took the class of all algebra fitting to a given specification as its semantics under one category.

The first specification language based on algebraic specifications was CLEAR invented by Burstall, where it was used to serve the needs of few product features.

Later on the concept of parameterized specifications in algebraic specification languages was encouraged the most popular one are ACT ONE founded by Ehrig and OBJ family by Goguen and Futatsugi, both based on many sorted algebra.

Algebraic specification languages may be considered as strongly typed functional languages like HOPE or as rewrite rule by Burstall and Huet. A combination of initial algebra semantics with Horn clause logic resulted in EQLOG and LPG.

The literature related to algebraic specifications discussed here includes topics like correctness, theorem proving, parameter zing, error handling and abstract implementations. Algebraic specification techniques and languages have been successfully applied to the specification of systems ranging from basic data types as stacks and natural numbers to highly sophisticated software systems as graphical programming language and the Unix file system. Algebraic specification techniques are used in wide spectrum of applications which allows the derivation of correct software from formal requirements through design specifications down to machine oriented level using jumps and pointers.

At the moment, many researchers all over the world are involved in research in the field of Algebraic specifications. Algebraic methods in software engineering are one of the fertile areas of research under one popular name Formal methods. Conceptually, algebraic specification provides a framework to formally describe software design. This framework allows for a better understanding of the software development process providing methodological insight concerning different issues. Algebraic specification is a formal specification approach that deals with data structures in an implementation-independent manner.

III. INTUITIVE APPROACH USING ADTS

The aim of the software engineering is to develop software of high quality. By software we mean large programs. Quality sometimes called software engineering criteria are divided into two categories external and internal qualities. The external qualities we are particularly interested in are correctness, robustness, extendibility, reusability and efficiency. The internal qualities are modularity and continuity.

- *Correctness and reliability*: is the ability of the software system to perform its services as defined by its requirements definition and specification.

- *Robustness*: is the ability of a software system to continue to behave reasonably even in abnormal situations.

- *Efficiency*: is the ability of software to make good use of hardware resources and operating system services.

- *Modularity*: is the property of software to be divided into more or less autonomous components connected with a coherent and simple interface. Modularity is not only important at implementation level but also at specification level.

- *Continuity*: is a quality criterion that yields software systems that won't need drastic modifications because of small changes in the requirements definition.

Abstract data type is a class of data structures described by an external view, i.e. available services and properties of these services [4].

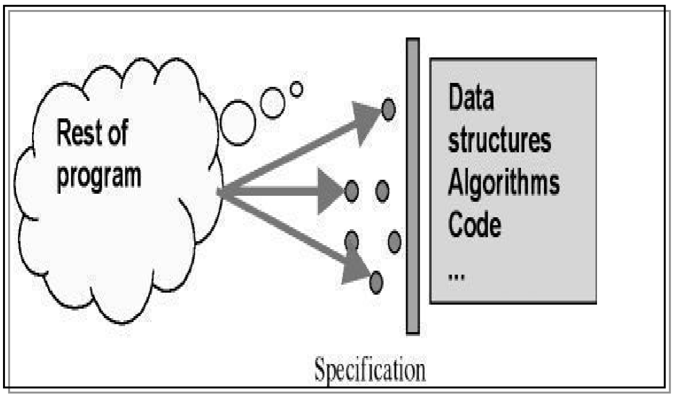

Figure. 1

The notion of an abstract data type is quite simple. It is a set of objects and the operations on those objects. The specification of those operations defines an interface between the abstract data type and the rest of the program. The interface defines the behavior of the operations – what they do, but not how they do it. The specification thus defines an abstraction barrier that isolates the rest of the program from the data structures, algorithms, and code involved in providing a realization of the type abstraction[5].Most of the software engineering methodology has one aspect in common, software is structured around data rather than around functions. The reason for this choice is that functions are not the most stable part of a system.Structuring around data yields systems with a higher degree of continuity and reusability. The key point in structured design of software systems is to look for abstract data types, abbreviated as ADTs. Roughly speaking, a specification of an ADT describes a class of data structures by listing the services available on the data structures, together with the intrinsic properties of these services. By specifying ADT, we do not care how a data structure is actually represented or how each operation is implemented [7]. What matters is what the data structure signifies at the level of a customer who wants to make instantiations of the data type for further use in his program.

To illustrate the concept of ADT, let us take the class of stacks of natural numbers, called stack. The specification of the stack will list the services newstack, push, isnewstack, pop and top. Furthermore, given an object of type stack, it describes how these services must be called for that object and it describes the intrinsic properties of these services. An example of such a property of stack is,

$$\text{pop (push(s, n))} == s; \qquad (1)$$

where s is any stack object and n is any natural number. This property simply expresses that pushing a natural number on a stack s. The identifiers s and n are variables ranging over instantiations that is objects of types stack and Nat respectively.

Writing specification of ADTs is an activity that is located in the design phase of the software life cycle [8]. Specifications are designed in a modular way. Roughly speaking, with each specification module in the design phase corresponds a program module in the implementation phase. Specification modules, unlike program modules, make abstraction of all irrelevant details of data representation and procedure implementation. An important remark is that finding the appropriate set of specification modules is not an easy job. The choice of the modules must be such that complexity of the module interfaces is minimal and that continuity of the software system is maximal. Mostly a trade-off between these criteria has to be strived for. The main reason why we are so interested in modeling ADTs by mathematical objects is that we can profit from rigorous reasoning as defined for these objects. Rigorous reasoning on algebraic specification is based on two important techniques called equational reasoning and induction. Both techniques enable the designer to derive theorems from algebraic specification. These theorems then represent properties of the algebraic specification and of the software system described by it. The fact that such a theorem has been derived implies that the property it represents has been proved to be true. Due to the mathematical foundation of the chosen model, namely many sorted algebras, designers are able to give well defined and implementation independent meanings to ADTs [6]. A many sorted algebra is an abstract structure consisting of a family of sets of objects and a number of functions whose arguments and results belong to these sets. Due to this mathematical frame work, algebraic specifications can be made accurate and unambiguous. Initial algebras are often characterized by their properties of having no junk and having no confusion. Having no junk means that each object of the algebra can be denoted by at least one variable free term. Having no confusion means that two variable free terms denote the same object if they can be proved to be equal by equational reasoning from the given axioms [9]. The general and typical algebra is always initial. In literature, axioms are also called equations, laws or identities, and the terms are sometimes called expressions or formulas.

IV. RESULTS AND DISCUSSIONS

An algebraic specification is a mathematical description of an Abstract data type. Reasoning about the correctness of programs is made possible only by having a way to express their intended behavior. This is the object of algebraic specification -- programs are regarded as algebras consisting of data types and operations, and the intended behavior of a program is specified by means of formulas (say, equations) concerning these operations.

A. Algebraic specification in Rapid prototyping

Let us consider a abstract data type stack formally described by algebraic specification:

```
Sort stack;
operations
        newstack:→ stack;
    push:stack × Nat→stack;
    isnewstack:stack→Bool;
        pop:stack→stack;
    top:stack→Nat;
declare s:stack;   n:Nat;
 axioms
    isnewstack(newstack)= =true;
    isnewstack(push(s,n) = = False;
    pop(newstack)= = newstack;
    pop(push(s,n) = = s;
    top(newstack) = = zero;
    top(push(s,n) = = n;
```

Figure.2

The sort(s) part lists the names of the abstract data types being described. In this example there is only one type, namely stack. The operations part lists the services available on instances of the type stack and syntactically describes how they have to be called. These parts are called the signature of the algebraic specification. For instance,

Push: stack * Nat → stack; (2)

means that push is a function with two arguments, with respective types Stack and Nat, and yields a result of type stack. It is also called constant. The term function here is used in the mathematical sense, not in the context of programming. So functions in the algebraic specification have no side effects. The axioms part formally describes the semantic properties of the algebraic specification. The specification can be applied to any data structure with the services described by functions with the same signature. The algebraic specification of stack expresses only the essential properties of the stack services without over specifying. It makes abstraction from any stack representation and service implementation details. It is the over specification that makes verification and rigorous reasoning difficult. Algebraic specifications provide a computational model with ADTs. As an example of such computations, consider the following expressions,

declare s1, s2 : stack ; n:Nat;

s1: pop(push(push(newstack,5),7));

s2: push(push(push(newstack,0),top(s1)),4);

n:top(pop(pop(s2))); (3)

By applying the axioms, successive simplications may be performed. These algebraic simplifications can be carried out mechanically. After these simplifications are carried out, the above expression becomes:

s1:= push(newstack,5);

Top(s1):= 5;

s2:= push(push(push(newstack,0),5),4);

n:= 0; (4)

This kind of symbolic computation is heavily related to concepts such as constructivity, term rewriting and rapid prototyping.

B. Maintaining the Integrity of the Specifications by Equational reasoning

Equational reasoning is one of the techniques that enable the software developer to use so called rigorous mathematical reasoning. Properties of the specification of the software can be proved to be true, even before the implementation has been started. Such proofs of properties are very similar to proofs of theorems in mathematics. Proofs about specifications of programs serve two purposes. They constitute the program documentation by excellence and they enhance software correctness and reliability. Given a presentation, equational reasoning is the process of deriving new axioms by applying the following rules.

i) Reflexivity : If t is a term of the presentation,

declare <declaration part>

axiom

t= = t;

is derivable by reflexivity if the variables used in the term t are listed in the declaration part.

ii) Symmetry : if the axiom

declare <declaration part>

axiom

t1= = t2;

if given or derivable, then

declare <declaration part>

axiom

t2= = t1;

is derivable.

iii) Transitivity: if the axioms

declare <declaration part>

axiom

t1= = t2;

t2= = t3;

are given or derivable, then

declare <declaration part>

axiom

t1= = t3;

is derivable.

iv). Abstraction:

declare <declaration part>

axiom

t1= = t2;

is given or derivable, x is a variable of sort Sj and x is not declared in the declaration part, then

declare x : Sj; <declaration part>

axiom

t1= = t2;

is derivable.

v) Concretion: if the axiom

declare x : Sj; <declaration part>

axiom

t1= = t2;

is given or derivable, the set of variable- free terms of sort Sj is not empty and x does not appear in t1 nor t2, then

declare <declaration part>

axiom

t1= = t2;

is derivable.

Given a presentation, deriving new axioms by equational reasoning always yields axioms that are satisfied by all algebras of the variety over the presentation. A second important property is that every axiom satisfied by all algebras of the variety over the presentation can be deduced using these rules. This above is a generic discussion that can be applied to any data structure in a software specification to check for consistency and soundness depending on the functionality and applicability.

C. Proof by Induction for technical soundness

Like equational reasoning, induction is a mathematical technique that can be used to derive new axioms from a given presentation. Axioms derivable by equational reasoning are satisfied by every algebra of the variety over the presentation. Axioms derivable by induction will be satisfied by every term algebra of the variety over the given presentation. As equational reasoning, induction is a very important technique to prove theorems of abstract data types. The main idea behind Induction is that one assumes instances of property being proved during its own proof. One of the hardest problems in discovering an inductive proof is finding an appropriate induction scheme that is complete and sound. Let us consider a classical example:

```
Sort Z
Operations
        Zero:  Z→ Z;
        Succ : Z→ Z;
        Pre :  Z→ Z;
        Add : Z* Z→ Z;
declare  i, j : Z;
axioms
        pre(succ(i) = = i;                 - 1 -
        succ(pre(i) = = i;                 - 2-
        add(zero,i) = = i;                  -3-
        add(succ(i),j) = = succ(add(i,j));  -4-
        add(pre(i),j) = = pre(add(i,j);     -5-
```

Figure.3

The presentation in Fig.3 defines the abstract data type of the integers including the successor, predecessor and addition functions. An axiom derivable by induction is the commutativity of the addition:

declare i,j:Z;
axiom

add(j , i) = = add(i, j);

It is provable by induction over j as well as over i.

These are some of the algebraic techniques that are useful in software engineering for verification and validation of specification and enhance confidence early in the lifecycle.

V. CONCLUSION

In this paper a novel concept of abstract data types is proposed through sensible use of mathematics to assist in the process of software development. The algebraic specifications of abstract data types are defined separately on the syntactic level of specifications and on the semantic level of algebras. The main results of the paper are different kinds of correctness criteria which are applied to a number of illustrating examples. Algebraic specification are used here to model prototypes, techniques like Equational reasoning and proof by Induction serve as uniqueness and completeness criteria and provides technical soundness for the specification. Properties of the specification of the software can be proved to be true, even before the implementation of software. Such proofs of properties are very similar to proofs of theorems in mathematics.

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AUTHORS PROFILE

L.Rakesh received his M.Tech in Software Engineering from Sri Jayachamarajendra College of Engineering, Mysore, India in 2001 as an honour student. He is a member of International Association of Computer Science and Information Technology, Singapore. He is also a member of International Association of Engineers, Hong Kong. He is pursuing his Ph.D degree from Magadh University, India. Presently he is working as a Assistant professor and Head of the Department in Computer Science & Engineering, SCT Institute of Technology, Bangalore, India. He has presented and published research papers in various National, International conferences and Journals. His research interests are Formal Methods in Software Engineering, 3G-Wireless Communication, Mobile Computing, Fuzzy Logic and Artificial agents.

Dr.Manoranjan Kumar Singh received his Ph.D degree from Magadh University, India in 1986. This author is Young Scientist awardee from Indian Science Congress Association in 1989. A life member of Indian Mathematical society, Indian Science congress and Bihar Mathematical society. He is also the member of Society of Fuzzy Mathematics and Information Science, I.S.I. Kolkata. He was awarded best lecturer award in 2005. He is currently working as a Senior Reader in post graduation Department of Mathematics, Magadh University. He is having overall teaching experience of 26 years including professional colleges. His major research Interests are in Fuzzy logic, Expert systems, Artificial Intelligence and Computer-Engineering. He has completed successfully Research Project entitled, Some contribution to the theory of Fuzzy Algebraic Structure funded by University Grants Commission, Kolkata region, India. His seminal work contribution to Fuzzification of various Mathematical concepts was awarded prestigious Doctor in Science degree.

Evaluating the impact of information systems on end user performance: A proposed model

Ahed Abugabah, Louis Sanzogni, and Osama Alfarraj
Griffith University, Brisbane, Australia
a.abugabah, L.sanizo, o.alfarraj @griffith.edu.au

Abstract- In the last decades, information systems (IS) researchers have concentrated their efforts in developing and testing models that help with the investigation of IS and user performance in different environments. As a result, a number of models for studying end users' systems utilization and other related issues including system usefulness, system success and user aspects in business organizations have appeared. A synthesized model consolidating three well-known and widely used models in IS research is proposed.

Our model was empirically tested in a sophisticated IS environment investigating the impacts of the enterprise recourse planning (ERP) systems on user perceived performance. Statistical analysis was performed including factors analysis and regression to test the model and prove its validity. The findings demonstrated that the proposed model performed well as most factors had direct and or indirect significant influences on user perceived performance suggesting therefore that the model possesses the ability to explain the main impacts of these factors on ERP users.

Keywords: Information systems, user performance, task technology fit, technology acceptance model.

I. INTRODUCTION

From the mid-nineties, IS researchers have concentrated their research efforts in developing and testing models that help in investigating IS aspects in different environments. As a result, a number of models for studying the systems utilization of end users and other related issues including system use, system success and user aspects in business organizations appeared.

The most commonly used models are, the technology acceptance model (TAM), the task-technology fit model (TTF), and DeLone and McLean (D&M) model. Each model focuses on different aspects and has different perspectives on the impacts of IS on users and or at least follows a specific researcher's goals and purposes. Overall, previous models provide a much-needed theoretical basis for exploring the factors that explain IS utilization and impacts on user performance [16].

This signifies the need for a model that can help understand the relationship between IS and users in different environments. Such a model should encompass different dimensions of IS, technology and users contemporaneously. This would help identify most overall important aspects and shift the focus from less important factors to more important factors that bring new useful ideas to both practitioners and researchers.

This study thus starts with a common argument that the aforementioned models were criticized for different reasons as each one alone tells only a particular part of the story and none of them alone has achieved a universal acceptance in terms of comprehensiveness and suitability to various IS environments. The study also discusses weaknesses among these models and the overlap between them as a basic step to understand a suitable way to integrating them into one more comprehensive and powerful model. For example, we note that the development of new and complex IS, such as ERP systems require different investigative approaches.

II. LITERATURE REVIEW

The difficulty in measuring actual performance led many previous studies to use multiple perspectives and theories to reach more accurate and rigorous results [39], [1]. Thus, we argue that current IS models individually are not broad enough to measure such a relationship as they do only capture a subset of the factors in the broad context of IS, reflecting a common agreement between many researchers [29], [16], [21]. For example, TAM and TTF overlap in a significant way and they could provide a more coherent model if they are integrated, such that model could be even stronger than either standing alone. Recent research on the D & M's model also showed that the model is incomplete and needs to be extended with other factors [29], such as usefulness and the importance of the systems [34].

In light of these facts, especially the difficulty of objectively measuring performance, IS researchers have used these models as surrogate measures to predict users behaviours and IS successes in various types of IS environments and business organizations [35]. For that reason, research on extending, integrating and replicating these models and constructs has been appearing in the IS literature [18], [32].

There are many examples of this, for instance, [32] developed a new model by integrating the user satisfaction model with other variables such as information accuracy, system adequacy and timeliness to investigate user satisfaction in small business. In another instance, [39] extended TAM in order to investigate the actual usage of the systems. [17], integrated TAM and TTF to investigate individual performance because the new model has more significant improvement over either model alone. The integrated model provided more explanatory power than any of these models alone. Later on [18], also proposed a model extending TTF with a computer self-efficacy construct explaining the link between the two models to help managers understand PEOU can be increased.

In a similar vein, [27] extended TAM and TTF in on an internet environment and found support for a model that includes TTF and the TAM to predict actual use and attention to use, others also extended TAM with other variables from IS literature and found support for integrating new variables to new models in different environments [5], [2], [7].

Recently, researchers have started even to expand these models with new factors aiming at developing new models to suit with the advanced and complex IS projects in various industries [23], [26]. [38], used an extended model to study the relationship between TAM variables and actual usage. [41], demonstrated that the extended TAM with initiative IT factors such as facility and compatibility the model possesses the ability to interpret individual behaviour and users' acceptance.

Prior IS models including TAM and TTF were used to carried out research in traditional and relatively simple but important environments, such as spreadsheet software and personal computing [2]. However, with the development and implementation of complex and costly IS that cut across organizational functions, it is clear that there is an increased need for research that examines these models and extends them to a complex IS environment [24].

Despite the large body of existing research on TAM, TTF and D & M's models [21], [28], [20], none of these models have achieved universal acceptance either due to narrowness of focus or inadequately developed methodologies [10]. These largely independent streams of research sparked our interest to explicitly discuss the main weakness in previous models with the goal of combining a new powerful validated model to further the understanding of the relationship between IS and users including performance impacts and systems usefulness [22], [13], [14]. Previous models focused on user acceptance and satisfaction as surrogates to measure the impact of IS on individual user's performance [15], [33], [29]. The argument in support of this approach stems from the difficulty in identifying a set of objective measures to evaluate the benefits of IS to users and organizations [3].

Specifically, a number of important shortcomings plague these models. For instance, TAM is widely employed in IS research, but has been criticized because of lack of task concentration [16], inability to address how other variables affect core TAM variables, such as usefulness [2], over assumptions on voluntary system utilization [22], some explicit recognition that frequent utilization of a system may not lead to higher user's performance and inadequate systems may be evaluated positively by users due to factors such as accessibility, and personal characteristics [22].

Similarly, a major concern about studies conducted using TTF is the inadequate attention given to a very important element related to system quality and usefulness especially when it is known that system usefulness must be evaluated before systems can deliver performance impacts [22].

The D & M's model is one of the most widely applied in IS research. It identifies the complexity that surrounds the definition of IS success offering valuable contributions to the understanding of IS performance impacts and providing a scheme for classifying the different measures of IS. However, researchers have claimed that the D & M's model is incomplete; suggesting that further factors should be included in the model [12], [40], [38], [29].

In view of that, this study developed and statistically validated a new model for examining the impact of IS on user performance. The model combines the core factors from the TAM, TTF and D & M's models (See figure 1 below), thereby achieving a more adequate and accurate measure of user performance.

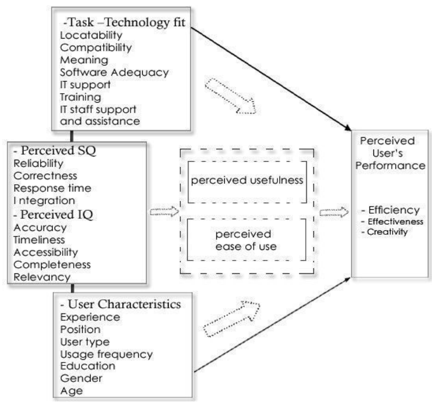

Figure 1. The study model

TAM, TTF and D & M models have been tested in traditional IS environments, the new combined model was tested within an ERP systems environment. This environment was deemed appropriate as ERP systems are large scale systems which contains a range of applications that are used by various types of business organizations.

III. METHODOLOGY

This section describes the methodology used in the study and gives an overview of the pilot study and pretest procedures applied in order to validate the study model.

A. PARTICIPANTS

The respondents numbered 387 ERP users in total from various functional areas in different organizations. Data was collected from the ERP users by means of a written questionnaire. The questionnaire was synthesized after an extensive review of the IS and ERP literature. The questionnaire consisted of two parts, the first part involved demographic questions about the respondents and the frequency of ERP usage, while the second part involved questions about the factors including the fit between the system and task requirements and users' needs, System Quality (SQ), Information Quality (IQ), Perceived Usefulness (PU), Perceived Ease of Use (PEOU) and User Performance (UP). Both five and seven point Likert scales were used (see Appendix 1).

B. PILOT STUDY AND PRE-TEST

Although most of the factors used in the instrument were validated by prior research, the adopted questionnaire was evaluated through a focus group and tested in a pilot study to ensure content and construct validity and also to ensure appropriateness within the context of ERP environments.

The instrument then was distributed to 15 ERP users in three universities to evaluate ERP impacts on their performance. The data from those users was analyzed and the results of the analysis showed a high level of reliability. After ensuring appropriateness of the instrument the main study was conducted.

IV. RESULTS

This section provides the main findings of the study and explains the results of the reliability and validity tests.

A. MULTIVARIATE ASSUMPTION TESTING

A preliminary analysis was performed to check for violations of the assumptions. The assumptions tested included outliers, linearity [25], homoscedasticity [38] and independent residuals [31].

The histogram plots showed some deviations from the normality for some variables, however, these deviations were not significant and they did not show any violations after they were tested using correlation tests.

The results presented in Table 1 show that all values of Durbin-Watson test came very close to 2, meaning no presence of autocorrelation in the residuals. The results also showed that all values are less than one for Cook's distances and close to zero for the leverages thus confirming that no autocorrelation exists [9].

Table 1. Independence and outlier's analysis

Factors	*DV*	*R*	*R^2*	*S.E*	*DW*	*CD*	*CL*
TTF	UP	.63	.40	.88	2.09	.034	.027
TTF	PU	.55	.30	.65	1.85	.155	.027
TTF	PEOU	.64	.41	.68	1.79	.093	.027
IQ	UP	.69	.47	.83	2.10	.037	.024
IQ	PU	.67	.46	.57	1.76	.035	.024
IQ	PEOU	.65	.42	.68	1.93	.076	.024
SQ	UP	.79	.62	.70	2.02	.097	.034
SQ	PU	.61	.37	.62	1.93	.214	.024
SQ	PEOU	.66	.44	.67	1.74	.019	.034
PU	UP	.75	.57	.75	2.10	.155	.035
PEOU	UP	.65	.43	.86	1.93	.027	.017

DW: *Durbin-Watson, CD: Cook's Distance, CL: Centered Leverage, DV: Dependent variables.*

B. COLLINEARITY AND MULTICOLLINEARITY

In practice, the most common level of cut-off points used for determining the presence of multicollinearity are tolerance values of less than .10, or Variable Inflation Factor (VIF) values of above 10 [31]. As illustrated in the Table 2, the tolerance values for all variables were above .10, and VIF values for each variable were less than 10, therefore, the study did not violate the multicollinearity assumption [8].

C. RELIABILITY

The internal consistency reliability was assessed by calculating Cronbach's alpha values. An alpha of .70 or higher is normally considered satisfactory for most purposes [11], [30].

All individual factors, as well as the entire instrument have shown high levels of reliability. The Cronbach's alpha of the study instrument ranges from 0.84 for the usefulness to 0.97 for the user performance indicating high reliability. As summarized in Table 3 in the next section.

Table 2. Cronbach's coefficient for the 52 item instrument and correlation of the study variables

Constructs	Mean	S.D	*Inter correlation between variables***						***Collinearity***	
			TTF	IQ	SQ	PU	PEOU	UP	**Tolerance**	***VIF***
TTF	4.95	.96	**(.90)**						.434	2.304
IQ	3.60	.61	.69	**(.87)**					.327	3.057
SQ	3.30	.64	.65	.69	**(87)**				.389	2.57
PU	3.90	.78	.54	.59	.61	**(84)**			.504	1.983
PEOU	3.30	.89	.62	.63	.67	.54	**(89)**		.457	2.188
UP	4.50	1.14	.61	.61	.76	.75	.65	**(97)**		
TTF: Task technology fit, IQ: information quality, SQ: system quality, PU: perceived usefulness, PEOU: perceived ease of use, UP: user performance.										

* Numbers in Parenthesis represent Cronbach's alpha. **Correlation is significant at the 0.01 level (2-tailed).

D. VALIDITY

Validity is the extent to which a construct measures what is supposed to measure reflecting how truthful the research results are, determining whether the research measures what was intended to measure [19].

Both Convergent and discriminant validity were used to confirm the appropriateness of the measurement obtained for the factors used in the study. The cut-off point used in this analysis was .3, as recommended by [37] and / or [31]. All correlations below this point were considered low. The analysis was conducted for each variable as shown in Table 3 below, followed by a discussion of the analysis results.

.

Table 3. Results of factor analysis*

Factors/Items	Loading	Mean	SD	Factors/Items	Loading	Mean	SD
Task technology fit		4.9	.96	Corr1	.75	3.2	.93
Loc1	.74	5.3	1.39	Corr2	.60	3.3	.92
Loc2	.81	4.9	1.39	Perceived usefulness		3.9	.78
Com2	.74	5.4	1.12	PU1	.69	3.9	.83
Com3	.75	5.3	1.14	PU2	.67	4.2	1.03
ITsub2	.84	4.7	1.33	PU3	.76	3.7	.92
ITsub3	.85	4.8	1.31	PU4	.73	3.7	.98
Ade1	.84	4.8	1.34	Perceived ease of use		3.3	.89
Ade2	.60	4.8	1.36	PEOU1	.72	3.2	1.00
Mea1	.74	4.5	1.30	PEOU2	.85	3.2	.97
Mea2	.78	4.3	1.30	PEOU3	.89	3.4	.98
Information quality		3.6	.61				
Accees1	.71	3.5	.90	User performance		4.5	1.14
Access2	.82	3.4	.91	Effici1	.81	4.6	1.28
Complet1	.50	3.4	.88	Effici2	.77	4.9	1.34
Complet2	.50	3.7	.76	Effici3	.76	4.7	1.29
Tim1	.53	3.6	.86	Effici4	.76	4.6	1.32
Tim2	.69	3.6	.87	Effici5	.65	4.6	1.24
System quality		3.3	.63	Effici6	.78	4.7	1.32
Integ1	.77	3.1	.85	Effici7	.74	4.8	1.35
Integ2	.78	3.3	.83	Effici8	.69	4.7	1.34
Integ3	.58	3.2	.99	Effec1	.715	4.5	1.38
Relia1	.66	3.7	.87	Effec2	.61	4.4	1.32
Relia2	.83	3.6	.79	Effec3	.60	4.7	1.30
Restime1	.73	3.3	.96	Crea1	.91	3.9	1.52
Restime2	.74	3.2	.94	Crea1	.83	3.7	1.57

*Only loadings of 0.5 or above are shown

4.4.1. DISCRIMINANT VALIDITY

We test discriminant validity for a construct using Cronbach's alpha. According to [4], [6] for a construct to be valid its Cronbach's alpha should be greater than its correlation with other constructs. As shown in Table 2 comparison of the correlations with the Cronbach's alphas indicated that this is true for all constructs and thus discriminant validity is satisfied [36].

4.4.2. CONVERGENT VALIDITY

All of the loadings of the constructs' items were higher than the cutoff criteria of 0.50, with most of items above 0.70, demonstrating high construct validity as shown in Table 3. However, two items of the TTF construct (Com1 and ITsub1) did not meet the cutoff criteria and thus were removed from any further analysis.

Similarly, Access3 and Tim3, belonging to the SQ construct were dropped from any further analysis as they did not meet the cutoff criteria.

Accuracy and relevancy were not included in the factor analysis as they were measured by two items only. However, these sub-constructs show high correlation in terms of user performance, so they have been retained in the model.

In relations to UP, one item (Crea 3) was removed from the analysis because it had high loadings with other two sub-constructs and therefore creates ambiguity. To ensure that this item had no adverse effects, the reliability alpha was checked in both cases and showed no significant changes. Lastly, the PEOU and PU were tested. All items had high loadings (< .60) in their perspective constructs suggesting high construct validity.

4.5. MULTIPLE REGRESSION ANALYSIS

A multiple regression analysis was performed to identify the significant contributions of each factor in explaining user performance with ERP systems. The results of the analysis, including significance levels, t-statistics and coefficients for each factor are summarized in Table 4. Three factors, PU, SQ and PEOU were found to be the best predictors of user performance explaining 61% of the variance in user performance. Furthermore, since PU had the strongest impacts on user performance further analysis was conducted to identify factors affecting PU. The analysis yielded a regression function with R^2=0.44, based on all independent variables as summarized in Table 4.

Table 4. Multiple regressions analysis

DV	R^2	IV	Beta	T	Sig
UP	0.61	TTF	.076	1.411	.058
		IQ	-.076	-.250	.077
		PU	.430	11.315	.000
		PEOU	.149	3.620	.000
		SQ	.409	9.228	.000
PU	0.44	TTF	.130	2.293	.022
		SQ	.328	5.877	.000
		IQ	.280	4.714	.000

5. CONCLUSIONS

The study provides insights to a potentially valuable tool for IS researchers and practitioners. The new combined model investigating the relationships between a set of factors including IQ, SQ, TTF and UP shows promise in enhancing the understanding of IS impacts in business organizations related to user performance.

Empirical findings demonstrated the significance of all of these factors but with different relative importance. The findings demonstrated that most factors in the proposed model have direct and/or indirect significant influence on user perceived performance suggesting therefore, that the model possesses the ability to explain the main impacts of these factors on ERP users.

The study shows that the most significant factor influencing user performance is Perceived Usefulness closely followed by system quality. These two factors provide a wider understanding of the factors that impact users when utilizing IS. The study provides a new foundation and draws attention for academic research related to information systems impacts and contributes to the improvement of user performance.

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Corresponding author: Ahed Abugabah
Email: a.abugabah@griffith.edu.au
+61402336029

Appendix 1

Constructs	Measurement items	Source
Task technology fit **		[20], [22]
Locatability	1. It is easy to determine what application is available and where to do my job.	
	2. It is ease to locate the data in the ERP applications that I use.	
Compatibility	1. ERP applications that I use are consistent with my tasks.	
	2. ERP applications fit with my work aspects.	
Meaning	1. The exact meaning of information obtained from the ERP, relating to my task, is easy to find out.	
	2. The correct meaning of the information is obvious and clear on the ERP software	
Adequacy	1. The ERP software that the university has meets my task requirements.	
	2. The ERP software is adequate to handle my work processing needs.	
IT support	1. I get the kind of quality computer-related training that I need.	
	2. The IT people I deal with understand my work objectives.	
	2. It is easy to get IT support and advice from IT people when I use ERP applications.	
Information quality *		[13], [14]
Accuracy	1. Our ERP system provides me with accurate information.	
Relevancy	1. Our ERP system provides relevant information.	
Timeliness	1. Our ERP system provides me with the information I need in a timely manner.	
	2. The information in our ERP system is timely and regularly updated.	
	3. Getting information from our ERP system on time improves my work quality.	
Completeness	1. I can find complete information when I need it in our ERP system.	
	2. The information in our ERP system is sufficient to do my work.	
Accessibility	1. The information in our ERP system is easily accessible.	
	2. Information in our ERP system is easy retrievable.	
	3. Convenience of information in our ERP system saves my time in my job.	
Perceived usefulness *		[5], [12]
	1. Our ERP system is useful for my job performance.	
	2. I can not accomplish my job without the ERP system.	
	3. Our ERP system supports me in attaining my overall performance goals.	
	4. Our ERP system makes it easer to do my job.	
Perceived ease of use*		[5], [12]
	1. Our ERP system is user friendly.	
	2. It is easy to learn how to use our ERP system.	
	3. I find the ERP system is easy to use.	
System quality *		[13], [14]
Reliability	1. Our ERP system is reliable.	
	2. Our ERP system has consistent information.	
Correctness	1. I find it easy to correct the errors related to my work by using our ERP system.	
	2. Our ERP system helps me reduce the errors in my job.	
Response time	1. Our ERP system reacts and responds quickly when I enter the data.	
	2. Our ERP system responds quickly to my inquiries.	
Integration	1. Our ERP system allows for integration with other systems.	
	2. Our ERP system effectively combines data from different areas of the university.	
	3. Our ERP system is designed for all levels of user.	
User performance**		[2], [21], [13]
Efficiency	1. I can accomplish my work quickly because of the ERP system quality.	
	2. Our ERP system lets me do more work than was previously possible.	
	3. Our ERP system has a positive impact on my productivity.	
	4. Our ERP system reduces the time taken to accomplish my tasks.	
	5. Our ERP system increases the cases I perform in my job.	
	6. Using our ERP system in my job enables me to accomplish tasks more quickly.	

	7. Overall, our ERP system improves my efficiency in my job.
	8. Our ERP improves my performance quality.
Effectiveness	1. Our ERP helps me solve my job problems.
	2. Our ERP reduces performance errors in my job.
	2. Our ERP system enhances my effectiveness in my job.
Creativity	1. Our ERP helps me to create new ideas in my job.
	2. Our ERP system enhances my creativity.
	3. Overall our ERP system helps me achieve my job goals.

Network Anomaly Detection via Clustering and Custom Kernel in MSVM

Arvind Mewada
Dept. Of Computer Science
Maulana Azad National Institute of Technology, MANIT
Bhopal, India
mewadatec@yahoo.co.in

Shamaila Khan
Dept. Of Computer Science
RITS, Bhopal, India
shamailabist@gmail.com

Prafful Gedam
Dept. Of Computer Science
Technocrat Institute of Technology, TIT, Bhopal, India
Prafful_it@yahoo.com

***Abstract*—Multiclass Support Vector Machines (MSVM) have been applied to build classifiers, which can help Network Intrusion detection. Beside their high generalization accuracy, the learning time of MSVM classifiers is still a concern when applied into Network intrusion detection systems. This paper speeds up the learning time of MSVM classifiers by reducing the number of support vectors. In this study, we proposed KMSVM method combines the K-means clustering technique with custom kernel in MSVM. Experiments performed on KDD99 dataset using KMSVM method, and the results show that the KMSVM method can speed up the learning time of classifiers by both reducing support vectors and improve the detection rate on testing dataset.**

Keywords-IDS; K-mean; MSVM; RBF; KDD99, Custom Kernel.

I. INTRODUCTION

The intrusion detection system is designed in such a way that any kind of malicious activities in computer network and its resources can be identified and vigilance [1]. *Intrusion Detection Systems* (IDS) are computer programs that tries to perform intrusion detection by comparing observable behavior against suspicious patterns, preferably in real-time. Intrusion is primarily network based activity [2]. The primary aim of Intrusion Detection Systems (IDS) is Monitoring and analyzing both user and system activities, Analyzing system configurations and vulnerabilities, Assessing system and file integrity, Ability to recognize patterns typical of attacks, Analysis of abnormal activity patterns and Tracking user policy violations to protect the availability, confidentiality and integrity of critical networked information systems. IDS can be classified based on which events they monitor, how they collect information and how they deduce from the information that an intrusion has occurred. IDSs that operates on a single workstation are known as host intrusion detection system (HIDS), A HBIDS adds a targeted layer to security to particularly vulnerable or essential systems, it monitors audit trails and system logs for suspicious behaviors [3] while A network-based IDS monitors network traffic for particular network segments or devices and analyzes network, transport, and application protocols to identify suspicious activity. Misuse detection uses the "signatures" of known attacks to identify a matched activity as an attack instance. Misuse detection has low false positive rate, but unable to detect novel attacks. It is more accurate but it lacks the ability to identify the presence of intrusions that do not fit a pre-defined signature, resulting not adaptive [4]. Misuse detection discovers attacks based on patterns extracted from known intrusions [5].

II. SVM/MSVM AND K-MEAN ALGORITHM

A. BINARY CLASS SUPPORT VECTOR MACHINE

The basic principle of SVM is finding the optimal linear hyperplane in the feature space that maximally separates the two target classes. The hyperplane which separates the two classes can be defined as:

$$\omega \cdot x + b = 0$$

Here xk is a group of samples:

$\{(x_1, y_1), (x_2, y_2), \cdots (x_k, y_k)\}, x_k \in R^n, y_k\{-1,1\}$, and

k is the number of styles; n is the input dimension; w and b are nonzero constants [6] [7].

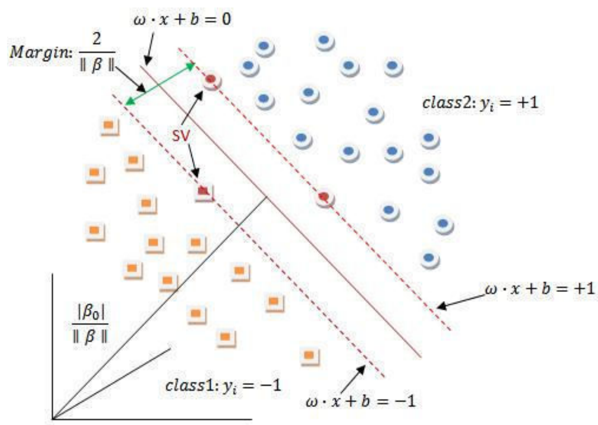

Figure 1. The optimal linear hyperplane (SV=Support vector)

Assume a training set:

$\{(x_1, y_1), (x_2, y_2), \cdots (x_k, y_k)\}, x_k \in R^n, y_k\{-1,1\}$, k is the number of samples. Thus, the problem can be described as:

$$\text{Minimize} \quad \frac{1}{2}\|\omega\|^2 \tag{1}$$

Subject to $y_i(\omega \cdot x_i + b) \geq 1, i = 1,2,\cdots,k$ .This is a quadratic programming (QP) problem. To solve it, we have to introduce Lagrangian:

$$L(\omega, b, \alpha) = \frac{1}{2}(\omega \cdot \omega) - \sum_{i=1}^{k} \alpha_i \{[(x_i \cdot \omega) + b]y_i - 1\} \tag{2}$$

According to the Kuhn-Tucher conditions, we obtain

$$\sum_{i=1}^{k} y_i\,\alpha_i = 0, \omega = \sum_{i=1}^{k} \alpha_i\, y_i x_i \tag{3}$$

With the Lagrange multiplier $\alpha \geq 0$ for all i =1, 2… k. So the dual of equation (1) is:

$$\text{maximize} \sum_{i=1}^{k} \alpha_i - \frac{1}{2}\sum_{i=1}^{k}\sum_{j=1}^{k} \alpha_i\,\alpha_j\; y_i y_j (x_i . x_j) \tag{4}$$

$$\text{subject to} \sum_{i=1}^{k} y_i \alpha_i = 0, \alpha_i \geq 0 (i = 1,2,\cdots,k)$$

For this problem, we also have the complement condition

$\alpha_i\big(y_i(\omega \cdot x_i + b) - 1\big) = 0$.

So the optimal separating hyperplane is the following indicator function:

$$f(x) = \text{sign}\{(\omega \cdot x) + b\} = \text{sign}\left\{\sum_{i=1}^{l} \alpha_i y_i (x_i \cdot x) + b\right\} \tag{5}$$

We can obtain the value of vector ω from (3). In the non-linear problem, it can be solved by extending the original set of variables x in a high dimensional feature space with the map Φ. suppose that input vector x Є Rd is transformed to feature vector Φ (x) by a map Φ: Rd→H, then we can find a function K (R', R') → R that satisfies condition K (xi, xj) = Φ(xi).Φ(xj) , so we can replace the inner-product between two vectors (xi , xj)by K (xi, xj) and the QP problem expressed by (4) becomes:

$$\text{maximize} \sum_{i=1}^{k} \alpha_i - \frac{1}{2}\sum_{i=1}^{k}\sum_{j=1}^{k} \alpha_i\,\alpha_j\; y_i y_j (x_i . x_j) \tag{6}$$

$$\text{subject to} \sum_{i=1}^{k} y_i \alpha_i = 0, \alpha_i \geq 0 (i = 1,2,\cdots,k)$$

The optimal separating hyperplane (5) can be rewritten as:

$$f(x) = \sum_{\text{sup vector}} \alpha_i y_i \Phi(x_i)\Phi(x) + b$$

$$= \sum_{\text{sup vector}} \alpha_i y_i \mathrm{K}(x_i, x) + b \tag{7}$$

B. MULTICLASS SUPPORT VECTOR MACHINE

The multi-class classification problem is commonly solved by decomposition to several binary problems for which the standard SVM can be used. The MSVM can be constructed in two kinds of way: One-Against-All (OAA) and OAO. OAO approach for multi class classification has been shown to perform better than OAA. OAO method constructs k (k −1) / 2 classifiers where each one is trained on data from two classes. For the training data from i-th and j-th classes, we solve the following binary classification problem:

$$\min_{w^{ij}, b^{ij}, \xi^{ij}} \frac{1}{2}(w^{ij})^T w^{ij} + C\sum_t \xi_t^{ij}(w^{ij})^T$$

$$s.t.\ (w^{ij})^T \varphi(x_t) + b^{ij} \geq 1 - \xi_t^{ij}, x_t \text{ belong to i} - \text{th}$$

$$(w^{ij})^T \varphi(x_t) + b^{ij} \leq 1 - \xi_t^{ij}, x_t \text{ belong to j} - \text{th}$$

$$\xi_t^{ij} \geq 0 \tag{8}$$

After all *k* (*k* −1) / 2 classifiers are constructed, we use the following voting strategy to do future test: if $\text{sign}((w^{ij})^T\varphi(x_t) + b^{ij})$ says ***x*** is in the *i*-th class, then the vote for the *i*-th is added by one. Otherwise, the *j*-th increased by one. Then we predict ***x*** is in the class with the largest vote. In case those two classes have identical votes, we simply select the one with the smaller index. Practically we solve the dual of Eq. (8) whose number of variables is the same as the number of data in two classes. Hence if in average each class has *l* / *k* data points, we have to solve *k* (*k* −1) / 2 quadratic programming problems where each of them has about 2*l* / *k* variables.

C. CUSTOM KERNEL AND SUPPORT VECTOR MACHINE

D. K-MEAN ALGORITHAM[21]

K-means is a centroid-based clustering with low time complexity and fast convergence, which is very important in intrusion detection due to the large size of the network traffic audit dataset. Each cluster in profile can be simply expressed as a centroid and an effect influence radius. So a profile record can be represented as the following format

(Centroid, radius, type)

Centroid is a centric vector of the cluster, radius refers to influence range of a data point (represented as the Euclidean distance from the centroid), and type refers to the cluster's category, e.g. normal or attack. We can determine whether a vector is in the cluster or not only by computing the distance between the vector and the centroid and comparing the distance with the radius. If the distance is less than radius, we consider that the vector belongs to the cluster. And then we can label the vector as the cluster's type. Therefore, the whole search in the profile only includes several simple distance calculations, which means we can deal with the data rapidly. Of course, not all clusters can serve as the profile. Some maybe include both normal and attack examples and not fit for the profile apparently. It is necessary to select some clusters according to a strategy. A majority example is an example that belongs to the most frequent class in the cluster. The higher the purity is, the better the cluster is served as a profile. A cluster with small purity means that there are many attacks with different types in the cluster, so we don't select such cluster as our profile. Instead, we use them as the training set for classifier. After the clusters are selected for the profile, we put them into the profile repository. The basic contents include centroid, radius and type. Here, we use the type of majority examples in one cluster as the whole cluster's type regardless of the minority examples.

III. PRAPOSED KMSVM MODEL

To separate attacks from legitimate activities, all of the machine learning based intrusion detection technologies will have two main phases, training procedure and detection procedure. As shown in Fig. 2, in the training procedure of KMSVM, K-mean is used to extract the optimal discriminate support vectors of the whole training data. In MSVM for making decision function needs support vectors other vectors far from decision boundary useless for MSVM

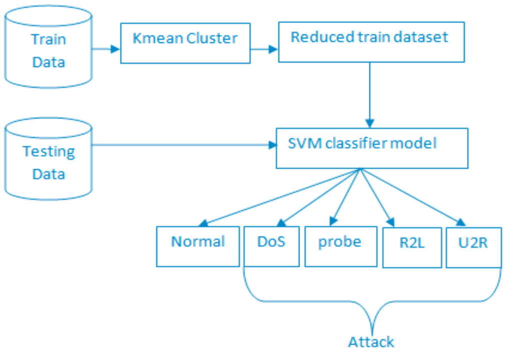

Figure 2. KMSVM model

K-mean clustering algorithm is used to cluster the projected training datasets and remove unused data by using the information provided by the K-mean clustering results, to setup the multiclass SVM detection model. The detection model consists of many binary detection models. Each binary detection model includes two main types of information, the optimal discriminate support vectors extracted from the sub training data by using K-mean and the MSVM classifier based on the projected sub training data. In the detecting procedure, we project the test dataset according to the detection model and then classify the data as normal or malicious by using the detection.

A. KMSVM ALGORITHM

Step 1: three input parameters are selected: the kernel parameter γ, the penalty factor C, and the compression rate CR

Step 2: the K-means clustering algorithm is run on the original data and all cluster centers are regarded as the compressed data for building classifiers

Step 3: SVM classifiers are built on the compressed data

Step 4: three input parameters are adjusted by the heuristic searching strategy proposed in this paper according to a tradeoff between the testing accuracy and the response time

Step 5: return to Step 1 to test the new combination of input parameters and stop if the combination is acceptable according to testing accuracy and response time

Step 6: KMSVM classifiers are represented as the formula in equation (8)

IV. DATASET AND EXPERIMENTS

The KDD Cup 1999 uses a version of the data on which the 1998 DARPA Intrusion Detection Evaluation Program was performed. Each instance in the KDD Cup 1999 datasets contains 41 features that describe a connection. Features 1-9 stands for the basic features of a packet, 10-22 for content features, 23-31 for traffic features and 32-41 for host based features. There are 38 different attack types in training and test data together and these attack types fall into five classes: normal, probe, denial of service (DoS), remote to local (R2L) and user to root (U2R) [14]. In this experiment we use Pentium (IV 3GH) processor, 512 MB RAM, running window XP (SP2) based SVM multiclass [15].The experiment using RBF [16] [17] [18], polynomial and Custom kernel function for intrusion detection (multiclass classification) with parameters as g=0.001, c=0.01, q=50, n=40. Results are shown in below table.

Table1: RBF kernel (confusion matrix)

	normal	Probe	DoS	U2R	R2L
normal	172175	106	0	0	0
Probe	2953	806	301	0	0
DoS	228	0	57721	0	0
U2R	16176	13	0	0	0
R2L	60198	277	75	0	0

Table2: Polynomial kernel (confusion matrix)

	normal	Probe	DoS	U2R	R2L
Normal	156	72	0	0	0
Probe	3529	441	196	0	0
DoS	180309	8	49536	0	0
U2R	16183	6	0	0	0
R2L	60455	102	36	0	11374

Table3: Custom kernel (confusion matrix)

	Normal	Probe	DoS	U2R	R2L
Normal	69	0	159	0	0
Probe	705	0	3461	0	0
DoS	116802	0	113051	0	0
U2R	15361	0	828	0	0
R2L	58637	0	1956	0	0

Above give table 1, table 2 and table 3 show that RBF kernel give good result for class normal, probe and DoS, polynomial kernel gives the best result for R2L and DoS attack and Custom kernel gives best result for DoS class. We used complete dataset for training and testing and got accuracy of multi class support vector machine 73%for whole testing dataset.

V. CONCLUSION AND FUTURE WORK

There are many kernel functions which can be used for intrusion detection purpose. Among those we have conducted experiment using RBF, Polynomial and custom kernel function over MSVM. And found that the RBF kernel function's performance is better for intrusion detection. We can improve over all performance of the MSVM for four types of attack and normal (five classes) by combining above three kernels into one.

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Iris Recognition System

Neha Kak, Rishi Gupta
Computer Science Engineering
Lingayas Institute of Technology and Management
Faridabad, Haryana,INDIA
neha_kak@yahoo.in, rishi26gupta@gmail.com

Sanchit Mahajan
Information Technology
Lingayas Institute of Technology and Management
Faridabad, Haryana,INDIA
sanc_1988@yahoo.com

***Abstract*— In a biometric system a person is identified automatically by processing the unique features that are posed by the individual. Iris Recognition is regarded as the most reliable and accurate biometric identification system available. In Iris Recognition a person is identified by the iris which is the part of eye using pattern matching or image processing using concepts of neural networks. The aim is to identify a person in real time, with high efficiency and accuracy by analysing the random patters visible within the iris if an eye from some distance, by implementing modified Canny edge detector algorithm. The major applications of this technology so far have been: substituting for passports (automated international border crossing); aviation security and controlling access to restricted areas at airports; database access and computer login.**

***Keywords*— iris recognition, biometric identification, pattern recognition, segmentation**

I. INTRODUCTION

Iris recognition is the process of recognizing a person by analyzing the random pattern of the iris (Figure 1). The automated method of iris recognition is relatively young, existing in patent only since 1994.The iris is a muscle within the eye that regulates the size of the pupil, controlling the amount of light that enters the eye. It is the coloured portion of the eye with colouring based on the amount of melatonin pigment within the muscle (Figure 2).[2]

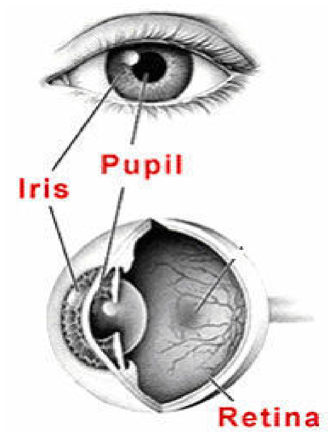


Figure.1 Human Eye

Figure.2 Colored porton of eye

II .THE IRIS AS A BIOMETRICS

The iris is an overt body that is available for remote assessment with the aid of a machine vision system to do automated iris recognition.

A. Iris recognition technology combines computer vision, pattern recognition, statistical inference, and optics.
B. The spatial patterns that are apparent in the human iris are highly distinctive to an individual.
    - Clinical observation
    - Developmental biology

Although the coloration and structure of the iris is genetically linked, the details of the pattern are not. The iris develops during prenatal growth through a process of tight forming and folding of the tissue membrane. Prior to birth, degeneration occurs, resulting in the pupil opening and the random, unique patterns of the iris. Although genetically identical, an individual's irides are unique and structurally distinct, which allows for it to be used for recognition purposes. [1][2]

III. METHODOLOGY

The system is to be composed of a number of sub-systems, which correspond to each stage of iris recognition. These stages are:

- Image acquisition-capturing eye image
- segmentation – locating the iris region in an eye image
- normalization – creating a dimensionally consistent representation of the iris region
- feature encoding – creating a template containing only the most discriminating features of the iris.[9][2]

The input to the system will be an eye image, and the output will be an iris template, which will provide a mathematical representation of the iris region.[2]

IV. IMAGE ACQUISITION

The iris image should be rich in iris texture as the feature extraction stage depends upon the image quality. Thus, the image is acquired by 3CCD camera placed at a distance of approximately 9 cm from the user eye. The approximate distance between the user and the source of light is about 12 cm. The image acquisition setup is given in Figure 1. The following attentions have been taken care at the time of grabbing the image

- High resolution and good sharpness: It is necessary for the accurate detection of outer and inner circle boundaries
- Good lighting condition: The system of diffused light is used to prevent spotlight effect[10]

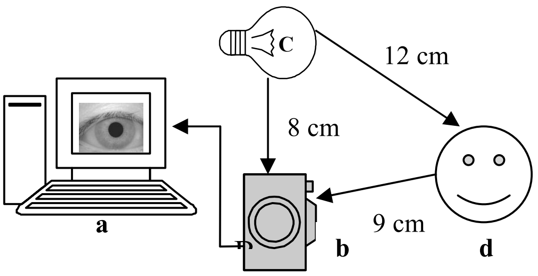
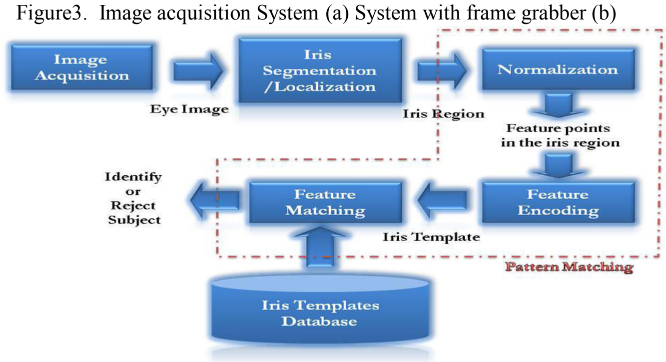


Figure3. Image acquisition System (a) System with frame grabber (b)



CCD Camera (c) Light Source (d) User

Figure4. Schematic diagram of iris recognition

V. SEGMENTATION

The first stage of iris recognition is to isolate the actual iris region in a digital eye image. The iris region, shown in the above figure, can be approximated by two circles, one for the iris/sclera boundary and another, interior to the first, for the iris/pupil boundary.[5][6]

The success of segmentation depends on the imaging quality of eye images. The center of pupil can be used to detect the outer radius of iris patterns. The iris inner and outer boundaries are located by finding the edge image using the Canny edge detector [6].

VI. MODIFIED CANNY EDGE DETECTOR

The algorithm runs in 5 separate steps:

1. Smoothing: Filtering and blurring of the image to remove noise, such that pixels creating indifferent spots can be reduced.

Figure4. Blurred and filtered image

2. Finding gradients: At the points/pixels where colour pattern falls in the similar threshold region are grouped together.

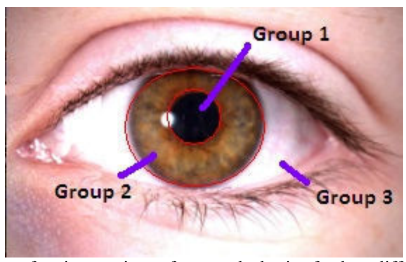


Figure5 Grouping of various regions of eye on the basis of colour differences.

The edges should be marked where the gradients of the image has large magnitudes.

3. Non-maximum suppression: The image portion to be processed is non linear and circular or convex hence, boundary region matching the closets shape is taken out for only local maxima and then should be marked as edges.

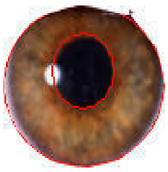


Figure6. Crop out portion of eye that needs processing.

4. Double thresholding: Potential edges are determined by thresholding.

5. Edge tracking by hysteresis: Final edges are determined by suppressing all edges that
are not connected to a very certain (strong) edge.[12]

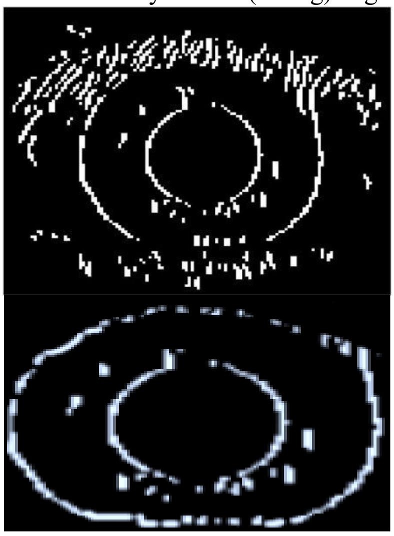


Fig-7. Canny edge image with result of modified image using algorithm.

VII. HOUGH TRANSFORM

The Hough transform is a standard computer vision algorithm that can be used to determine the parameters of simple geometric objects, such as lines and circles, present in an image. The circular Hough transform can be employed to deduce the radius and centre coordinates of the pupil and iris regions.[1][7]

Firstly, an edge map is generated by calculating the first derivatives of intensity values in an eye image and then thresholding the result. From the edge map, votes are cast in Hough space for the parameters of circles passing through each edge point. These parameters are the centre coordinates x_c and y_c, and the radius r, which are able to define any circle according to the equation

$$x^2_C + y2_C - r^2 = 0 \quad (1)$$

(a) (b) (c)

Figure 8 (a) Contrast enhanced image

(b) Concentric circles of different radii

(c) Localized Iris image

VIII. IMAGE NORMALIZATION

Once the iris region is segmented, the next stage is to normalize this part, to enable generation of the iris code and their comparisons. Since variations in the eye, like optical size of the iris, position of pupil in the iris, and the iris orientation change person to person, it is required to normalize the iris image, so that the representation is common to all, with similar dimensions.[8]

Normalization process involves unwrapping the iris and converting it into its polar equivalent. It is done using Daugman's Rubber sheet model. The centre of the pupil is considered as the reference point and a Remapping formula is used to convert the points on the Cartesian scale to the polar scale.

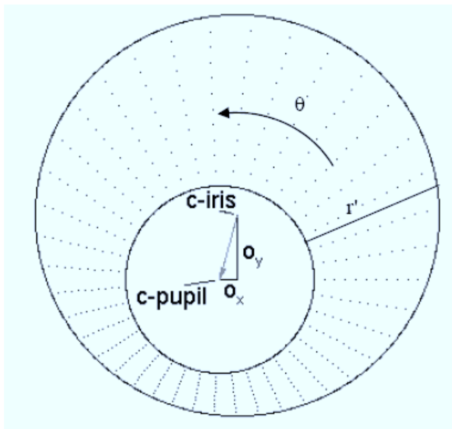


Figure 9: Normalization process

$$r' = \sqrt{\alpha}\beta \pm \sqrt{\alpha\beta^2 - \alpha - r_I^2} \quad (2)$$

Where r1 = iris radius

$$\alpha = o_x^2 + o_y^2$$

$$\beta = \cos\left(\pi - \arctan\left(\frac{o_y}{o_x}\right) - \theta\right) \quad (3)$$

The radial resolution was set to 100 and the angular resolution to 2400 pixels. For every pixel in the iris, an equivalent position is found out on polar axes.[8]The normalized image was then interpolated into the size of the original image, by using the interp2 function. The parts in the normalized image which yield a NaN, are divided by the sum to get a normalized value.[8][5]

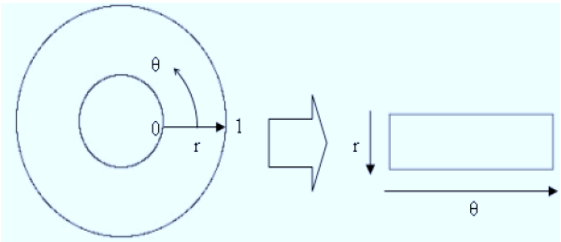


Figure 8 : Unwrapping the iris

IX ENCODING

The final process is the generation of the iris code. For

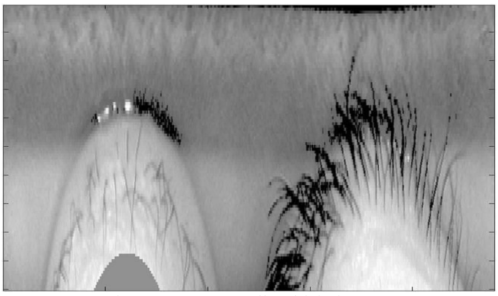


Figure 10: Normalized iris image

this, the most discriminating feature in the iris pattern is extracted. The phase information in the pattern only is used because the phase angles are assigned regardless of the image contrast.[10] Amplitude information is not used since it depends on extraneous factors. Extraction of the phase information, according to Daugman, is done using 2D Gabor wavelets. It determines which quadrant the resulting phasor lies using the wavelet:

$$h_{\{Re,Im\}} = \mathrm{sgn}_{\{Re,Im\}} \int_\rho \int_\phi I(\rho,\phi) e^{-i\omega(\theta_0-\phi)} \cdot e^{-(r_0-\rho)^2/\alpha^2} e^{-(\theta_0-\phi)^2/\beta^2} \rho d\rho d\phi \qquad (4)$$

where, $h_{\{Re,Im\}}$ has the real and imaginary part, each having the value 1 or 0, depending on which quadrant it lies in.

An easier way of using the Gabor filter is by breaking up the 2D normalized pattern into a number of 1D wavelets, and then these signals are convolved with 1D Gabor wavelets.[8]

Gabor filters are used to extract localized frequency information. But, due to a few of its limitations, log-Gabor filters are more widely used for coding natural images. It was suggested by Field, that the log filters (which use Gaussian transfer functions viewed on a logarithmic scale) can code natural images better than Gabor filters (viewed on a linear scale). Statistics of natural images indicate the presence of high-frequency components.[1][8] Since the ordinary Gabor filters under-represent high frequency components, the log filters become a better choice. LogGabor filters are constructed using

$$G(f) = \exp\left(\frac{-(\log(f/f_0))^2}{2(\log(\sigma/f_0))^2} \right) \qquad (5)$$

X. PATTERN MATCHING

- Purpose: to establish a precise correspondence between characteristic structures across the two images.
- Both of the systems under discussion compensate for image shift, scaling, and rotation.
- For both systems, iris localization is charged with isolating an iris in a larger acquired image and thereby accomplishes alignment for image shift.

In pattern matching of pixels with the databases will be done using the following algorithm:

An emerging technique in this particular application area is the use of Artificial Neural Network implementations with networks employing specific guides (learning rules) to update the links (weights) between their nodes. Such networks can be fed the data from the graphic analysis of the input picture and trained to output characters in one or another form. Specifically some network models use a set of desired outputs to compare with the output and compute an error to make use of in adjusting their weights. Such learning rules are termed as Supervised Learning.

XI. BACK PROPAGATION

Back propagation, or propagation of error, is a common method of teaching artificial neural networks how to perform a given task. It requires a teacher that knows, or can calculate, the desired output for any given input. It is most useful for feed-forward networks (networks that have no feedback, or simply, that have no connections that loop).[13] The term is an abbreviation for "backwards propagation of errors". Back propagation requires that the activation function used by the artificial neurons (or "nodes") is differentiable. It has two phases:

1. Training

2. Testing

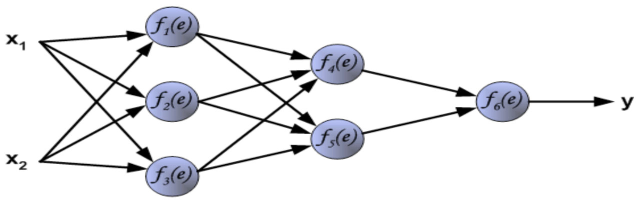


Figure11. Three layer neural network with two inputs and one output

Each neuron is composed of two units. First unit adds products of weights coefficients and input signals. The second unit realise nonlinear function, called neuron activation function. Signal *e* is adder output signal, and $y = f(e)$ is output signal of nonlinear element. Signal *y* is also output signal of neuron.

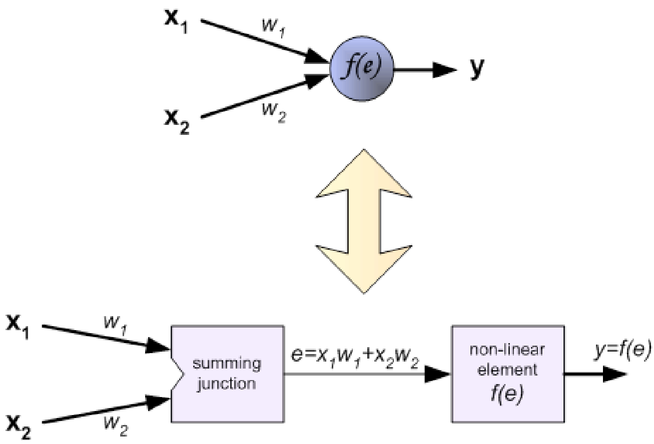


Figure12 Functioning of system with weights.

To teach the neural network we need training data set. The training data set consists of input signals (x_1 and x_2) assigned with corresponding target (desired output) *z*.

The first method is to start teaching process with large value of the parameter. While weights coefficients are being established the parameter is being decreased gradually. The second, more complicated, method starts teaching with small parameter value.[13]

Back propagation Algorithm

Actual algorithm for a 3-layer network (only one hidden layer):

Initialize the weights in the network (often randomly)

Do

For each example e in the training set

O = neural-net-output(network, e) ; forward pass

T = teacher output for e

Calculate error (T - O) at the output units

Compute delta_wh for all weights from hidden layer to output layer ; backward pass

Compute delta_wi for all weights from input layer to hidden layer ; backward pass continued

Update the weights in the network

Until all examples classified correctly or stopping criterion satisfied Return the network[14]

XII. APPLICATIONS

- Today's e-security is in critical need of finding accurate, secure and cost-effective alternatives to passwords and personal identification numbers (PIN) as financial losses increase dramatically year over year from computer-based fraud such as computer hacking and identity theft . [3]

- Biometric solutions address these fundamental problems, because an individual's biometric data is unique and cannot be transferred and therefore can be used for identifying a person or verifying the identity of a person.

- For an enterprise, biometrics provides value in two ways. First, a biometric device automates entry into secure locations, relieving or at least reducing the need for full-time monitoring by personnel. Second, when rolled into an authentication scheme, biometrics adds a strong layer of verification for user names and passwords.

- Biometrics adds a unique identifier to network authentication, one that is extremely difficult to duplicate. Smart cards and tokens also provide a unique identifier, but biometrics has an advantage over these devices.

- It is being implemented and substituted for passports (automated international border crossing), aviation security and controlling access to restricted areas at airports, database access and computer login, premises access control.[3]

XIII WORK CITED:

We have developed this recognition system as our major project in our final year. In the project we used canny edge and Hough transform algorithms to find the iris region. After that we applied the Daugman's algorithm to convert the circular region into rectangular block.

Backpropogation algorithm was developed on our own in which we developed a network taking input images as the normalised images obtained from normalization process.

One of the images from the database was used as the main image for iris comparison. In testing phase we tested whether the main image was there in our database or not using the trained algorithm. If the image was found then the recognition system was a success otherwise backpropogation would start training the network again.

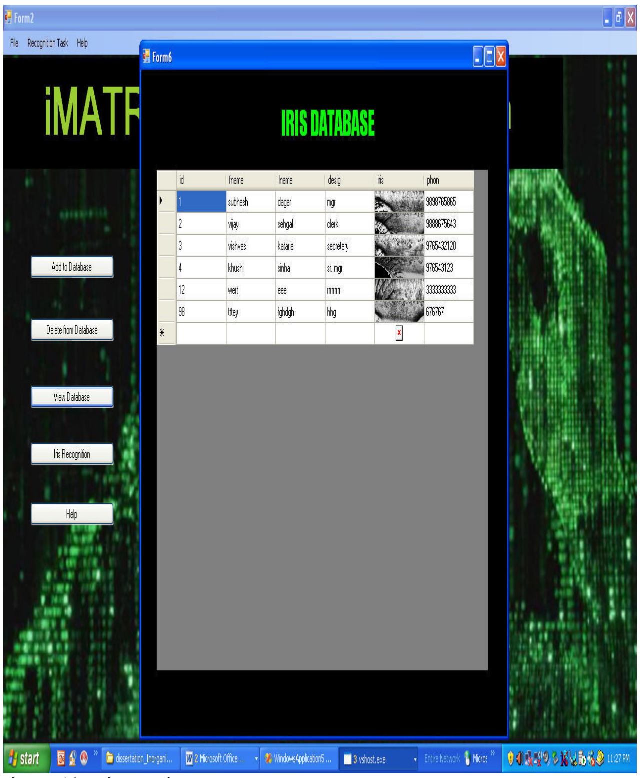


Figure 13: Iris Database

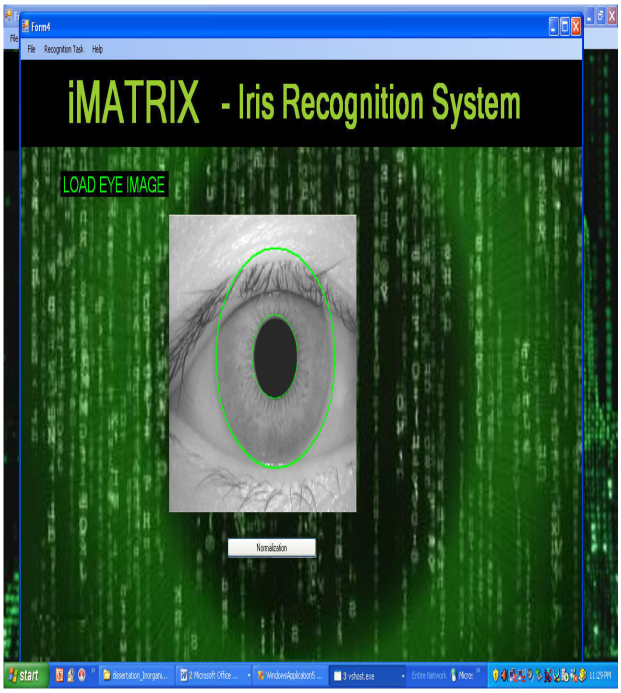


Figure 14: Loading image from data base

Figure 15: Iris Recognition

XIV. CONCLUSION

In this paper we have analysed how the network behaves when an input is given and for that error rate specified was. The network has been trained and tested for a number of eye images. our project is a system that can take a image(as input of human eye) and can distinguish between pupillary body and iris part of the human eye. For this we had used different mathematical functions and calculations to detect various eye boundaries and it encircles outer boundary of pupil which is inner boundary for the iris using modified Canny edge detector algorithm. After this the detection of outer boundary of the iris is done. The development tool used is c# using windows application, matlab and emphasis is given on software for performing recognition, and not hardware for capturing an eye image.

A. Performance Observation.

1. Increasing the number of images in the training network generally slowed down the learning rate.

2. The size of the input states is also another direct factor influencing the performance. It is natural that the more number of input symbol set the network is required to be trained for the more it is susceptible for error.

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AUTHORS PROFILE

Neha Kak, a final year Computer Science student at Lingaya's Institute of Mngt. & Tech., Faridabad, Haryana, India. Areas of interests include DBMS, data warehouse and data mining, Web Technologies.

Rishi Gupta, a final year Computer Science student at Lingaya's Institute of Mngt. & Tech., Faridabad, Haryana, India. Subjects under study includes Computer networks, operating systems, Image processing.

Sanchit Mahajan, a final year information technology student at Lingaya's Institute of Mngt. & Tech., Faridabad, Haryana, India. Subjects are DBMS, CN, OS, Image processing, A.I.

RADIO FREQUENCY IDENTIFICATION BASED LIBRARY MANAGEMENT SYSTEM

Priyanka Grover and Anshul Ahuja
Information Technology Engg.
Lingaya's Institute of Mngt. & Tech,
India
priyanka_grover88@yahoo.co.in, anshul1311@yahoo.com

Abstract— **Radio frequency identification (RFID) is a term that is used to describe a system that transfers the identity of an object or person wirelessly, using radio waves. It falls under the category of automatic identification technologies. This paper proposes RFID Based Library Management System that would allow fast transaction flow and will make easy to handle the issue and return of books from the library without much intervention of manual book keeping. The proposed system is based on RFID readers and passive RFID tags that are able to electronically store information that can be read with the help of the RFID reader. This system would be able to issue and return books via RFID tags and also calculates the corresponding fine associated with the time period of the absence of the book from the library database.**

Keywords- Radio frequency identification technology; RFID Readers; RFID Tags; Inductive Coupling

I - INTRODUCTION

Radio-frequency identification (RFID) is an automatic identification method, which can store and remotely retrieve data using devices called RFID tags. [1] The technology requires cooperation of RFID reader and RFID tag. The RFID based LMS facilitates the fast issuing, reissuing and returning of books with the help of RFID enabled modules. It directly provides the book information and library member information to the library management system and does not need the manual typing. This technology has slowly begun to replace the traditional barcodes [8] on library items and has advantages as well as disadvantages over existing barcodes [2].The RFID tag can contain identifying information, such as a book's title or code, without having to be pointed to a separate database. The information is read by an RFID reader, which replaces the standard barcode reader commonly found at a library's circulation desk. For which utmost care has been taken to remove manual book keeping of records, reduce time consumption as line of sight and manual interaction are not needed for RFID-tag reading and improve utilization of resources like manpower, infrastructure etc.

The remainder of this paper is organized into following sections:

Section 2 briefly reviews the concept of RFID technology, components of RFID and operating principles of these systems; Section 3 gives the details of the methodology used for implementing the system; Sector 4 draws the conclusion about the robustness of the technology.

Background and Related Work

There is a boom in the industry to use RFID technology in the recent years. Research and development in this field has made this technology to be used in supply chain management, attendance management, library management, automated toll collection etc.

There are multiple RFID standards being used in the industry. The existence of these multiple standards helps the users of this technology to choose between various standards and choose the approach which best suits them and then implement it for communication between an interrogator (RFID reader) and the RFID tag.

In more specific terms relating RFID to library, RFID in libraries was first developed and was proposed to the world in the late 1990s. RFID technology aimed at increasing the overall workflow in the library to the maximum as possible and to make everything like book issuing to book returning automatic. Singapore [4] was the first country to introduce RFID in libraries and the Rockefeller University in New York was the first academic library in the U.S to make use of this technology. Farmington Community Library was the first public institution to use the RFID technology. Both Rockefellers University and Farmington started using RFID in 1999. In Europe, the first public library to use RFID is the Hoogezand-Sappemeer, the Netherlands, in 2001, where borrowers were given options. It was proved in a survey that 70% people adapted to the RFID technology quickly.

Overall, RFID technology is used in United States the most and then in United Kingdom and then in Japan.

But there is an issue that this technology is still costly in today's market for the smaller organizations as compared to the larger organizations.

II - LOGIC BEHIND THE SYSTEM

A. Concept

The concept [6][7] of RFID can be viewed as an extension to electronic barcode[8], which can be used to identify, track, or detect holdings in the daily maintenance of library. This system, consist of smart RFID tags, that provides libraries with more effective way of managing their collections while providing greater customer service to their users. The technology works on small and thin tags, which allows it to be placed on the inside cover of each book in a library's collection. The tag consists of an antenna and a tiny chip which stores small amount of data to identify each item. These tags are applied directly on library books and can be read with a RFID Reader. Line of sight is not essential for reading the tags with the reader, therefore, the books require much less human handling to be read and processed. Server software integrates the reader hardware with the Library Automation Software for seamless functioning of book keeping. The information contained on microchips in the tags affixed to library materials is read using radio signals regardless of item orientation or alignment. It provides a wireless data link, without need for line of sight. In addition to tags, an RFID system requires a means for reading or "interrogating" the tags to obtain the stored data and then some means of communicating this tag data to library information system. RFID tag's listen for a radio query from the reader and respond by transmitting their unique ID code. When the data stored in the chip inside the tag is transmitted to the reader, the reader stores this data in a log file. This log file is read by the Server's Library Automation Software and this data is, in turn, stored in the database that resides in the server.

B. *Components*

RFID system consists of following four components [2]:

- RFID tags
- RFID readers
- Antenna
- Server

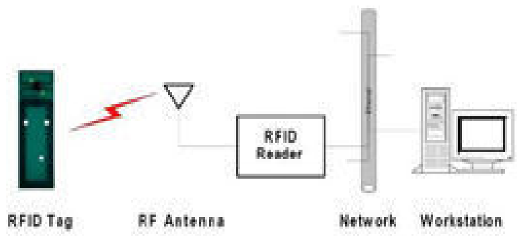

Figure 1. RFID Components

RFID Tags**:** Tags are thin labels which can be fixed inside a book's back cover. RFID tags are made up of carbonic structure which contains a magnetic strip or coil layer inside the tag which helps in sensing the tags. This magnetic layer inside the tag helps in generating the magnetic field. In the figure shown, the tag contains a unique serial number like "0600394791 000345" which is used for the authentication of the user.

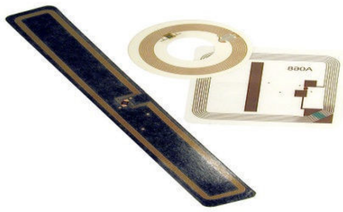

Figure 2. RFID Tags

When we bring the tag in front of the reader or in a close proximity of the reader, the reader antenna senses the tag and checks for the unique serial number of the tag. If the tag is registered in the reader's database then the reader authenticates the tag otherwise the reader shows an error and gives the message that the tag is not registered or the tag is not authenticated.

There are three types of tags: read only, WORM, and read/write. Tags are "read only" if the identification is encoded at the time of manufacture and not rewritable. "WORM" (Write-Once-Read-Many) tags are programmed by the using organization, but without the ability to rewrite the data in them later. "Read/write tags," provides the ability to change existing information in the tag or to add new information in it when some editing is needed.

RFID Readers: RFID readers are used to interrogate data stored in tags. It contains a radio frequency module, a control unit and an antenna to interrogate electronic tags via radio signals. The antenna inside the reader generates electromagnetic field. When a tag passes through the field, the information stored on the chip in the tag is interpreted by the reader and sent to the server, which, in turn, stores or retrieves information about the book's issue or return.

Figure 3. RFID Reader

Antenna: The antenna resides inside the reader. It generates electromagnetic field. Whenever a tag comes in close proximity of the electromagnetic field it gets activated and it is able to read and write data to the reader by producing radio signals. Antenna behaves like a communication media between the tag and the reader.

Server: Server is a computer that contains a database where information related to book's issue and return are stored and this information can be retrieved when needed. Server connected to the reader via a cable. It receives information from the readers when the tag is brought in close proximity of the reader.

C. Operating Principle

Inductive Coupling: Inductive Coupling is the transfer of energy from one circuit to another through a shared magnetic field which is produced due to mutual inductance between two circuits. In RFID systems based on inductive coupling, the reader antenna and the tag antenna each consists of a coil. An electric current passing through the coil of reader's antenna generates a magnetic field that induces an electric current in the coil present in the tag which is exposed to that field. Inductively coupled tags are said to be operated passively because all the energy required to activate the tag is provided by the reader. Tag does not contain any source for power supply to activate itself. When the tag is in the close proximity of the reader, the magnetic field emitted by the reader penetrates the coil of the tag. The tag then takes energy from this filed. By mutual inductance between the tag and the reader, a voltage is generated in the tag's coil. This voltage serves as the power supply for the microchip carrying the data which is present inside the tag. This voltage is used by the microchip to change the electrical load on the tag antenna. These changes are recorded by the reader antenna and are converted into a unique serial number. This data is stored in the reader's log file as the data read from the tag. Server connected to the reader then takes up this data for processing through Library Automation System.

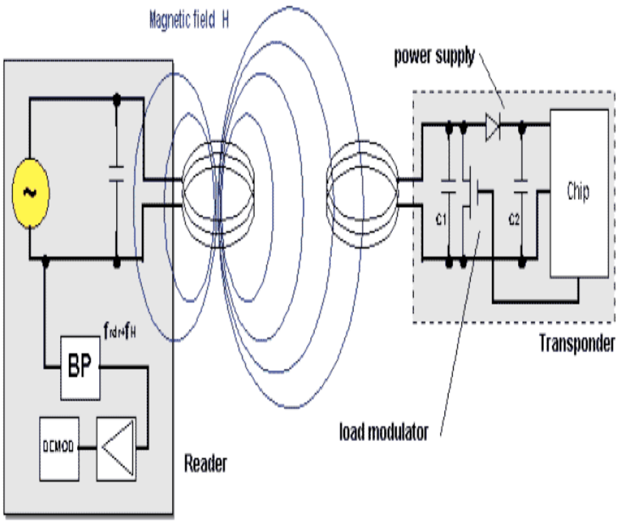

Figure 4. Inductive Coupling: Electromagnetic Field Generated Between Tags and Reader

The above figure describes inductive coupling [9] [10]. A capacitor is connected in parallel with the reader's antenna coil. The capacitor has capacitance such that it is compatible with the coil inductance of the antenna coil to form a parallel resonant circuit, with a resonant frequency that corresponds with the transmission frequency of the reader. The resonance step-up in the parallel resonant circuit generates high current in the antenna coil of the reader, which can be used to generate the required magnetic field to activate the remote tag. The antenna coil of the tag and the capacitor C1 to form a resonant circuit tuned to the transmission frequency of the reader. The voltage U in the tag coil reaches a maximum due to resonance step-up in the parallel resonant circuit.

The efficiency of power transfer between the antenna coil of the reader and the tag is proportional to the operating frequency f, the number of windings n, the area A enclosed by the transponder coil, the angle of the two coils relative to each other and the distance between the two coils. Generally, the operating frequencies up to 135 KHz are used. As frequency f increases, the required coil inductance of the tag coil, and thus the number of windings n decreases. Because the voltage induced in the tag is still proportional to frequency f, the reduced number of windings barely affects the efficiency of power transfer at higher frequencies.

III - METHODOLOGY

The process involved is divided into a total of five modules that are described as follows [3]:

A. Module 1 The Initial Setup

Whenever a new book is acquired by the library, an RFID tag is attached into the book with the relevant information like, call number, accession number, book number, etc. The detailed information regarding the book is also captured in the computer database. The computer database also stores all information for individual users (patrons) of the library. Each patron is supplied with registered RFID cards. These cards carry identification data and other associated details like: address, roll no., and telephone no. etc for each patron.

B. Module 2 The Login Process

There is an administrator with special privileges who has a unique master password controlling the GUI of the RFID LMS system. As soon as he powers on the system, the first screen displays the LOGIN dialogue box. The admin then enters the corresponding password and enables the system for further usage [5].

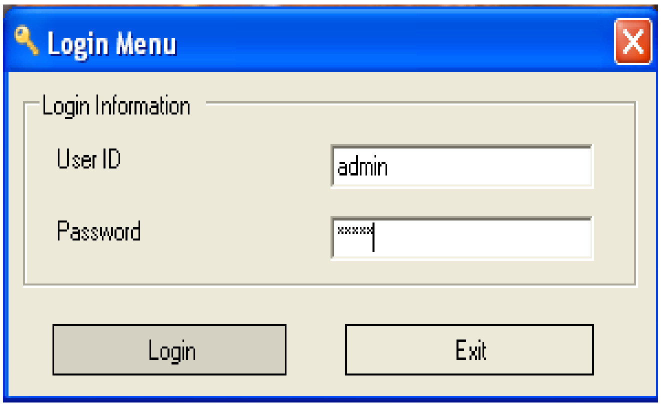

Figure 5. Login Page for Administrator

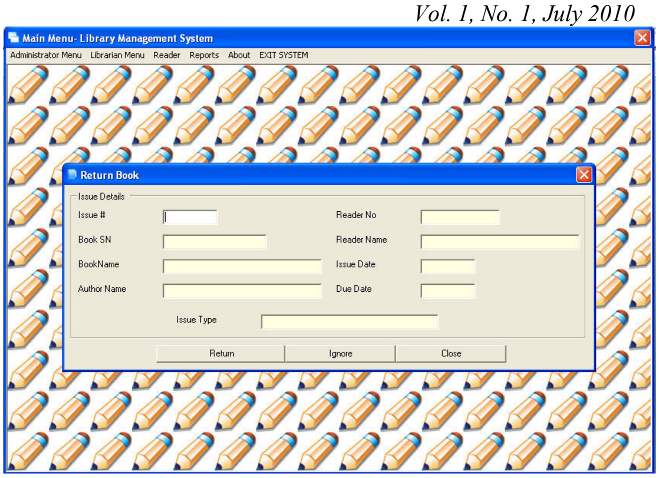

Figure 7. Return of Books

C. Module 3 The Issue Process

When a patron needs to get a book issued, he can get it done without any manual intervention. He simply flashes RFID card in front of the RFID reader and it automatically opens his/her login account page. He then flashes the selected books to be issued, one by one in front of the RFID reader. The computer records all these data against his name. Finally a message is displayed informing the patron that the ISSUE has been successful [9]. The user takes the books for a specified time from the library after which he has to return the books to the library.

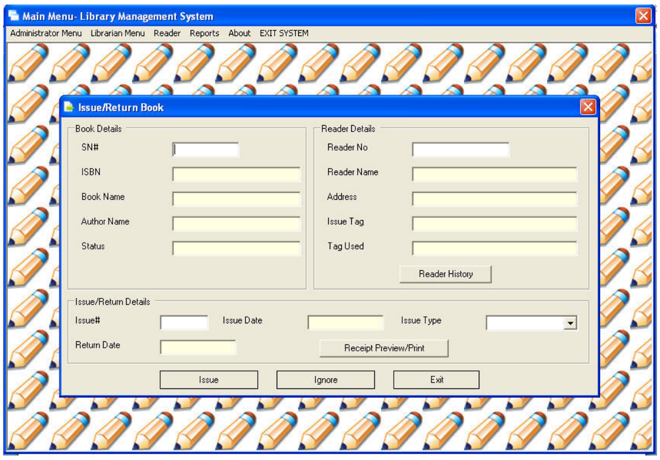

Figure 6. Issue of Books

D. Module 4 The Return Process

When a patron wants to return books, he simply places the books again in front of the RFID controller and the books automatically are adjusted for return against the patron's name[9].

E. Module 5 Fine Calculation

When a patron wants to return books, he simply places the books again in front of the RFID controller and the books automatically are adjusted for return against the patron's name. For this the patron during the time of returning the book, clicks or activates the fine calculation button on the display area or GUI panel. The same returns the fine.

IV - CONCLUSION

Radio Frequency Identification (RFID) Systems have been in use in libraries for book identification, for self checkout, for anti-theft control, for inventory control, and for the sorting and conveying of library books. These applications can lead to significant savings in labor costs, enhance customer service, lower book theft and provide a constant record update of new collections of books.

It also speeds up book borrowing, returning and monitoring, and thus frees staff from doing manual work so that they could be used to enhance user-services task. The efficiency of the system depends upon the information to be written in tag. To yield best performance, RFID readers and RFID tags to be used must be of good quality.

ACKNOWLEDGMENT

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AUTHOR'S PROFILE

Priyanka Grover, a final year information technology student at Lingaya's Institute of Mngt. & Tech., Faridabad, Haryana, India. Her areas of interests include database management system, data warehouse and data mining, network programming and computer networks.

Anshul Ahuja, a final year information technology student at Lingaya's Institute of Mngt. & Tech., Faridabad, Haryana, India. His areas of interests include computer networks, internet fundamentals, database mngt. system, and data warehouse and data mining.

PC And Speech Recognition Based Electrical Device Control

Sanchit Dua
IT LIMAT, Faridabad
India
Sanchit_dua@yahoo.com, sanchit_dua@in.com

Abstract– **controlling of various appliances using PC. It consist a circuit for using the printer port of a PC, for control application using software and some interface hardware. The interface circuit along with the given software can be used with the printer port of any PC for controlling up to eight equipments. Parallel port is a simple and inexpensive tool for building computer controlled devices and projects. The simplicity and ease of programming makes parallel port popular.**

Index terms: Electronic device controller, Diode, Transformer

I. INTRODUCTION

We are controlling electrical devices connected with PC parallel port, either by wired link or wireless (optional) link. The output from parallel port of PC is TTL i.e. 5V. It is not advisible to drive the load relay directly to the PC parallel port as the current at this point is quite low. Thus we have to connect a relay driver circuit with this.

The software in VB or .Net will access the input from the microphone and the devices connected to the parallel port will get operated with this.

The software initially get it trained to recognize a particular word say 'one' or 'two', the project according to this will sense the mic. Input provided and the device corresponding to that voice will get activated from the parallel port output.

The relay driver unit consist of a regulated power supply and a single transistor operated simple relay switching circuit. When the TTL logic 1 comes from PC, the transistor gets activated and the device connected to the relay gets 'on' and vice versa. The software controlling the whole circuit, working on the real time of PC provides the desired output a per one's personal choice of time.

We are controlling electrical devices connected with PC parallel port, either by wired link.

II. PROBLEM FORMULATION

A. To design four circuits for relay driver Unit using transistor as switch.

B. To design a regulated power supply compatibles for the above relay driver circuit using suitable voltage regulator.

C. To write a program in VB/.NET (any one) etc. using GUI for parallel port interfacing for electrical device switching circuit with real time operating.

D. To design an IR/RF Transmitter/Receiver Circuit for the devices connectivity to access with remote operation (Load Connected at distant Location).

E. To attach the multimedia headphone with the audio adaptor card for audio input to be provided using microphone.

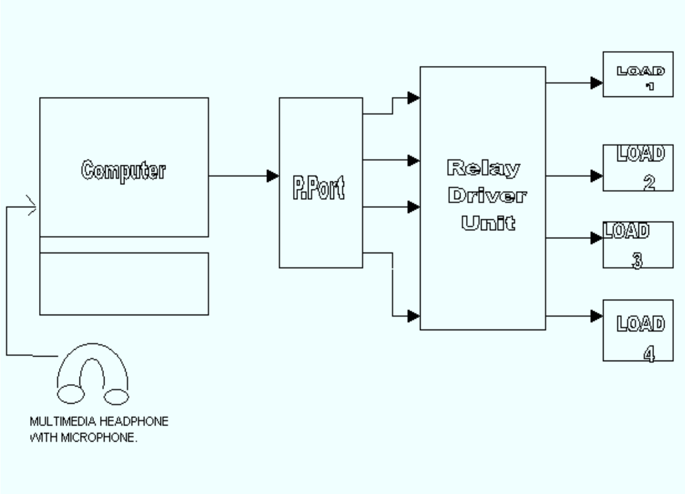

Fig 1. Wired Link

III. PARALLEL PORT

Hardware:-The pin outs of DB25 connector is shown in the picture below:

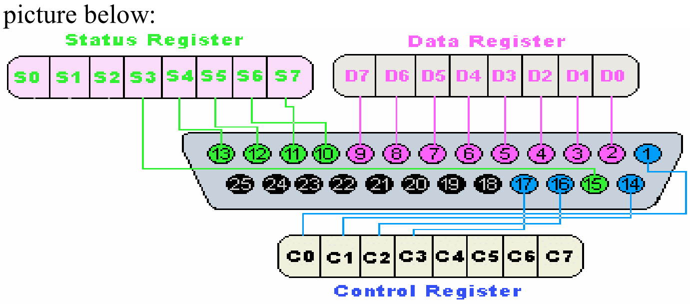

Fig 2. The pin outs of DB25 connector

The lines in DB25 connector are divided into three groups, they are:

A. Data lines (data bus)
B. Control lines

C. Status lines.

As the name refers, data is transferred over data lines. Control lines are used to control the peripheral, and of course, the peripheral returns status signals back to the computer through Status lines. These lines are connected to Data, Control and Status registers internally.

A. Parallel port registers

The Data, Control and Status lines are connected to there corresponding registers inside the computer. So, by manipulating these registers in program, one can easily read or write to parallel port with programming languages like 'C' and BASIC.

The registers found in a standard parallel port are:

A. Data register
B. Status register
C. Control register

IV. RELAY

A **relay** is an electrical switch that opens and closes under control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. It was invented by Joseph Henry in 1835. Because a relay is able to control an output circuit of higher power than the input circuit, it can be considered, in a broad sense, to be a form of electrical amplifier.

These contacts can be either **Normally Open (NO)**, **Normally Closed (NC)**, or **change-over** contacts.

- Normally-open contacts connect the circuit when the relay is activated; the circuit is disconnected when the relay is inactive. It is also called **Form A** contact or "make" contact. Form A contact is ideal for applications that require to switch a high-current power source from a remote device.
- Normally-closed contacts disconnect the circuit when the relay is activated; the circuit is connected when the relay is inactive. It is also called **Form B** contact or "break" contact. Form B contact is ideal for applications that require the circuit to remain closed until the relay is activated.
- Change-over contacts control two circuits: one normally-open contact and one normally-closed contact with a common terminal. It is also called **Form C** contact.

Operation

When a current flows through the coil, the resulting magnetic field attracts an armature that is mechanically linked to a moving contact. The movement either makes or breaks a connection with a fixed contact. When the current to the coil is switched off, the armature is returned by a force that is half as strong as the magnetic force to its relaxed position. Usually this is a spring,but gravity is also used commonly in industrial motor starters. Relays are manufactured to operate quickly. In a low voltage application, this is to reduce noise. In a high voltage or high current application, this is to reduce arcing.

If the coil is energized with DC, a diode is frequently installed across the coil, to dissipate the energy from the collapsing magnetic field at deactivation, which would otherwise generate a spike of voltage and might cause damage to circuit components. If the coil is designed to be energized with AC, a small copper ring can be crimped to the end of the solenoid. This "shading ring" creates a small out-of-phase current, which increases the minimum pull on the armature during the AC cycle.

By analogy with the functions of the original electromagnetic device, a solid-state relay is made with a thyristor or other solid-state switching device. To achieve electrical isolation, a light-emitting diode (LED) is used with a photo transistor.

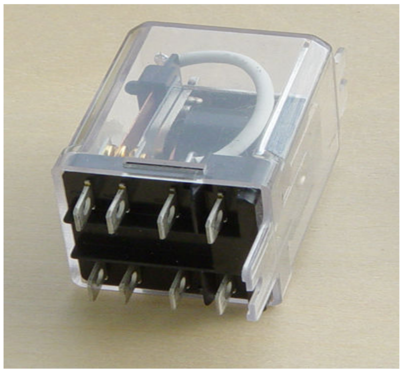

Fig 3. RELAY

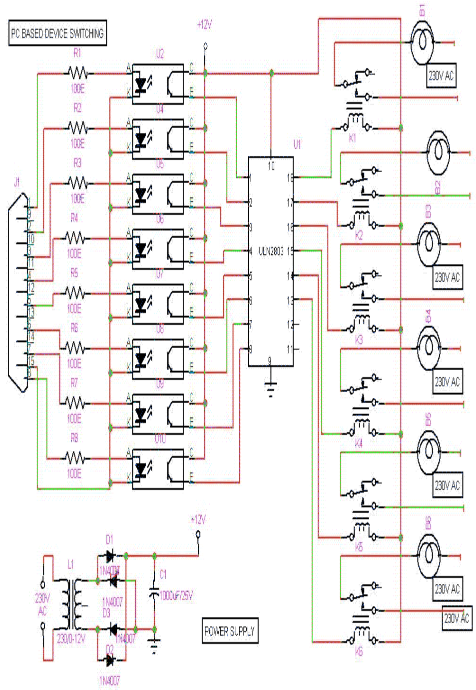

Fig 4. Circuit Diagram Of Project

V. CAPACITORS

It is an electronic component whose function is to accumulate charges and then release it.

To understand the concept of capacitance, consider a pair of metal plates which all are placed near to each other without touching. If a battery is connected to these plates the positive pole to one and the negative pole to the other, electrons from the battery will be attracted from the plate connected to the positive terminal of the battery. If the battery is then disconnected, one plate will be left with an excess of electrons, the other with a shortage, and a potential or voltage difference will exists between them. These plates will be acting as capacitors. Capacitors are of two types: - (1) **fixed type** like ceramic, polyester, electrolytic capacitors-these names refer to the material they are made of aluminium foil. (2) **Variable type** like gang condenser in radio or trimmer. In fixed type capacitors, it has two leads and its value is written over its body and variable type has three leads. Unit of measurement of a capacitor is farad denoted by the symbol F. It is a very big unit of capacitance. Small unit capacitor are pico-farad denoted by pf (Ipf=1/1000,000,000,000 f) Above all, in case of electrolytic capacitors, it's two terminal are marked as (-) and (+) so check it while using capacitors in the circuit in right direction. Mistake can destroy the capacitor or entire circuit in operational.

VI. DIODE

The simplest semiconductor device is made up of a sandwich of P-type semiconducting material, with contacts provided to connect the p-and n-type layers to an external circuit. This is a junction Diode. If the positive terminal of the battery is connected to the p-type material (cathode) and the negative terminal to the N-type material (Anode), a large current will flow. This is called forward current or forward biased.

If the connections are reversed, a very little current will flow. This is because under this condition, the p-type material will accept the electrons from the negative terminal of the battery and the N-type material will give up its free electrons to the battery, resulting in the state of electrical equilibrium since the N-type material has no more electrons. Thus there will be a small current to flow and the diode is called Reverse biased.

Thus the Diode allows direct current to pass only in one direction while blocking it in the other direction. Power diodes are used in concerting AC into DC. In this, current will flow freely during the first half cycle (forward biased) and practically not at all during the other half cycle (reverse biased). This makes the diode an effective rectifier, which convert ac into pulsating dc. Signal diodes are used in radio circuits for detection. Zener diodes are used in the circuit to control the voltage.

VII. TRANSFORMER

A. Principle of Transformer

Two coils are wound over a Core such that they are magnetically coupled. The two coils are known as the primary and secondary windings.

In a Transformer, an iron core is used. The coupling between the coils is source of making a path for the magnetic flux to link both the coils. A core as in fig.5 is used and the coils are wound on the limbs of the core. Because of high permeability of iron, the flux path for the flux is only in the iron and hence the flux links both windings. Hence there is very little 'leakage flux'. This term leakage flux denotes the part of the flux, which does not link both the coils, i.e., when coupling is not perfect. In the high frequency transformers, ferrite core is used. The transformers may be step-up, step-down, frequency matching, sound output, amplifier driver etc. The basic principles of all the transformers are same.

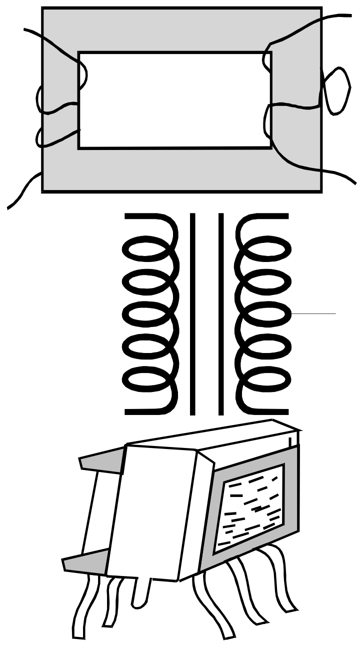

Fig 5. Transformer Equipments

VIII. SPEECH RECOGNITION

A. Introduction

Speech Recognition(also known as automatic speech recognition or computerspeech recognition) converts spoken words to machine readable input(for ex, to key presses, using the binary code for a string of characters codes).Tthe term "voice recognition" is sometimes used to referto speech recognition where the recognition

System is trained to a particular speaker , as is the case for most desktop recognition software, hence there is an aspect of speaker recognition, which attemts to identify the person speaking , to better recognize what is being said.Speech recognition is a broad term which means it can recognize almost anybody's speech such as a call centre system designed to recognize many voices.Voice recognition is a system trained to a particular user, where it recognizes their speech based on their unique vocal sound.

1) Applications

a) Heath Care
b) Military
c) Telephony
d) People with disabilities
e) Further applications

IX. List of Instruments and Equipment needed for the project work

A. Hardware

- One computer with 1 GB of memory
- 20 GB hard disk space
- An Intel Pentium Core 2 Duo based computer working at least @ 2.2 GHz speed
- 15 inch monitor
- A microphone
- Transmitter and Receiver
- Relay driver unit
- Parallel Port
- Electrical Devices

B. Software

- Programming Languages
- Speech Recognition Software
- Readymade application software developed by scholars or institutions.

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[Survey Report]

How WiMAX will deploy in India

Rakesh Kumar Jha
Department of Electronics and Communication Engineering
SVNIT,Surat
Gujarat, India 395007
Email: jharakesh.45@gmail.com
https://sites.google.com/site/jharakeshnetworkcom/

Dr Upena D Dalal
Department of Electronics and Communication Engineering
SVNIT,Surat
Gujarat, India 395007
Email: upena dalal@yahoo.com
http://svnit.ac.in/

***Abstract*—How WiMAX can be deployed in India is really a challenge for researchers with respect to the country's structure prospective. WiMAX subscriber base is expected to reach 19 million by 2012 and WiMAX equipment market value to top US$ 600 million. Eventually following the auction of 2.3GHz and 2.5GHz licenses in the first quarter of 2010, the Indian WiMAX market presents enormous business opportunities. This report seeks to provide a comprehensive picture of WiMAX development in India, focusing ion three aspects of policy, industry, and market. Topics include India's telecom and WiMAX spectrum licensing policies, as well as issues related to WiMAX equipment certification; profile of the overall WiMAX industry in India and current development of companies positioned throughout the industry value chain; an overall sketch of the WiMAX subscriber market in India and outline of Indian WiMAX carriers current status and future development.**

I. INTRODUCTION

WiMAX, Worldwide Interoperability for Microwave Access, is an emerging wireless communication system that can provide broadband access with large-scale coverage. As a cost-effective solution, multi-hop communication is becoming more and more important to WiMAX systems. But there will be no benefit, if this research will not full fill the nation's requirement. Thus this paper gives a brief survey on WiMAX deployment for India’s prospective and also gives some useful data in this way. This will provide interest to deploy the WiMAX in the country. India started its economic liberalization program in 1991. In 1994, the first step to opening the telecom market to privatization was taken. The first private sector wire line and cellular licenses were issued in 1995. From then on, Indian telecom has seen and crossed several milestones and many missteps that provided valuable lessons. The effective telecom tariff for domestic voice service has dropped from Rs 14 per minute (US$ 0.3 at US$1 = Rs 44.5) to about Rs 1 (US$ 0.02) per minute in the last 10 years. The result is that the number of telephone connections (wire line and wireless lines) has doubled in the past two years, to about 150 million. The Ministry of Telecom has set a target for 2007 of about 250 million connections and mobile coverage for 85. India now has 49.75 million fixed subscribers and 100 million mobile users, for a total of about 150 million. That may seem like a large figure, but with a population of 1.08 billion, it translates to just 14 phones for every 100 people. And that number is skewed by the relative wealth of the cities while urban teledensity is around 31 percent; just 2 percent of the rural population has phone lines. With India's expanding middle class, demand for telephone services is growing beyond carriers' ability to keep up. The telecom ministry is initiating an ambitious project to release a total of about 45 MHz of spectrum from the Department of Defence to augment necessary spectrum for 3G services.

Although details are not yet available, the cost has been estimated at about US$225 million and the time frame is expected to be early 2010. With respect to rural connectivity, the government's objective is to reach about 50 million rural connections, or one phone per three rural households, by 2007 and about 80 million rural connections, or one phone per two rural households, by 2010.

II. BROADBAND ACCESS ANYWHERE

The two driving forces of modern Internet are broadband, and wireless. The systems based on Institute of Electrical and Electronics Engineers (IEEE) 802.16 standards combine the two, delivering high-speed broadband Internet access over a wireless connection. The systems based on latest IEEE 802.16e standard will help in achieving the goal of ”Broadband Access Anywhere”. [1]

A. WiMAX Forum

The WiMAX Forum is an industry-led, non-profit corporation formed to help, promote and certify the interoperability of broadband wireless products compliant with the IEEE 802.16 standards. The Forum's goal is to accelerate global deployments and grow the market for standards-based, interoperable, broadband wireless access solutions. The WiMAX Forum is working with member companies to develop standardized profiles and inter operable WiMAX products around specific spectrum bands. To date, there are over 368 member companies in the WiMAX Forum including, 136 service providers. The systems/CPEs based on IEEE 802.16 family of standards after certification for conformance and interoperability by WiMAX forum is called as WiMAX systems

B. IEEE 802.16: Technology Overview

IEEE 802.16 is a family of standards designed to address the needs for Wireless Metropolitan Area Networks

(WMANs). There are currently two implementations being implemented for Broadband Wireless Access (BWA) systems: 802.16-2004 commonly known as 802.16d OFDM based for fixed applications and 802.16e OFDMA (orthogonal frequency division multiplexing access) for mobile applications.

(i) IEEE 802.16-2004 OFDM Based (Generally called as 16d): IEEE 802.16-2004 was released in June 2004 and contains a physical (PHY) and MAC layer specification for two key applications: The most common implementations at this time are 256 OFDM for bandwidths below 10 MHz.

(ii) The IEEE 802.16e standard was finalized in December, 2005 and released in February, 2006. IEEE 802.16e Standard envisages enhancements designed to add a new Physical (PHY) and Media Access Control (MAC) layer for mobile Broadband Wireless Access (BWA). This standard is known as 802.16e - 2005 OFDMA and has also been referred to as 802.16e or Mobile Worldwide Inter operable Microwave Access Systems (WiMAX).

The expectations from mobile application of WiMAX are cellular-like mobility with higher bandwidth and lower costs as compared to 3G cellular systems. The evolving 802.16e OFDMA based systems are initially focusing on licensed bands in the 2 to 4 GHz range. The equipments have also been envisaged in the unlicensed 5 GHz band. Leading global companies are making significant R&D investments in 802.16e systems betting that it may become one of the key global standards for mobile broadband wireless access with end-to-end IP technology. *[2,3]*

C. Spectrum for WiMAX [4]

WiMAX frequency bands and profiles for Certification - Initial plan:

(a) The frequency bands for the 802.16-2004 profiles: Profiles are a set of options of modulations, number of Fast Fourier Transforms (FFTs) etc. given in IEEE standard. The WiMAX Forum certification working groups have finalized the initia l certification profile for the first wave of WiMAX Forum Certified equipment (being called as Certification Wave 1 'CW1') as below in TABLE 1

Freq Band(MHz)	**Duplexing**	**Channelization(MHz)**
3400-3600	TDD	3.5 and 7.0
	FDD	3.5 and 7.0
5725-5850	TDD	10

TABLE I
FIRST WAVE" PROFILES

(b) The frequency bands for the 802.16e-2005 profiles: The initial profile plan for certification against IEEE 802.16e - 2005 is shown in TABLE 2 below:

Freq Band(MHz)	**Duplexing**	**Channelization(MHz)**
2500-2690	TDD	5.0 and 5.5
	FDD	5.0 and 5.5

TABLE II
WIMAX PROFILES SHOWING TDD AND FDD OPTIONS FOR 2.5 GHZ

Note: Profiles are for PMP systems only and for 256 OFDM

D. WiMAX frequency bands and profiles for Certification - Current plan:

Recently WiMAX Forum collected data from the market and based on the survey, the tentative plan for certification against IEEE 802.16e-2005 under consideration is as shown below in Fig 1 (Plan under consideration as draft in WiMAX Forum).Till date WiMAX forum have not adopted 3.3-3.4 GHz band in its recommended profiles or in its road map of up to 2007 (only recently in a draft plan it is included and not yet formally approved due to lack of available manufacturer's interest). This implies that protocol conformance testing and interoperability testing will be a key issue in 3.3-3.4 GHz band.

Certification Profiles	Product Availability for Certification Submission				
Frequency Band/Channel Width	Q406	Q107	Q207	Q307	Q407
2.3 – 2.4 GHz, 8.75 MHz	X1			X2	
2.3 – 2.4 GHz, 5/10 MHz		X1		X2	
2.305 – 2.320, 2.345 – 2.360 GHz 5 MHz			X1	X2	

Fig. 1. Plan Under consideration as draft in WiMAX Forum for IEEE 802.16e products

III. KEY ISSUES

A. "Technology Neutral" or "16 d" or "16 e"

Considering higher spectral efficiency, whether India is to adopt and deploy 802.16d based systems at all or not or may allow up to a certain time period say December, 2006. After a time line say from 1st January 2007 only systems based on 802.16e were mandatory. The worldwide operators and administrations are tracking 802.16e developments. The method to enforce a policy needs consideration.

B. Alignment of Spectrum

How we will align our spectrum allocation to worldwide spectrum allocations. For this 2.5 GHz band, 2.3 GHz band and 700 MHz band may be thought along with 3.3-3.4 GHz and 3.4 - 3.6 GHz for IEEE 802.16e-2005 based systems. In U.S., 700 MHz band were allocated in 2009 for which WiMAX society is also looking eagerly for possible deployment.

C. FDD or TDD or Both

The frequency plan adoption should be based on FDD or TDD. Worldwide trend is for TDD.

1) Band Partitioning: Whether FDD and TDD mixed allocation within a band can be done or band is to be partitioned for FDD allocation and TDD allocation to minimize mutual interference.

2) Three Sectors or Four Sectors: Typically three sector (three carriers or one carrier) and four sector (two carriers) working is possible. A three sector site may be deployed with different frequency carrier (total three carriers) in each sector or with same carrier in each sector (frequency reuse of 1case). Whether three sectors and frequency reuse of one should be made mandatory or it may be left to the operators considering spectral efficiency issue.

D. Full Mobility and VoIP

Considering full mobility and VoIP application, there is a need to identify licensing and regulatory issues and to sort them out. India started its economic liberalization program in 1991. In 1994, the first step to India started its economic liberalization program in 1991. In 1994, the first step to opening the telecom market to privatization was taken. The first private sector wireline and cellular licenses were issued in 1995. From then on, Indian telecom has seen several milestones crossed and many missteps that provided valuable lessons.

The effective telecom tariff for domestic voice service has dropped from Rs 14 per minute (US$0.3 at US$1 = Rs 44.5) to about Rs 1 (US$0.02) per minute in the last 10 years. The result is that the number of telephone connections (wireline and wireless lines) has doubled in the past two years, to about 150 million. The Ministry of Telecom has set a target for 2009 of about 350 million connections and mobile coverage for 85% of the countries geographical area, from about 30India now has 59.75 million fixed subscribers and 125 million mobile users , for a total of about 200 million. That may seem like a large figure, but with a population of 1.18 billion, it translates t o just 14 phones for every 100 people. And that number is skewed by the relative wealth of the cities - while urban teledensity is around 31 percent, just 2 percent of the rural population has phone lines. With India's expanding middle class, demand for telephone services is growing beyond carriers' ability to keep up. The telecom ministry is initiating an ambitious project to release a total of about 45 MHz of spectrum from the Department of Defence to augment necessary spectrum for 3G services. Although details are not yet available, the cost has been estimated at about US$400 million, and the time frame is expected to be early 2009. With respect to rural connectivity, the government's objective is to reach about 50 million rural connections, or one phone per three rural households, by 2009 and about 120 million rural connections, or one phone per two rural households, by 2010.

IV. BROADBAND MARKET

Broadband services were launched in India in 2007. ADSL services now cover 300 towns with a combined 1.5 million connections, while broadband wireless subscriber figures are still negligible. While low broadband penetration is a clear opportunity for BWA/WiMAX, the market take off will re-quire sufficient spectrum, very low cost CPE and affordable end-to-end connectivity, including the computing platform. A country where broadband's average revenue per user (ARPU) is estimated at US$8-10 requires very low equipment cost. In fact, Huawei is already delivering DSL modems at US$13 to Indian operators. The Indian telecom sector operates in a volume-driven market. If the broadband market in India grows to meet the government's revised targets, it might spur one of the world's largest broadband wireless markets. For example, target broadband connections have been currently revised to 15 million subscribers by 2009 and 20 million by 2010. Quite likely the majority of these will be wireless broadband connections because of the poor wireline infrastructure in place.[1,5]

1) BWA/WiMAX Regulation [6,7]: Enough operators are complaining about lack of adequate radio spectrum, that the government is considering the release of some of the spectrum held by the departments of Space and Defence. Currently, license holders in the 3.3-3.4 GHz band have on average, a spectrum of 2x6 MHz to deploy broadband services, even though an analysis shows that 20 MHz is the minimum to support wide scale deployments and hence a profitable business case.

At the end of June 2006, the Telecom Regulatory Authority of India (TRAI) initiated a public consultation on ”Allocation and pricing of spectrum for 3G services and broadband wireless access” including WiMAX. This consultation, in which the WiMAX Forum is keen to participate, and we know price has been finalized in mid June 2009. Further pressure on available bandwidth is coming from operators who require allocations of the 3G/UMTS spectrum. BWA/WiMAX technologies require specific frequency bands to be opened u p in the 3.5 GHz band (an internationally approved standard), which is currently allocated to the Department of Space for INSAT downlink. Regulators and policy makers are deciding the best way to manage the spectrum.

2) BWA/WiMAX Activity [10] [8]: Bharti TeleVentures, Reliance, SIFY, BSNL and VSNL (Tata Group) have all acquired licenses in 3.3 GHz range and are in various stages of trials. VSNL has announced Phase 1 pre-WiMAX deployment of Aperto gear in 60 locations, extending to 200 locations within the year. Although there is clearly insufficient spec trum to offer DSL-like service, several operators have indicated that there is still a huge market for 64 and 128 kb/s connections, which should alleviate the lack of spectrum. Other active players include utilities and several branches of the Indian government. Intel is making significant progress in working closely with the Indian Government in bringing the latter's rural broadband goals to reality. The innovative ”village entrepreneur” model, together with a net-enabled community info-kiosk, is an ideal way to reach the many who are not yet connected. While Motorola is strengthening its presence in the hinterlands through its extensive BWA projects for state governments, A lcatel has set up a joint venture with the C-Dot (the RD arm of the DoT) to focus on exclusive BWA/WiMAX solutions that are tailor made for India at price points the Indian consumer is comfortable paying.Current Market Structure in India is givenin Fig 2.

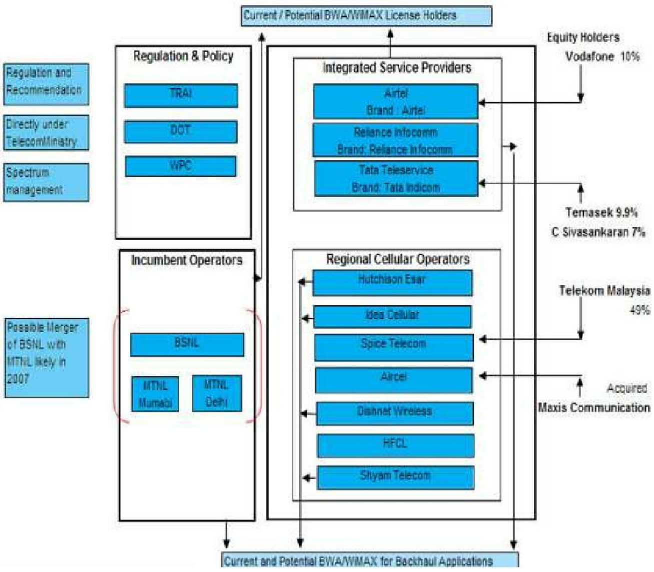

Fig. 2. Current Market Structure: India

3) Anticipated Developments: Several key events should influence the Indian BWA/WiMAX environment in the months ahead. While most operators have only conducted limited trials of vendor products, we expect larger deployments to begin in January 2009, provided that the needed additional spectrum is made available as envisioned. The mobile industry, already faced with a steep decrease in voice ARPU, is expanding its reach by offering voice services in rural areas and high-margin data services in urban areas in order try to increase revenues. Mobile TV, IPTV and other broadband applications are under trial at Reliance, Bharti and MTNL. The increased level of ecommerce activity - mainly through travel bookings, discount airfares, holiday destination packages, job hunting and matrimonial services - is creating a huge demand for always-on broadband services that is expected to take the current Internet user population to 150 million before 2009. Government-led initiatives with strong technology partners such as Intel, Motorola and Alcatel will trigger successful applications such as the Railtel cyber-cafe network along the entire rail route of the nation. Local technology-product companies with differentiated products engineered in India will have an opportunity to deploy in large domestic networks, learn from the experience and go global. Thus, they could form the first-generation Indian telecom product companies to address global markets. The mobile-content industry in India is on the threshold of great change, as television, production houses and content aggregators are working frantically to define the new fronti er in the Indian content business. Mobile operators and ISPs that have strong alliances with content developers will be able to define the content-licensing model, which is at the heart of the broadband business. This will pose a new challenge for Indian service providers. Although the Indian broadband arena is emerging, it clearly offers huge potential for those that can demonstrate perseverance, patience and commitment. Market Forecasts [6][9] In 2009, the BWA equipment market opportunity was a mere US$10 million, dominated by small deployments for backhaul applications to enterprises with outdoor equipment. However, we believe that with the upcoming spectrum opening, the certification o f new equipment and lower-cost CPEs, the annual 3.3 and 3.5 GHz equipment opportunity will increase from US$4 million in 2009 to US$300 million in 2012.This report projects an accumulated 18 million BWA subscribers by 2012, counting both residential and business segments. WiMAX subscribers should represent two-thirds of this figure. Approximately 60% of the WiMAX subscribers will be mobile customers, who are predominately residential, while fixed WiMAX will continue to be driven by large corporations and, to a lesser extent, by SME customers. Methodology Assumptions [2] The research was conducted through two main channels:

4) Primary Sources: The survey took place from January to June 2009 and involved discussions with product managers, marketing executives, regulators, technologists and sales people at all organizational levels.

5) Secondary Sources: We always strive to provide our clients with a new and unique perspective of the industry

based on our own research. To ensure that we add value to the information already available to stakeholders in the industry, we reviewed most of the market research available on broadband wireless access in India, including:

- ITU Statistical Yearbook, 2008
- TheWorld BankDevelopmentIndicators, 2008
- Numerousarticles
- IndianISP Association

V. CONCLUSION

In the current scenario with respect to the country India. WiMAX subscriber base is expected to reach 19 million by 2012 and WiMAX equipment market value to top US$600 million eventually following the auction of 2.3GHz and

2.5GHz licenses in the first quarter of 2010. This report seeks to provide a comprehensive picture of WiMAX development in India, focusing on the three aspects of policy, industry, and market.

VI. FUTURE RESEARCH

We know all over the world now in the condition to deploy the WiMAX or Korea, USA etc has been implemented successfully. But our country still in Dilemma we are still fighting for frequency band. In my view unfortunately this is beneficial for our country because we are in initial stage of 3G technology so cost is doesn't matter. We are in the really good condition to take the WiMAX technology. So we will give a proper and useful suggestion to govt of India so that we can able to deploy WiMAX in our country through this survey.

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