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The Application of Data Mining Technology (Based on literature review)

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Data mining technology is the process of taking out hidden information from the big database and facilitate decision making. The objective of this report is to show the applicability of Data mining technology by reviewing sample research works.

The first research review is on ATM analysis, it is possible to reach the following conclusion that the predictive data mining is helpful for analysis of ATM data to improve the quality of service that Banks provide to their customer.

The second research review is on CRM in radiology center, it is possible to reach the following conclusion that data Mining techniques specifically K-means succeeded in clustering patients into a group according to the requested service.

The third research review is on Credit Card Fraud Detection, and the research found out that neural network with Backpropagation algorithm combined with the genetic algorithm can play an important role in the task of credit card fraud detection.

The fourth research review is on identifying false alarm for network Intrusion detection system, from the research, based on acceptable levels of false alarm rate, the decision tree is more suitable for modeling intrusion detection system which in turn shows the applicability of data mining.

Finally, there is a discussion on the application of data mining techniques based on research findings and forward recommendations for upcoming researchers.

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Abbreviations

Term	Definition
ATM	Automated Teller Machine
CRM	Customer Relation Management
CRISP-DM	Cross-Industry Standard Process for Data Mining
DOS	Denial of Service
GA	Genetic Algorithm
HIDS	Host Based Intrusion Detection System
IDS	Intrusion Detection System
NIDS	Network Based Intrusion Detection System
R2L	Remote to User
U2R	User to Root

1   The Objective of the Report

The objective of this report is to show the applicability of Data mining technology, mainly in the following domains, ATM service analysis, Customer relationship management, Intrusion detection and internet credit card fraud detection. Hence companies who are engaged with a huge amount of data and found in this domain can apply the technology to provide effective service to their customers and create additional opportunity for a new business view. This research comes with the following research question,

- What kind of Data Mining researches have been done and review the result of each sample researches in the following domains?
    - ATM Service
    - CRM
    - Credit Card Fraud Detection
    - Intrusion Detection

The research is limited to only presenting theoretical part of the selected Data Mining techniques and review sample researches done using these techniques. The main reason is since Data mining is vast topic so that it will be difficult to address every part of it with the available time.

The paper is divided into eleven chapters, the first four chapters deal with an introduction, application and techniques, the next three chapters deal with Cybercrime, CRM and ATM. Chapter nine illustrates the research works on the application of data mining in four areas. Finally, chapter 1 concludes the research and give recommendations.

2   Introduction to Data Mining

Companies keep data that was generated long time ago believe that hidden & important patterns are in the data. (Anuwar et al., 2008). Even if this is true but there is a lack of organized information system to manage, so that most companies are in a problem of extracting knowledge.

The importance of valuable information in the business globe has given great priority. Everyone who has got this information is placed in high probability of to be successful.

Hence there is a need of technology that finds the previously unknown knowledge and facts from this big amount of data source for the usage otherwise, companies may not be competent in their day to day activities (Han & Kamber, 2004).

However, one of the parts of information technologies has made it easy to make use out of a big amount of data by collecting, storing and processing (Han & Kamber, 2004). This is called data mining technology.

Data mining technology is the process of taking out hidden information from the big database and facilitate decision making. By considering different disciplines and knowledge from the big database it facilitates the work of organization(Piatetsky-Shapiro,1996). This technology applied in different industries such as Banking Finance, Merchandising business, Healthcare and Telecommunication companies.

In order one to apply the Data mining technology, one must follow the standard process steps, for instance Cross-industry standard process for data mining can be taken. Based on (CRISP-DM); business understanding, data understanding, data preparation, data modeling, deploy the model and evaluation the model are the basic steps to be considered (Pete et al., 2005). Below here each step will be summarized.

2.1 Business understanding

This step is concerned with understanding the goal of the project & needs from the business view and followed by converting the knowledge into data mining problem definition (Top 10 Trends in BI, 2016).

2.2 Data Understanding

since the databases is not uniform it requires figuring out what data are needed and not needed (Abrahams et al.,2013).

Hence during this phase, there are four primary tasks to consider;

- Collect data: in this task, outline data requirements, verify data availability and define selection criteria will be considered and after data is collected a report about the collecting process is needed.

- Describe data: this task contains data description report that explains the source and formats of the data, the number of cases, the number and descriptions of the fields, and other general information that may be important.

- Explore data: in this task, the data will be examined more closely. To be more familiar with the data and find out data quality problems.

- Verify data quality:in this task, the data problems minor and major quality issues will be considered with the possible alternatives. When we say quality issues it may be about is the data good enough to support our goals or there can be missing and incorrect values that need correction (Top 10 Trends in BI, 2016).

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2.3 Data Preparation

This step involves collecting, cleaning, consolidating and checking for data integrity, (Berry and Linoff,2004).

This phase is where data-mining researchers spend most of their time, there are five tasks to consider;

- Select data: in this task, decision will be made for including (relevance for our goal) or excluding a portion of the data that we are going to use for data mining.

- Clean data: in these task, specific data corrections, excluding some cases or individual cells or replacing some items of data will be done.

- Construct data: in this task, some new fields and a new form of data will be derived.

- Integrate data: in this task, data in several disparate datasets, will be merged together to get ready for the next phase.

- Format data: in this task, data, will be formatted in most convenient for modeling (Top 10 Trends in BI, 2016).

2.3 Data Modelling

At this step using data mining models and tools, the data will be analyzed and convert into knowledge for decision making (Anuwar et al., 2008).

Hence during this phase, there are four primary tasks to consider;

- Selecting modeling techniques: Data mining offers so many of modeling techniques, but it is important to select based on the kinds of variables involved and business consideration hence in this task techniques will be selected.
- Designing test: in this task, a design will be tested for example splitting your data into a group of cases for model training and another group for model testing.
- Building model: in this task, more emphasize will be done on parameter settings and model description and finally model building.

- Assessing model: in this task, the model will be evaluated from a technical standpoint and from a business standpoint (Top 10 Trends in BI, 2016).

2.4 Evaluation of Model

This step is concerned in evaluating the knowledge of the model, so that it makes it ready for decision making (Pete et al., 2005).

Hence during this phase, there are three primary tasks to consider;

- Evaluating results: in this task, the value of models will be evaluated for meeting the business goal. Further, the model can be tested in a practical application.
- Reviewing the process: in this task, the process will be reviewed hence there will be an opportunity to spot issues that might have overlooked to correct the problem before deployment.

- Determining the next steps: in this task, the process will be reviewed hence there will be an opportunity to spot issues that might have overlooked to correct the problem before deployment (Top 10 Trends in BI, 2016).

2.5 Deploy the Model

This step concerned with how to make the model ready for customer to apply for decision making (Pete et al., 2005).

Hence during this phase, there are four primary tasks to consider;

- Planning deployment, in this task, a strategy will be done to put the plan to be applicable in business.

- Planning monitoring and maintenance, in this task, monitoring, and maintenance plan will be developed to ensure that it is being used properly ongoing basis and that any decrease in model performance will be detected.

- Reporting result, in this task, the final report will be prepared that summarizes the entire project by assembling all the reports previously done.

- Reviewing result, in this task, the data-mining group meets to discuss what is done and not done, which activities good to repeat again and which one must avoid (Top 10 Trends in BI, 2016).
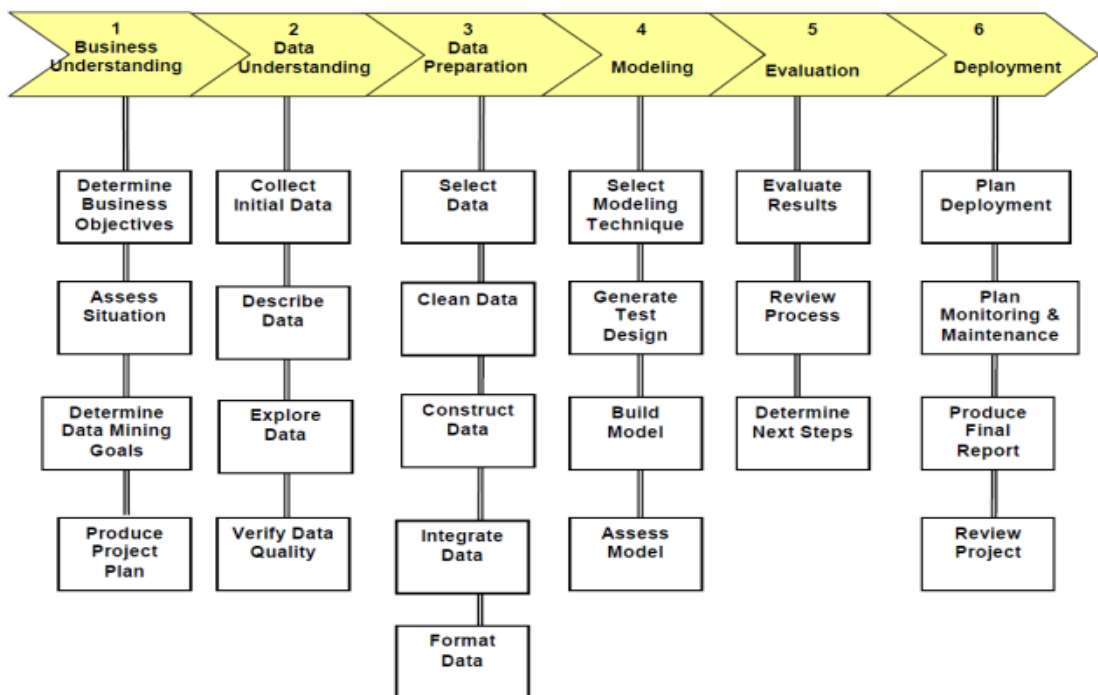
Figure 1. CRISP-DM Methodology Diagram

3 Data Mining Tasks

As defined previously data mining deals with the patterns that can be mined. Hence

based on the kind of data to be mined, there are two main functions,

- Descriptive
- Classification and Prediction

3.1 Descriptive Function

The descriptive function concern on the general properties of data in the database. Below here is list of descriptive functions,

- **Class Description**: Class description refers to the data to be associated with the classes. For instance, in a company, there can be classes of items for sales that include computers and printers. Such descriptions are called class descriptions. (Tutorial Point, 2016).

- **Frequent Pattern mining**: It concerns with patterns that occur frequently in day to day transactional data. For instance, it can be a frequent item like milk and bread or it can be frequent subsequence like purchasing a camera is followed by memory card (Tutorial Point, 2016).

- **Association**: This process concerns in discovering the relationship among data then determining association rules. Particularly it can be used in retail sales to identify patterns that are purchased together, for example, a retailer generates an association rule that shows 70% of time milk is sold with bread and only 30% of times biscuits are sold with bread (Tutorial Point, 2016).

- **Correlation**: It is a kind of analysis performed to discover interesting statistical correlations between two item sets to analyze that if they have positive, negative or no effect on each other (Tutorial Point, 2016).

- **Clustering**: It refers to forming of a group of objects that are very similar to each other but are highly different from the objects in other clusters (Tutorial Point, 2016).

3.2 Classification and Prediction

Classification and Prediction are the functions that find a model that describes the

data classes or concepts. (Tutorial Point, 2016). The sub-functions that are involved here are listed below,

- **Classification**: It concerned with finding the class of the objects whose class is unknown based using derived model. To have a derived model, there must be done analysis on a training data.

- **Prediction**: It is concerned with predicting the missing numerical data values.

- **Outlier Analysis**: It concerned with special data that do not comply with the general behavior of the whole data.

- **Evolution Analysis**: It concern with the analysis of an object's behavior or trends which change over time.

4   Data Mining and Data Warehousing

Data warehouse is a collection of data which are focused on specific area, integrated, historical and non-volatile thus it can be used in support of decision-making process in an enterprise when it is needed (Han & Kamber, 2004).

Data warehousing normally uses a repository called database in which information from multiple sources is integrated and stored in this database for direct querying and analysis. As previously defined Data Mining is a technology that extracts out valid and yet unknown and hidden information from a large database. This means there is real benefit if the data for datamining purpose is already is in data warehouse because readymade database is very relevant precondition for Data Mining process.

Hence at this point it is very easy to infer what kind of relation can exists between data warehousing and data mining.

5 Data Mining Application

Data mining can give answers to many problems as many types of researches show. It helps organizations to know the situations in internal factors and external factors (Bill, 2005).

Below here there are a few areas in which organization use it in order to hit their target.

Direct Marketing:
The main point at this situation is to find out who is most likely to buy the products and services which is used for several marketing activities (Bill, 2005).

Trend Analysis:
Trend analysis used by companies to predict the situation in the marketplace. So that companies can be adjust the costs and be fit into the market (Bill, 2005).

Fraud Detection:
Companies use data mining to identify fraud, thus, it can be applied in insurance, cellular phone calls or credit card purchases (Bill, 2005).

Customer relationship management:
It is a process of saving customer and prospect contact information, account information and sales opportunities in one location so that it will be retrieved by many (Bill, 2005).

6 Data Mining Techniques

Data mining technology has different techniques, Decision Network, Neural Network, Genetic Algorithm and Rule- based algorithm are some of the techniques.

This section will give an overview of about these data mining techniques.

6.1 Overview of Neural Network

Researchers found in Artificial intelligence area invented a computing neuron model to simulate human brain within specialized hardware, software and the multiple layers of simple processing elements called neurons (Stergiou, 1996).

These neurons use a mathematical model for information processing based on a connectionist approach. It changes its structure based on external or internal information flows through the network (Berry& Linoff, 2004).

It has been applied in from financial sector to medical sector conditions, from identifying valuable customers to fraudulent transaction (Berry & Linoff, 2004).

Even if It is the most complicated of the classification algorithms and consuming time but once trained it acts as experts. Moreover, the neural network can provide multiple outputs due to the reason that it only operates directly on numeric data. Hence any non-numeric must be converted to numeric (Bounsaythip & Rinta-Runsala,2001).

6.1.1 Structure of Neural Network

The artificial neural network consists of neurons that are linked to its neighbors. The strength of the connection among the neighbor neurons can be measured by coefficient of connectivity. The electrical information is simulated with certain values stored in it make these networks can learn, memorize and create connection amongst data (Nordbotten, 2006).

The set of neurons processing the entire neural network task and each is acting like a separate computation device. The three layered of artificial network is the most common one which is defined below.

- **Input Layer**: It is an input side of the network which receives unprocessed information for neural network and it is connected to the hidden layer (Bounsaythip & Rinta-Runsala, 2001).
- **Hidden Layer**: It is the middle layer which processes information between the input layer and output layer. Its activity is determined by the activities of the input units and the connections between the input and the hidden units (Bounsaythip & Rinta-Runsala, 2001).

- **Output Layer**: It is an output side of the network which produces processed information. The behavior of the output unit depends on the activity of the hidden units and the connection between the hidden and output units (Bounsaythip & Rinta-Runsala, 2001).

Even if there could be several input neurons, hidden neurons and output neurons, finding the number of hidden nodes is very crucial in the Neural Network (Bounsaythip & Rinta-Runsala, 2001).

In the Figure.2, below there are three input neurons, three hidden and three output neurons and the network has one input, one hidden and one output layer.

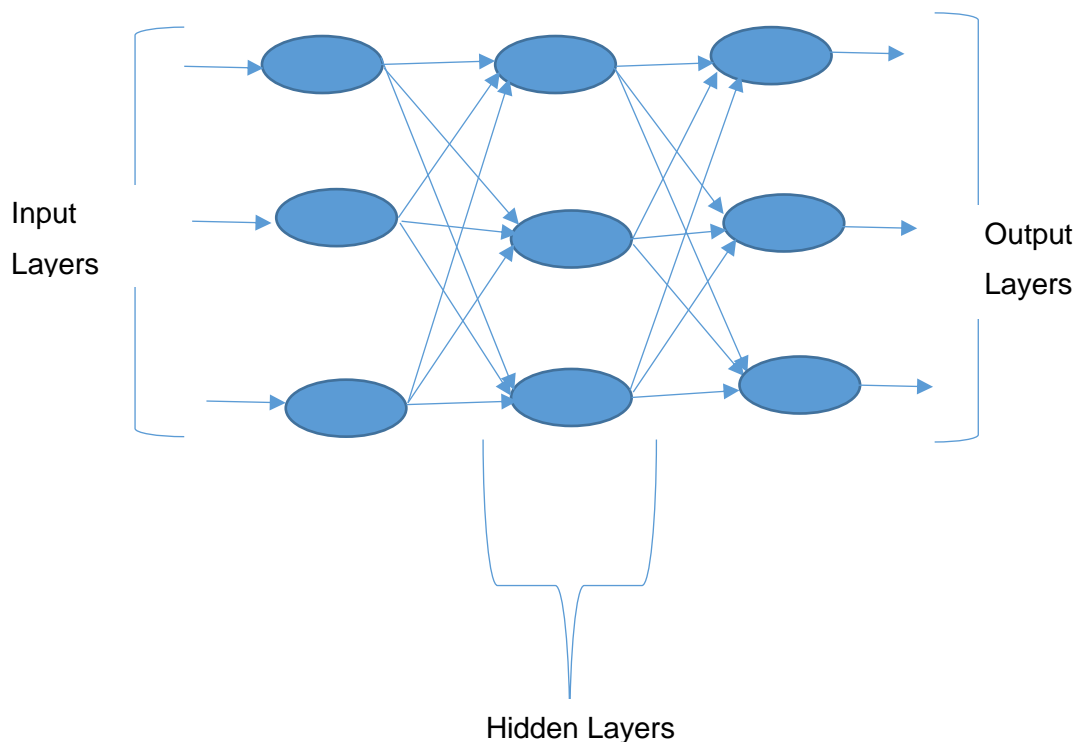Figure 2. Simple Neural Network with input, hidden and output layers

6.1.2 Training Neural Network

The ability of to learn by example and adjust itself to the data it is presented are some of neural network's interesting futures, in addition it can learn from distorted and incomplete data. Due to these reasons, neural networks are considered as appropriate tools for knowledge discovery (Han & Kamber, 2004).

6.2 Overview of Decision Tree

Decision tree is one of data mining techniques that can be applied in classification & prediction, to find out the relationship between input attributes and in modeling process (Berry & Linoff, 2004).

Decision tree basically divided into regression trees and classification tree. Regression tree is concerned with attributes which are continuous in nature and classification tree is concerned with attribute which are quantitative discrete or qualitative in nature (Giudici, 2003).

6.2.1 Decision Tree Structure

A decision tree is a structure that divides up a large collection of records into successively smaller sets of records by using decision rules so that humans can understand it easily. Basically, the rules are expressed in the if-then form (Berry and Linoff, 2004).
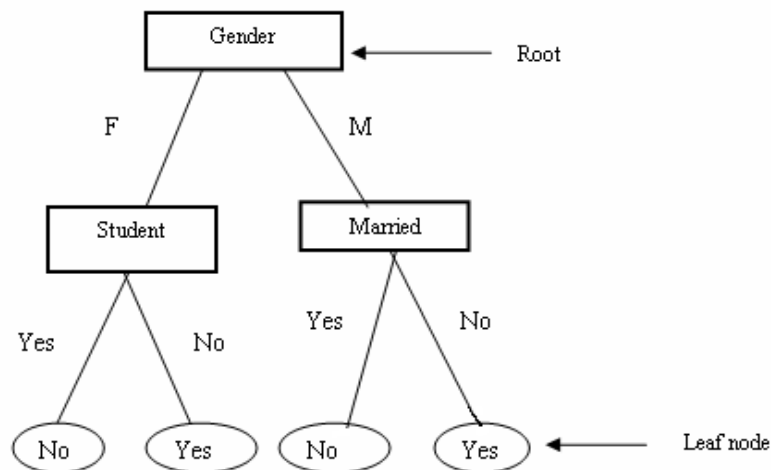
Figure 3. Simple classification decision tree

Figure.3. shows a simple classification decision tree, for the concept of Having a single room house, indicating whether an individual at specific company is likely to have a single room house, with the rectangular shapes show the attribute and the branching show the different values of the attributes and the oval shapes show the value of the attribute.

For example, in the above decision tree an individual whose gender is male and is not married has a single room house and an individual whose gender is female and a student has not a single room house.

6.2.2   Attribute Selection in Decision Tree

Attributes can contain useful information, which can be accessed directly or may be hidden and need some process to disclose it so that it is applicable to the given situation or task. Therefore, the selection of essential attributes is very important part of data mining (Han & Kamber, 2004).

To choose the best attribute Decision trees uses different measures, among these information gain is the one that used to select the attribute at each node. In the selection process the attribute with the highest information gain is chosen as the test attribute for the given node (Han & Kamber, 2004).

6.3   Other Datamining Techniques

Here we will see some additional data mining techniques for additional information such as K-mean algorithm, Genetic Algorithm and Rule- Based Algorithm.

K-mean algorithm: Clustering is the process of grouping a set of data objects into multiple groups so that objects within a group have high similarity and are very dissimilar to objects in other groups.

It is done by clustering algorithm and has many applications in different sectors such as biological research, security work, business intelligence, and Web search. Due to having unsupervised learning behavior, the class label information is not present. Hence the learning process is by observation, rather than learning by examples.

Due to scalability, the ability to deal with different types of attributes, noisy data, incremental updates, clustering algorithms have several requirements. One of the clustering methods is K-Means algorithm. It defines as the centroid of a cluster as the mean value of the points within the cluster (Han & Kamber, 2004). It works as follows. First, it randomly selects k of the objects in D, each of which initially represents a cluster mean or center. For each of the remaining objects, an object is assigned to the cluster to which it is the most similar, based on the Euclidean distance between the object and the cluster mean (Äyrämö & Kärkkäinen,2006).

The k-means algorithm then iteratively improves the within-cluster variation. For each cluster, it computes the new mean using the objects assigned to the cluster in

the previous iteration. All the objects are then reassigned using the updated means as the new cluster centers (Han & Kamber, 2004). The iterations continue until the assignment is stable. The algorithm of the k-means looks like below,

Input: k: the number of clusters, D: a data set containing n objects. Output: A set of k clusters.

Method:

 (1) Arbitrarily choose k objects from D as the initial cluster centers;

(2) Repeat

(3) (Re) assign each object to the cluster to which the object is the most similar, based on the mean value of the objects in the cluster;

 (4) update the cluster means, that is, calculate the mean value of the objects for each cluster;

(5) Until no change (Äyrämö & Kärkkäinen,2006).

Genetic Algorithm: (GA) It is like evolutionary ideas of natural selection and genetics that follow the principles of" survival of the fittest" Hence the model is focuses on exploitation of historical information to solve problems into the region of better performance within the search space (Marmelstein,1997).

Rule-based algorithm: Rule-based classifier makes use of a set of an IF-THEN rules for classification. We can express the rule in the following from: - IF condition THEN conclusion. The "IF" part of the rule is called rule antecedent or precondition. The "THEN" part of the rule is called rule consequent (Han & Kamber, 2004).

7   Cybercrime

Cybercrime is an activity that includes any crime act dealing with computers on the global or local network. Below here I will present two cybercrimes namely intrusion detection system attack and credit card fraud in related to this paper.

7.1 What is intrusion Detection System Attacks?

An intrusion detection system (IDS) controls network traffic for illegal activity and inform the situation to system administrator. In some cases, it can take actions such as blocking the user or source IP address from accessing the network (Giudici, 2003).

In addition, there are IDS that detect based on looking for specific signatures of known threats and detect based on comparing traffic patterns against a baseline and looking for anomalies (Giudici, 2003).
There exist numbers of different attack invented by cyber criminals, below here I will list some of them,

(i) Probing (Probe): Probing is the situation when attacker try to scan a network and gather information so that known vulnerabilities can be found. (Anuwar,Sallehudin,Gani and Zakari,2008).

(ii) Denial of Service (DOS): Denial of Service is the situation where an attacker makes the computing memory resource too busy so that it will not handle legitimate requests (Anuwar,Sallehudin,Gani and Zakari,2008).

(iii) User to root (U2R): In this situation, an attacker tries to access to a normal user account on the system by gaining root access (Anuwar,Sallehudin,Gani and Zakari,2008).

(iv) Remote to user (R2L): It is a situation of exploiting the machine's vulnerability by sending packets to a machine over a network hence finally it will be easy to gain local access as a user illegally to the machine (Anuwar,Sallehudin,Gani and Zakari,2008).

7.2 What is Credit Card Fraud?

Credit card fraud is a type of theft when an unauthorized taking of another's credit card information and perform activities without the knowledge of the owner (FindLaw,A Thomson Reuters Business.2013). Credit Card Fraud committed when a person,

(i) Fraudulently obtains credit card information.

(ii) Uses credit card with the knowledge that it is not at use.

(iii) Using credit card to sell goods or services with the knowledge that the card is illegally obtained (FindLaw,A Thomson Reuters Business.2013).

Credit card fraud can be either application fraud or account takeover. For example, if an offender can obtain enough personal information about the victim so that he can able to fill out the credit card application it is called Application fraud (Thomson Reuters Business.2013).

When an offender obtains enough personal information about the victim and then hijacking of an existing credit card account it is called Account takeover (FindLaw,A Thomson Reuters Business.2013).

8 Customer Relationship Management (CRM)

It is a process that maximizes customer value through ongoing marketing activities. It is also about perfecting relationships to maximize a customer's value over time. Currently, it is growing in importance due to the challenging business environment faced by an organization.
The company or organization is very rich in information about customers but the information is not shared, it is only available to specific job functions.
Hence CRM is an application that enables organization to be a customer- centered organization by putting the customer at the center of all the information and let authorized people within the organization to access the information they need and as result a customer in this organization feels more valued and the organization can develop higher customer retention rate (Gupta & Aggarwal, 2013).

CRM consists of the following four dimensions;

(i)   Customer identification: CRM begins with customer identification which involves targeting the prospect customers or most profitable to the company. Moreover, it involves analyzing customers who are being lost to the competition and how they can be won back (Ngai et al., 2009).

(ii)   Customer attraction: In this stage, organizations can direct effort and re-sources into attracting the target customer segments. The main element of customer attraction is direct marketing (Ngai et al., 2009).

(iii)   Customer retention: It is the main concern for CRM. Here customer satisfaction is the basic condition for retaining customers, basically in customer satisfaction there is a comparison of customers' expectations with perception of being satisfied, is the basic condition for retaining customers. (Ngai et al., 2009).

(iv)   Customer development: This involves expansion of transaction intensity, value, and individual customer profitability (Ngai et al., 2009).

(v)   Customer lifetime value analysis: It is defined as the prediction of the total net income that a company can expect from a customer (Ngai et al., 2009).

The term "customer lifecycle" refers to the stages in the relationship between a customer and a business (Rygielski et al.,2002). Here it can relate directly to customer revenue and customer profitability and provides a good framework to apply data mining to CRM. In the customer lifecycle, there are four stages.

(i) Prospects: People who are not customers currently but they will be in the future (Rygielski et al.,2002).

(ii) Responders: Prospect customers who are interested in a product or service provided by the organization (Rygielski et al.,2002).

(iii) Active Customers: Customers who are currently using the product or service of the organization (Rygielski et al.,2002).

(iv) Former Customers: Customers who are not appropriate or those who may have shifted to competing organization (Rygielski et al.,2002).

Hence using data mining, it is possible to Predict the profit as prospect customer become active customer and for how long the customer uses the product and in what situation they can shift or leave the customer relationship (Rygielski et al.,2002).

9 ATM

ATM stands for; Automated Teller Machine. It is also referred to as a cash machine, a cash dispenser and 'the hole in the wall' among other names. The ATM is an electronic computerized telecommunications device that allows financial institutions (e.g. bank or building society) customers to directly use a secure method of communication to access their bank accounts. Most ATM's also let users carry out other banking transactions (e.g. check balance).

ATM's are activated for example when a customer is trying to take out cash, a bank card inserted into the card reader slot and type pin number then, since the card contains the customer's account number and PIN on the cards magnetic stripe, the ATM contacts the banks computers to verify the balance finally gives out the cash and then transmits a transaction notice (Curran & king, 2008).

The idea for an ATM originally was to simply replace or reduce the workload of a bank teller (i.e. the person in the bank who gives out money to customers).

Although ATM's provide an extremely useful service to banks customers, but there are problems in the following areas (Curran & king, 2008).

      (i) In predicting/check the ATM usage level
      (ii) In identifying peak time of an ATM in a day/month
      (iii) In spotting out most used transaction in ATM

10 Review of Researches in ATM, CRM, Credit Card Fraud Detection and Intrusion Detection System

This section will present sample research work reviews which are done on ATM analysis, Customer relationship management credit card fraud and intrusion detection respectively by using data mining techniques.

10.1 Data Mining in ATM services

When we try to see what kind of researches have been done in ATM, it is possible to consider some,

For instance, research which is done on Credit and ATM Card Fraud Prevention using Multiple Cryptographic Algorithm, here the researchers focus on security & authentication to recognize & prevent fraudulent patterns, they propose a methodology that uses layers of security phases before typing the pin number. This methodology is very important because it asks secret question to user identification during Credit Card and ATM Transaction. In addition, in this methodology only a single file can be transferred from client to server by encryption & decryption process so it is not possible to hack the details. In this research data mining algorithm, namely des and 3-des algorithms are used. (Yenganti & Meshram,2013).

Another research which is done on Fraud Detection and Control on ATM machines, in this research through analyzing was done on the existing system of electronic Fund Transfer using ATM activities such as Cash withdrawal, fund transfer, password hacking, pin misplacement, and bio-technology and in various kinds of frauds. The main objective was to find a solution of how to reduce and control the acts of Fraud in the banking sector mainly through (ATM).

The researchers consider how to Combine the PIN and bio- metric operations so that only legitimate holders access the account. Using data mining the bio-data through biometric combinational operations at the first opening of the account and using the existing system. Finally, the researchers propose a design of ATM engine that has thumb print capture area and the possibility of the eye scanners in addition to pin numbers (Ibrahim & Barron,2011).

Further research is done by Madhavi, Abirami, Bharathi, Ekambaram, Krishna Sankar, Nattudurai and Vijayarangan in 2014.The main research concern was to analysis ATM service using predictive Data Mining to show to what extent Data Mining Technology is playing a crucial role for Banking Sector.

The motivation of the research is due to the reason that ATM is essential component of Banking industry with giving important service to bank customer and in addition,

the following problems are observed in ATM service which can lead to losing revenues, customer dissatisfaction and decreased profitability,

- The high utilization of ATM caused waiting for a long time in the queue
- Banks could not predicate the ATM usage level
- Banks could not identify the peak time of ATM
- Most used transaction type is not spotted

The traditional way of managing the complication need extra manpower and equipment in an expensive and unproductive manner, hence they consider to applying predictive data mining technology that deals with extracting important pattern and information from existing data by training and predicting patterns &trends for upcoming data.

To analysis this predicting data mining Weka software is used. It is a java based free software developed by University of Waikato, New Zealand. The software, using its visualizations tools and algorithms, supports process of large volume of data by splitting the data according to the user convenience. (Sudhir & Kodg, 2013).

From the fact that historical data is an asset for data mining. In this work, the researchers analyzed records of ATM transaction over a period, especially on a day. The data has the following main attributes Type, Location, Hour and Amount. Type tells the transaction type, for example, it can be deposit, withdrawal, advance or transfer. Location tells the location of ATM where the transaction had taken place. Hour tells the hour and Amount tells the amount of currency.

Table 1. Sample of 30 records of ATM transaction

ATM Data Set			
Type	**Location**	**Hour**	**Amount**
Deposit	CampusB	0	100
Withdrawal	CampusB	0	10
Deposit	DriveUp	0	71
Withdrawal	DriveUp	0	40
Withdrawal	CampusB	5	50
Withdrawal	DriveUp	6	60
Deposit	DriveUp	6	72
Withdrawal	DriveUp	6	40
Withdrawal	DriveUp	6	80
Withdrawal	DriveUp	6	20
Deposit	DriveUp	6	65
Withdrawal	DriveUp	7	60
Withdrawal	DriveUp	7	20
Deposit	DriveUp	7	373
Deposit	DriveUp	7	1002
Withdrawal	DriveUp	7	20
Withdrawal	CampusB	7	20
Withdrawal	DriveUp	7	150
Withdrawal	DriveUp	8	60
Withdrawal	DriveUp	8	120
Withdrawal	DriveUp	8	110
Deposit	CampusB	8	1000
Withdrawal	Driveup	8	50
Withdrawal	CampusB	8	30
Deposit	Driveup	8	785
Withdrawal	CampusB	8	60
Transfer	CampusB	8	10
Withdrawal	DriveUp	8	200
Withdrawal	DriveUp	8	20
Withdrawal	DriveUp	8	100

Based on the 30 records of ATM transaction on a day and analyzing it using Weka tool, the researchers found the following.

The first result which is found by comparison of the type of transaction, as we see in the graph the occurrence of withdrawing is very high (70%) when it is compared

to the other transaction and the occurrence of Transfer which is very low (3.33%) when it is compared to the other transaction, here we can see advance is zero.
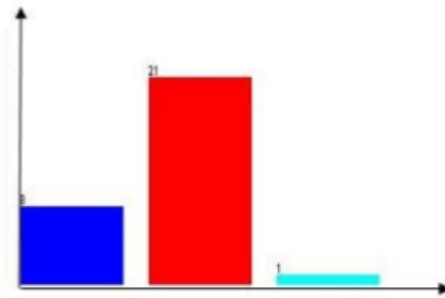
X-axis = Type of transactions
Y-axis = Occurrence of Transactions
The colors above graph indicate;
    Red -Withdraw (70%)
    Blue -Deposit (26.6%)
    Cyan -Transfer (3.33%)

Figure 4. Type of Transaction with its occurrence for 30 record of transactions

The second result which is found by comparison of the locations from which the data are being retrieved. Hence, we can see in Campus B the withdrawal and deposit is very high in percentage and there was no transfer but in Drive up there was three types of transactions but less in percentage.
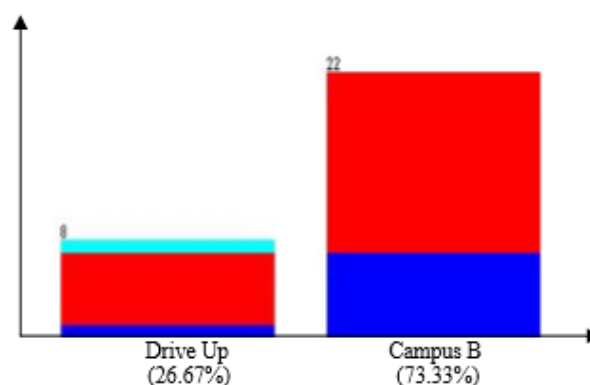
X-axis = Transaction of various ATMs
Y-axis = Occurrence of Transactions

Figure 5. Location of Transaction Occurs

The third result which is found by comparison of the transaction in the ATMs for a day (24 hours). As it shown in the figure below the maximum transaction occurred in ATM for an hour and type of transaction. Here when we consider the transaction in hours, it is easy to see from the figure below there were different transaction took place but we can observe that the peak time for the transactions is between 5 and 8.

X-axis = Time in hours (24-hr format)
Y-axis = Occurrence of Transactions
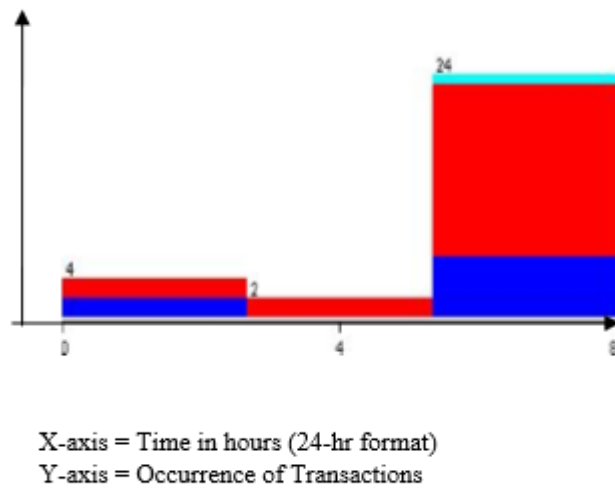
Figure 6. Transaction at Particular time

The research is extended to 14913 records for 30 days from different locations, then using weka tool predictive model the following major analysis are found.

The first result which is found by comparison of the type of transaction, as we see in the graph the occurrence of withdrawing is very high (71.85%) when it is compared to the other transaction and the occurrence of advance which is very low (0.76%) when it is compared to the other transaction.
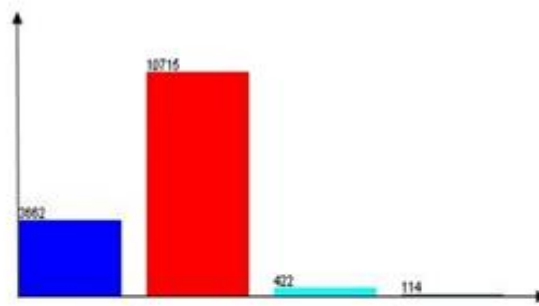
X-axis = Type of transactions
Y-axis = Occurrence of Transactions
The colors in the above graph indicate:
      Red   - Withdraw (71.85%)
      Blue   - Deposit (24.5%)
      Cyan   - Transfer (2.82%)
      Gray   - Advance (0.76%)

Figure 7.Type of Transaction with its occurrence

The second result which is found by comparing the type of transactions which have occurred in a different location. In this result, it is possible to locate in which location which type of transaction more frequently occurred.

For example, in location "campus B" withdrawal occurred more frequently than others, and in location "campus A" only withdrawal occurred.
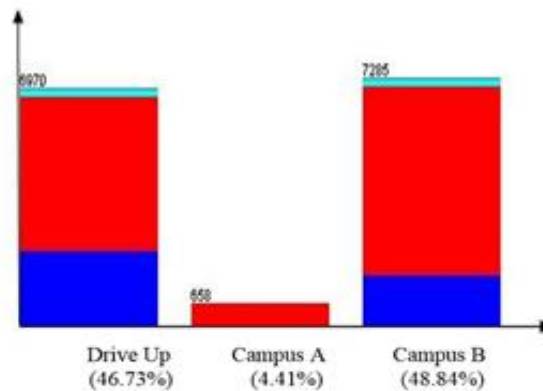
X-axis = Transaction of various ATMs
Y-axis = Occurrence of Transactions
      Red   - Withdraw
      Blue   - Deposit
      Cyan   - Transfer
      Gray   - Advance

Figure 8.Location of Transaction occurs

The third result which is found by comparing the transaction occurred in ATM in each hour and day, for example when we consider the transaction in hours starting from 0 to 23 o'clock. We can see from the figure below there were different transaction took place but we can observe that the peak time for the transaction is around 12 noon.


X-axis = Time in hours (24-hr format)
Y-axis = Occurrence of Transactions

Red   - Withdraw
Blue   - Deposit
Cyan   - Transfer
Gray   - Advance
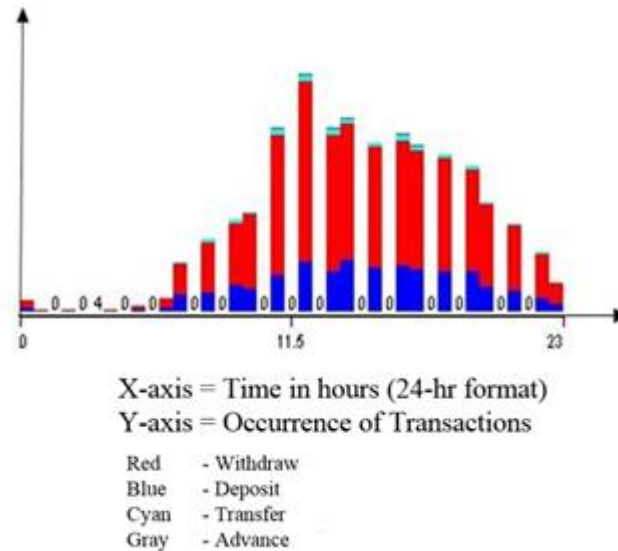
Figure 9. The occurrence of transaction in 24 hours

Then when we consider the analysis done based on days as we see from the figure below the occurrence of peak days' transaction after the mid of the month is larger than before the mid of the month.
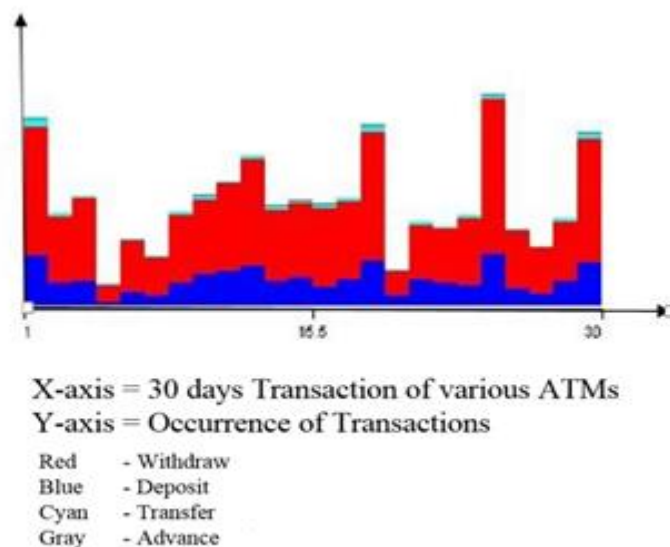

X-axis = 30 days Transaction of various ATMs
Y-axis = Occurrence of Transactions

Red   - Withdraw
Blue   - Deposit
Cyan   - Transfer
Gray   - Advance

Figure 10. The occurrence of transaction in 30 days

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Based on the above major analysis the predicted results are,

- It is possible to calculate the usage for every location
- It is possible to identify the location of ATM which provide service based on the usage
- The type of transaction which occurs frequently
- The peak hours and range of days in a month.

Finally, the researchers reach the following conclusion, the predictive data mining is helpful for analysis of ATM data to improve the quality of service that Banks provide to their customer.

10.2 Data Mining in CRM

When we consider what kind of researches have been done in CRM, it is possible to consider some,

For instance, a research on the Bank's CRM Based on Data Mining Technology is done, this research used 53872 customer information for data mining purpose from Agricultural Bank of China. First the data is processed using data mining of data preparation method so that it was possible to extract basic customer information. Next the processed data is loaded into the central database after classification and combination process are done. Finally using data mining algorithm ID3 and through judgment analysis and adjustment a model for CRM for the bank is constructed. Based on the model it is possible to reach on the following conclusions,

- The credit quality of customer is very important
- Monthly income is very important for preliminary sifting for customer classification.
- Even if monthly income is very important it is not absolute.
- The education background and credit record are very important factors to be high-value customer (Wang & Wu,2011).

In addition, another research done on Knowledge Management in CRM using Data Mining Technique, Here the researchers try to introduce the different parts of data mining in related to CRM and its application in detail by presenting sample

examples in each section. From the research findings, it is possible to reach on the following important conclusions

- Using clustering data mining technique, it is possible to group the customers into several numbers of groups based on purchasing of their behavior.
- Using classification algorithm, it is possible to predict unknown sample and possible to classify data into several numbers of groups.
- Using prediction algorithm, it is possible to predict customer behavior regarding the purchase order.
- Using association mining it is possible to get the frequent item set which occur during the purchase of product.
- Using Correlation analysis technique, it is possible to show how the different parameter of database is related. (Yadav et al.2013).

Further research is done to show the application of data mining techniques in customer relationship management. The researchers are Ahmed Bahgat El Seddawy from Arab Academy for science and Technology, College of Management, Dr. Ramadan Moawad from Arab Academy for science and Technology, College of Computer Science, Dr. Maha Attia Hana from Faculty of Computer & Information, Helwan University.

The main objective is to improve customer services in radiology centers by proposing new radiology data mining system (RDMS) in radiology centers.

This RDMS will cluster customer to find an unsatisfied need, promote service packages and create new service packages.it has the following components, pre-processing the collected data, clustering by K-mean algorithm then post processing which gives business-oriented results.
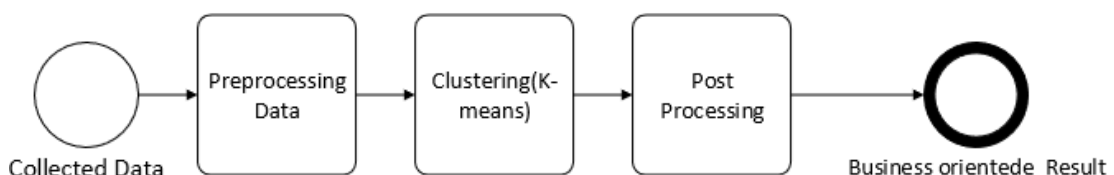

Figure 11. The RDMS process System

Based on the above-proposed system the following experiment was done. The first stage was data collection, here the experimental data was taken from radiology center which is in Egypt.

The center serves more than 1000 customer per year. By contracting more than 500 organizations and provides more than 450 scan type. The center provides patients' data from 11/1/2009 to 1/4/2009 which stored electronically in SQL database.

The database contains four attributes namely patient name with data type text, the employee organization with data type text, scan date with data type date and scan type with data type text. The total record was 6700 transactions for about 487 patients from 40 different organizations and these patients requested 30 scan types.

The computing resource for this research is a personal computer (processor 3.2, hard disk 160 GB, 17- inch monitor).

The operating system was window XP service pack 3, Microsoft excel sheet 2007 has been used for analysis and filtering data. Mat Lab version 6.5 has been used in data preprocessing and data classification. Weka is used for data mining.

Three data set are constructed for the experiment, the first one is called "A" which has 90% of data for a model training and 10 % for a model test. The second one is called "B" which has 85% of data for a model training and 15% for a model test. The third one is called "C" which has 80% of data for a model training and 20% for a model test.

Date	Patient Name	Scan type	Organization Name
03/03/2009M	رامى	رسم قلب عادى	يونى كير TE-Data
02/01/2009M	رامى	عادية على الصدر	يونى كير TE-Data
01/01/2009M	فتحى نجيب	مسح نرى على الكلى (مرحلة واحدة)	ت. صحى بنى سويف
01/01/2009M	صادق امين	رنين على الفقرات القطنية	مؤسسة الأخبار
11/04/2009M	كريم	دوبلر على القلب	نقابة الاطباء (القاهرة)
01/01/2009M	فريد	عادية على المسالك	شركة ايجيكير
01/01/2009M	فريد	تليفزيونية على البطن والحوض	شركة ايجيكير
21/01/2009M	نادية محمد	فحص ماموجرافى على الثدى الايسر	ت ص من شمال الصعيد
01/01/2009M	سميرة	رنين على الفقرات القطنية	العلاج على نفقة الدولة
01/01/2009M	ايناس نظيم	رنين على الكتف الايسر	ت. صحى القاهرة
...	...	...	...

Figure 12. Collected data in collection stage

In the second stage, which is called preprocessing, here the first step is, the collected data is converted from textual values to numeric to deal with identification numbers. In the second step, the interesting attributes are selected which are Patient Id and Scan Type Id.

Data	Patient ID	Scan ID	Organization ID
03/03/2009M	82803	12	0
02/01/2009M	82803	101	0
01/01/2009M	81205	190	268
01/01/2009M	81206	35	140
11/04/2009M	81207	12	135
01/01/2009M	81208	112	0
01/01/2009M	81208	478	0
21/01/2009M	81210	128	404
...	...	...	...

Figure 13. Preprocessed data

In the third step, the numeric matrix converted to a binary matrix. The rows of the matrix represent patient Id while columns represent the scan type represented.
In the fourth step, data filtering is done by elimination of all zero rows or all zeros column because not all patients' id is expected to exist neither all scan type Ids.

After all these steps are done, the next stage is clustering. using the k-mean algorithm. For each data set, three k-mean model are done with k=10, 15, 18, which means 9 experiments are done overall.

Table 2. Experiments with their percentage and cluster

	90%	85%	80%
Data	A	B	C
10 Cluster	EXP.1	EXP.4	EXP.7
15 Cluster	EXP.2	EXP.5	EXP.8
18 Cluster	EXP.3	EXP.6	EXP.9

After these experiments are done, because of it is an average behavioral nature from others data sets and by the discussion with the domain experts the data set "B" is taken into consideration by the researchers.
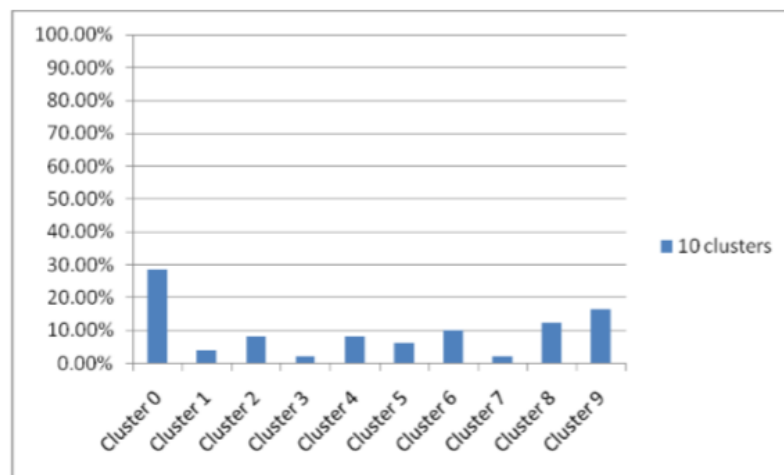

Figure 14. Distribution percentage of patients in testing set for data set B for 10 clusters model

As it shown in the above diagram for clustering k=10 model, 28% of the patients exist in cluster 0, nearly 16% of the patients exist in cluster 9. It also shows that the percentage starts to decrease in the other cluster which implies most the patients are in cluster 0 and 9.
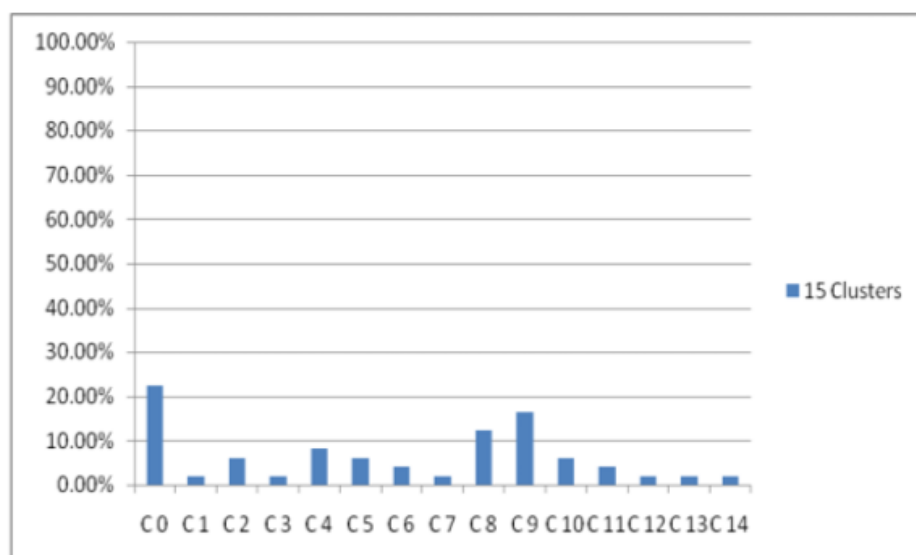

Figure 15. Distribution percentage of patients in testing set for data set B for 15 clusters model

As it shown in the figure above for clustering k=15, 22% of the patients exist in the cluster 0, nearly 16% of the patients exist in cluster. Here again, most the patients are in cluster 0 and 9.
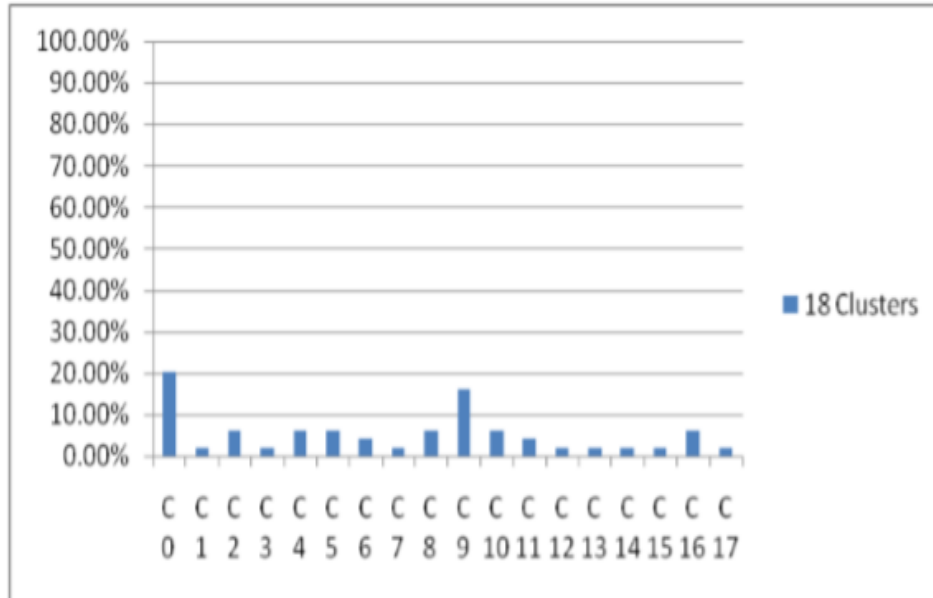

Figure 16. Distribution percentage of patients in testing set for data set B for 18 clusters model

In the figure above for clustering k=18, the result shows that 21% of the patients exist in cluster 0, nearly 16 % of the patients exist in cluster 9 almost 1% in cluster 16, 10,8,5,4 and cluster 2. Here we can see that the percentage starts to decrease in the other cluster from here we can infer most of the patients having most scan in cluster 0 and 9.

In order to fully understand the result, the patient cluster is presented to the domain expert. Hence the following findings are reported, as a package level for example "women scan" which contains the sequence of scans spatially done for women in the age range of 35-40." Bone scan" which contains the scans such as X-Ray for all bone and spinal cord, MRI for all bone and spinal cord.

In addition, the most common scans done in the center is in the brain, MRI dorsal or cervical. Graphical brain is never done because it is not supported in the center.

Based on the experiment the following final findings are found,

- The generated facts nearly match with the medical fact. Which means the system cluster the patients according to the requested scans.

- The most populated cluster is for the female sector.

- There are scans for older men that can be supported by special price to get more patient

- There are scans used for medical checks before hiring in most organization

- Based on RDMS result the market department of radiology center can devise an approach to compute in the market by offering affordable price for a scan and new packages of scan for targeted customer.

Finally, the researchers conclude that Data Mining techniques specifically K-means succeeded in clustering patients into a group per the requested service.

Here it is possible to see to what extent data mining technology supports customer relationship management in an organization.

10.3 Data Mining in Credit Card Fraud Detection

When we consider what kind of researches have been done in Credit Card Fraud Detection, it is possible to consider some,

A research on Data Mining Application in Credit Card Fraud Detection System is done. In this study, the design of model of neural network (NN) is done so that it runs at the back ground of existing banking system. In neural network modeling the data which is a mixture of normal and fraudulent transaction is used. The mixing process was done by unknown mechanism. Finally, the model is running at the background of existing banking system to detect illegal transaction in real time process. It is found out that it is effective since neural network can recognize similar pattern from experience and extract rules so that it can predict future activities.

Finally, the researcher draw a conclusion that by employing neural networks effectively, banks can detect fraudulent use of a card more efficiently. In the research the model detects most of the fraudulent transactions, but more importantly, probability of false positive was below 2% or 3 %(Ogwueleka,2011).

In addition, another research is done on Data Mining Application for Cyber Credit-Card Fraud Detection, in this study, a system's model for cyber credit card fraud detection is discussed and designed. This system uses the supervised anomaly detection algorithm of Data mining to detect fraud during transaction which takes place on the internet. The application accepts input which is formatted on a pattern on which a transaction is being executed and try to matches it with the credit-card holder's pattern. Next it will classify the transaction as legitimate, suspicious fraud and illegitimate transaction. The anomaly detection algorithm is designed on the Neural Networks. In the case of the transaction is suspicious fraud classification, the financial institution using the system can investigate further by calling the credit-card owner(Akhilomen,2013).

Further another research is done by Raghavendra Patidar, Lokesh Sharma; here they try to show the application of neural network with genetic algorithm in credit card fraud detection.

During the first face of the experiment, they use only neural network algorithm with three-layer and a learning algorithm namely "feed forward back propagation network" and additional important parameters such as weight, network type, number of layer, number of nodes.

with these the neural network train on sample information regarding various categories about the card holder such as the occupation of the card holder, income, number of large purchase on the card, frequency the large purchase and location where the large purchase took. Generally, all the attributes fall in one of the following main categories (current transaction category, transaction history descriptor, payment history descriptor and another descriptor) also the neural network trained about the various credit card fraud faced by bank previously.

At the end, they found a result which is promising but there were some problems in neural networks, several parameters must be set before any training can begin.

However, there are no clear rule or method to determine the optimal topology for a given problem because of the high complexity of large networks to set these parameters. Yet the choice of the basic parameter (network topology, learning rate, initial weights) often already determines the success of the training process.

Hence to solve this problem they consider combining another data mining technology technique is called genetic algorithm along the neural network and do the research and they found a fruitful result.

Finally, they reach the conclusion that states the neural network with Back propagation algorithm is the latest technique that has powerful capabilities of learning and predicting. At the same time if the genetic algorithm is combined, to choose those parameters (weight, network type, number of layer, number of nodes etc.), neural network can play an important role in the task of credit card fraud detection and it will be successful (Patidar & Sharma,2011).

10.4 Data Mining in Identifying False Alarm for Network Intrusion Detection System

When we consider what kind of researches have been done in Intrusion Detection System ,it is possible to consider some,

A research on Real-Time Classification of IDS Alerts with Data Mining Techniques is done, in this research, first the researcher try to overview of related work is provided then try to present the algorithm for building the classifier for IDS system then next they describe the classifier implementation and performance. finally point out even if the current result is promising but there is a need for further study on various statistical algorithms for detecting unexpected fluctuations in the arrival rates of routine alerts(Vaavandi,2009).

In addition, another research on study on Integrating IDS with Data Mining is done, this research presents the application of data mining approaches for an intrusion detection system. An IDS model is presented as well as its limitation in determining security violations. Furthermore, this research focuses on several data mining techniques like feature selection, machine learning. Statistical techniques and predictive analysis.

These techniques can aid in the process of intrusion detection. During the research activities, it is shown that data mining has been known to aid the process of intrusion detection. In addition, various data mining techniques have been applied and evaluated by researchers. Based on the research, the integration of data mining approaches can contribute significantly in the attempt to create better and more effective intrusion detection systems (Balitanas et al,2008).

Further research is done by Nor Badrul Anuar, Hasimi Sallehudin, Abdullah Gani, and Omar Zakari, here the researchers propose a strategy to evaluate and enhance the capability of the IDS to detect and at the same time to respond to the threats and benign traffic in critical segments of network, application and database infrastructures. Based on the previous stored well-known attack data stored in the database, the researchers perform experiment to classify network traffic patterns, such as,

1. Probing (Probe)

2. Denial of Service (DOS)

3. User to root (U2R)

4. Remote to user (R2L)

5. Normal (peaceful TCP/IP connection)

For each TCP/IP connection, 41 various quantitative and qualitative features were extracted from this database, a subset of 494021 data was used which compromised 20% of normal patterns. Here see5/C5.0 version 2.04 data mining software is used.

Hence, they apply decision tree for the first experiment by taking 10 percent of the data set as training and the found the following experimental result as shown in the table below,

Table 3. Experimental result of decision tree for five class

Class	Cases	False positive	False negative
Normal	97278	75	15
Dos	391458	9	19
Probe	4107	9	55
R2L	1117	6	23
U2R	59	32	19
Total	494021	131	131

From the 41 attributes of record only 20 of the attributes were used for decision trees classifier. From the table, we can see how the decision performs in each category.

The second experiment was based on a rule-based algorithm on the same data and found the following result shown in the table below.

Table 4. Experimental result rule based for five class

Class	Cases	False positive	False negative
Normal	97278	128	12
Dos	391458	48	20
Probe	4107	6	74
R2L	1117	2	49
U2R	59	3	28
Total	494021	187	187

Finally, the Performance Comparison of False Alarm Rate for the Class of Attack using Decision tree and Rule-based Classifier is given below,

Table 5. Final comparison

Class	False Alarm Rate for Decision Tree (%)	False Alarm Rate for Rule-based Classifier (%)
Normal	0.015	0.025
Dos	1.822*10-3	9.716*10-3
Probe	1.822*10-3	1.215*10-3
R2L	1.215*10-3	4.048*10-3
U2R	6.477*10-3	6.073*10-3

Here they have proven that the importance of decision tree for modeling intrusion detection for the class of normal, DoS, and R2L. For the class of Probe and U2R, rule-based classification is more suitable. However, based on acceptable levels of false alarm rate, the decision tree is more suitable than rule-based for modeling intrusion detection systems (Anuwar, Sallehudin, Gani and Zakari, 2008).

To see the general overview of data mining in the above domains, we can infer that data mining is highly applicable in ATM, CRM, Credit Card Fraud Detection and Intrusion detection system, if further studies are done it is possible to find new patterns which is very help full in prediction, classification and clustering process.

Further companies which are engaged in these domains be advised to integrate data mining models into their system for effective outcomes in day to day activities

11 Conclusion and Recommendation

We are living in the era of information technology is dominating every sector like communication, banking, commercial activities, etc. It is everywhere but on the

other hand, there are also so many risks also grown related to this technology unless early measures are not taken the disaster can be very serious.

To be profitable in the above sectors and manage risks, there are proposed scientific and technological techniques.

Data mining is one the technology that has so many applicable features. In this paper an attempt is made to review the research works done on the application of data mining technology in different sectors namely ATM analysis, Customer Relationship Management, credit card fraud and intrusion detection system attack.

From the review, it is possible to draw the following conclusions:

- The predictive data mining helpful for analysis of ATM data to improve the quality of service that Banks provide to their customer
- Data mining techniques specifically K-means succeeded in clustering patients into a group according to the requested service.

- Neural network with Back propagation algorithm is the latest technique that has powerful capabilities of learning and predicting. It can play an important role in the task of credit card fraud detection if it is combined with the genetic algorithm.

- Based on the accuracy it is possible to prove how suitable decision tree is for modeling intrusion detection systems.

Hence what can we infer from these points that, data mining technology has got great potential in solving issues in selected research topic areas. Below here I would like to forward my recommendations to harvest pretty much from data mining technology.

- A data mining task will be more facilitated if the data warehouse is available or created previously so it will be easy to get readymade data for the data mining process.

- At this research, only four areas are reviewed but attention must be given to other business sectors for new findings.

- If further investigation is done on big Banks, radiology centers and companies with a computerized system, more accurate data mining result can be found.

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