AN ANALYTICAL SURVEY ON ELECTRICITY THEFT DETECTION SYSTEM USING CONSUMPTION DATA

KALPESH CHAUDHARI[1], MAHESH MYADAMWAR[1], MANISHA YADAV[1], SHUBHAM ANNADATE[1], N.K. PATIL[2]

[1]UG Student, Dept. of Computer Engineering, Savitribai Phule Pune University
[2]Assistant Professor, Dept. of Computer Engineering, Savitribai Phule Pune University
kchaudhari686@gmail.com;mnmyadamwar@gmail.com;manishav16@gmail.com;shubham.annadate96@gmail.com;nkp.sit@sinhgad.edu

ABSTRACT

The overall economic growth of India is mostly affected because of endemic electric energy and higher shortages of Electric power supply. Data mining has been used in numerous areas, which include both private as well as public sectors. This paper presents new ways to identify electricity theft by using some intelligence based techniques. The different techniques available for detecting electricity theft are Mobile Remote Checker, Wavelet based feature extraction, Support Vector Machine and Fuzzy based classification techniques. The most of the above mentioned methodologies have performance issues concerning space and time. This paper concentrates on analyzing techniques and to find a proper way to improve Electricity Theft Detection.

Keywords—Electricity theft, Expert system, Extreme Learning Machine (ELM), Online Sequential Extreme Learning Machine (OSELM), Intelligent system.

KALPESH CHAUDHARI **MAHESH MYADAMWAR** **MAHESH MYADAMWAR** **SHUBHAM ANNADATE**

I. INTRODUCTION

Electricity fraud can be defined as stealing of electric power by the means of illegal consumption activities. So, in order to reduce the losses due to electricity theft we need to find the fraudulent customers. But, it is very difficult to identify honest and the fraudulent customers.

Due to increasing population, Electricity distribution system is facing various challenges due excess use of available electricity illegally. This includes electricity theft, meter tampering, unpaid bills, billing irregularities. To find such customers with dishonesty by using efficient measurement has been an active research. This paper presents a framework to identify electricity theft activity i.e.

excess consumption of electricity, unpaid bills and faulty meters etc. To identify such dishonest and fraud customer OS-ELM and SVM are used with Automatic feature extraction method. This study uses various user's metered data. Various patterns of electricity used by customer are extracted by using data mining and statistical techniques. Thus we are able to detect fraud activities.

Losses in developing and developed countries can be significantly represented using Nontechnical losses. There are many statistical methods that have been used to check the behavior of the customer in a way that allows detection of NTL activities. The most widely used method is load profiling which is a pattern of electricity demand of the customer. Classification techniques like supervised learning are used in order to extract customers load profile and other data which is useful for NTL analysis. There are many online applications which are needed to be handled, thus OS-ELM has been proposed. The OS-ELM can be used for the real time applications in industries in order to accommodate the data.

For the classification of the given samples we need the Kernel functions present in Support Vector Machine (SVM) that are needed to analyze the similarities between the input samples. Some standard kernels like Gaussian and Polynomial kernels are used to analyze the input samples, but in addition to that there are some kernels which are specially designed to consider structure in the samples. In this paper probabilistic mixture density models are used in order to capture the pattern in data, like Gaussian mixtures for real-valued spaces.

II.   LITERATURE SURVEY

Proposes a method that provides insight into the illegal use of abstraction of electricity. The importance and the economic aspects of theft detection are presented and current practices and experiences are discussed. A novel methodology for automated detection by illegal utilization of electricity in the future distribution networks equipped with smart metering infrastructure is proposed. This method may not be much efficient as this proposed system is found to be little bit complex as far as distribution network is

concerned. This methodology may save time as helps to maximize profit margin but is complex in its application. In future, this project can be implemented in remote areas, for three phase electric distribution system in India. [3]

Introduces a concept of Smart grid that is being used in order to modernize the electricity distribution system in most of the developing countries. The role of the Smart grid is to monitor, protect and optimize the operations of the interconnected elements automatically. The disadvantage of this system is that it can be easily hacked or hooked, so it is not completely efficient and the cost for the implementation is also very high. Veenetha Pruchuri proposed a mechanism in order to detect the electricity theft by using the BOUNCE algorithm along with some IEEE protocols like p1675 protocol. But this mechanism was only applicable to distribution lines which are highly equipped so the mechanism was not useful for the rural areas. Yang Xioa implemented a technique that discovers the meters which are problematic and provides inaccurate readings. This method was not that efficient because it considers only the nearby meter readings and do not provide the exact location of the theft. [2]

Describes a method that presents the Link method facility and Remote terminal facility in the control room. In the Link method they tried to link main energy meter in the substation transformer and the user energy meter, and proposed that output of user's single phase electric energy meter has an proportional relationship with power. It is not suitable in all cases in all the areas. All this method is based on an above mentioned assumption which is impractical in real case scenarios of electricity distribution and consumption. Also it is very expensive and is not practically possible to reach each and every rural area of the country. [4]

Narrates a method proposed by Christopher and Pravin Thangaraj which is based on Power Line Communication Concept. In the distribution network, High frequency changes its amplitude and frequency due to load in the Electricity Line Changes. Gain Detector is used to detect such a

change in high frequency. This can be detected if any activity is done between any two electricity poles and because of that change in Gain occurs and thus we are able to detect theft of electricity and can neutralize that theft but not able to detect improper usage by people and also one main disadvantage for this technique is that it is based on Infrastructure. [5]

Elaborates a method where approach history of user's data usage is used which tends to the creation of customer's information about load profile. Pre-processing of data used by customer is done which includes Data Selection, Data Separation and Data Normalization. After this Important data is automatically taken and then the data is arranged according to abnormal usage of data through the use of ELM and SVM. But SVM is not much accurate so just because of this use of SVM the accuracy of theft detection may reduce. [1]

III. ALGORITHMS

A. FUZZY LOGIC

The Fuzzy logic is the multi-valued logic in which the truth value of the variable may be any real number between 0 and 1. It is mainly used to handle the concept of partial truth and the truth value may range between completely true and completely false. The non-numeric values can also be used in order to facilitate the expressions of rules and facts. The Fuzzy logic imitates the way of decision making in humans that involves all the intermediate values between true and false. The fuzzy logic works on the levels of possibilities of input so that it can achieve definite output. It is a solution to complex problems in all fields, including medicine, as it imitates human way of reasoning and decision making.

B. DATA PROCESSING

Data processing is collection and manipulation of the data items so that it can be used to obtain the meaningful information that can be put to use. It is the way of re-structuring the data either by human or by the machine in order to increase the usefulness of that data. The Data processing works in three stages of input, processing and finally the output stage. Data

processing may involve image processing and template matching. The output of the operations can be in the form of audio/video, numeric, or text data file.

C. ARTIFICIAL NEURAL NETWORKS

Artificial Neural Networks are most powerful learning model. They can have wide range complex functions which represents multidimensional input and output maps. ANN is also an information processing paradigm that is motivated by biological nervous system like brain. ANN is used to estimate or approximate functions that can depend on large number of inputs are generally unknown.

D. K-MEANS ALGORITHM

K-means is simple unsupervised learning algorithm which forms various clusters. In K-means approach the data objects are classified based on their attributes or features into K number of clusters. In this K centroids for K clusters which are generally far away from each other are defined and then group the elements into the clusters, which are nearer to the centroid of that cluster. This algorithm aims at minimizing an objective function.

IV. CONCLUSION

Theft of electricity consumption adversely effects the national growth of any country. To address this problem more efficiently data mining techniques plays vital role to identify the theft by taking consumer consumption details of past months as the input. This paper tries to analyze the various techniques that are involved in this forensic analysis system of theft detection and tries get the glimpse of the major flaws in the system. In the end this paper comes to a conclusion that artificial intelligence systems are more efficient than the other techniques of data mining to catch the culprit more efficiently, whose incorporation will definitely enrich the system of theft detection in electricity.

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