Review Of Detection Of Electricity Theft In Smart Grid Environment

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Abstract: Electrical energy plays an important role in our day to day life and backbone for the industries. Today we can't imagine life without electricity. Because of the unnecessary actions taken by human beings, wastage, and theft of power increasing day by day. If proper actions are not taken to save electricity, future generations have no scope of living their life in light, peace, and harmony. Electricity theft is a great concern for the utilities. Many times power theft has been a major impact on the economy as well as the development of the country. The objective of this project is to design a system that will try to minimize the illegal use of electricity and also reduce the chances of theft, and if theft happens appropriate actions will be taken.

Keywords: **Energy Meter, Convolutional Neural Network, Advanced Meter Infrastructure, System Operators, System Grid**

I Introduction

Electricity theft is a very common problem, especially in our country. As our population is high so the use of electricity is tremendously high. There are many operational losses involve in the generation, transmission, and distribution of electrical energy. Whereas the losses implicated in generation can be technically defined, but transmission and distribution losses cannot be precisely quantified with the sending end information. In T&D the Technical losses are computed with the information about total load and the total energy bill. Electricity theft is a social evil, so it has to be eliminated completely. Power consumption and losses have to be closely monitored so that the generated power is utilized in a most efficient manner. The system prevents the illegal usage of electricity.

A large amount of electricity will save by implementation of this system will, and thereby electricity will be available for more consumers than earlier, in a highly populated country as INDIA. Of all the inventions made by mankind electricity is the most important one. Today's life is impossible to imagine without electricity. In India, every year there is very increasing number of electricity thefts across domestic electricity connection as well as industrial electricity supply, which results in loss of electrical energy and because of which we are facing the frequent problems of load shedding in urban as well as rural areas so as to overcome the need of electricity for whole state. Also the ways using which theft can be done are innumerable so we can never keep track of how a theft has occurred, and this issue is needed to be solved as early as possible.
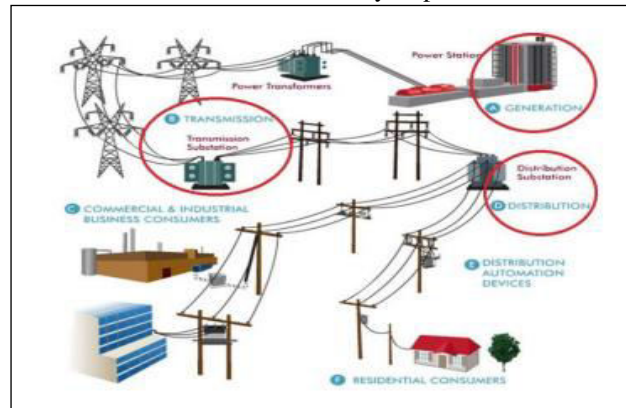

Fig 1. Electrical Network

Electrical Power System-Energy is a necessary input in creation models along with capital, technology and labor and its sustainable supply at reasonable prices is estimated for a modern economy. It is therefore, a permanent constraint to output development. Electricity shortfall effect economic development, causes joblessness, and increases the cost of manufacturing and doing businesses. Various studies specify the relationship among economic development and electricity consumption either through a demand-side model [1]. To full fill the demand of electricity consumers we need to have some good generating stations with well equipped generating plants and efficient generation capacity [2].

Generating plants are usually located near a source to fully utilize the flowing water in case of hydropower generation or other sources as per type of generating plant, Electrical energy is generated in large hydro-electric, thermal and nuclear power stations which are located far away from the load centres [3]. They are usually quite large in order to take advantage of the economies of scale. This necessitates a widespread power supply set-up between generating stations and the consumer's loads. This network is divided into two parts:

Power Theft -Theft of electricity is the illegal practice of thieving electrical power. It is a crime and is punishable by fines and/or imprisonment. According to the annual Emerging Markets Smart Grid Outlook 2015, study by the Northeast Group, LLC, the world loses US$89.3 billion annually to electricity theft. The highest losses were in India ($16.2 billion), followed by Brazil($10.5 billion) and Russia ($5.1 billion). The state of Maharashtra which includes Mumbai alone loses $2.8 billion per year, more than all but eight countries in the world. Nationally, total transmission and distribution losses approach 23% and some state's losses exceed 50%.

Types of Theft -There are more ways to snaffle power. Some techniques are very simple, but effective, while others are sophisticated and difficult to detect including tapping a line or bypassing the energy meter. According to a study, 80% of worldwide theft occurs in domestic consumers and 20% on commercial and industrial premises. The various types of electrical power thefts are as follows.

- Direct hooking from line Hooking is the most used method. 80% of world's power theft is by direct tapping from the line. The thief taps into a power line from a point ahead of the energy meter. This energy consumption is immeasurable and procured with or without switches.
- Bypassing the energy meter in this method, the input and output terminals of the energy meter is short-circuited, preventing the energy from recording into the energy meter.
- Injecting foreign element into the energy meter Meters are controlled via remote by installing a circuit inside the meter, so that the meter can be slowed down at any time. This type of changes can evade external inspection attempts because the meter is always shows correct reading, unless the remote is turned on.
- Physical obstruction this type of theft is done to electromechanical meters with a rotating element. Foreign material is placed inside the meter to disturb the free movement of the disc. A slower rotating disk signals less energy consumption.

LITERATURE SURVEY

In [1], a brand new method towards Nontechnical loss (NTL) detection in electricity utilities the usage of synthetic intelligence based method and pattern category method so that you can locate and pick out load intake patterns of fraud customers. on this device client committing fraud activities before the 2 year length will not be detected by means of the FDM.

In [2] numerous theft detection approach was proposed, based totally on purchaser no longer paying the bill, bypassing the poles, reception of misused power, tapping on a transmission line as defined.

In [3], unearths out on which electrical line there may be tapping. This is a real time machine. wi-fi records transmission and receiving technique is used. This could offer an extra facility of wireless meter studying with the identical technique and in identical price. This will shield the distribution network from strength theft carried out by means of tapping, meter tampering and so forth. The proposed gadget located to be a little bit complex as far as distribution community is concerned; however, it's an automated gadget of theft detection.

In [4], incidents of power theft wherein cheating customers might decrease their strength payments by using tampering with their meters. The physical attack can be extended to a community assault by means of fake records injection (FDI). A hybrid detection framework is evolved to come across anomalous and malicious sports so that the community observability and detection accuracy may be advanced by means of grid-located sensor deployment. The hindrance of the proposed technique is confined to a one-participant attack. p.c's are used for excessive overall performance installation protection system. it is able to be received only at the fee of fantastically complicated relay scheme.

The design of an electric Meter for lengthy-distance data © information transfers which based totally upon GPRS is proposed in [5]. These systems can't be carried out so easily because the everyday use of GPRS is still a dream to the commonplace humans. A GSM-based totally concept is used to generate a bill is to be had as SMS on the time of era itself and hard copies are to be had to the consumer as postal mail. A smooth reproduction can be ship to the client's e-mail if the consumer is registered together with his e mail deal with [19]. These days, the set of factors has come to be a famous time period for describing eventualities in which internet connectivity and computing functionality make bigger to the diffusion of objects,

devices, sensors, and ordinary gadgets. Whilst the time period "net of things" is quite new

The concept of mixing computers and networks to reveal and manage devices has been round for decades. effective information fusion strategies broaden for improving occupancy monitoring accuracy is proposed in [6] using a multitude of resources for the occupancy series of data, IR sensors are used for the detection of the existence of the persons and it's going to be counted the humans in the homes coming into. IOT comes into the photograph with the involvement of smartphones, and wi-fi APs. a unique design approach of minimizing the queue is discussed in [7], the power billing counters and to restrict the usage of energy mechanically, if the invoice isn't always paid and also reduces the loss of energy and sales because of strength thefts and different unlawful activities. This module will reduce the complexity of providing energy by establishing the connection easily and no theft of power will take place.

In[8] system eliminates the human involvement in electricity maintenance. The system is inefficient in terms of monitoring our energy consumption. Also, the provision for generating bills automatically is limited and inefficient

In this paper, [9] had proposed with GSM modules helps company to monitor the amount of usage by this specified costumer and generate bill periodically and send it to costumer via SMS, thus saving lot of labour work, time and cost of reading .The proposed found to be little bit complex as far as distribution network is concerned, but it's an automated system of theft detection. It saves time as well as help to maximize profit margin for utility company working in electrical distribution network. In this paper,

[10] Had done the project model to reduce the manual manipulation work and theft. Use of GSM in our system provides a numerous advantages of wireless network system. The government saves money by the control of theft in energy meter and also more beneficial for customer side and the government side. The metering IC ensures the accurate and reliable measurement of power consumed. Cost wise low when compared to other energy meter without automatic meter reading and theft control.

In this paper,[11] S had done the system, in which service provider can collect the bill any time with a single message. The data collection and manipulation task becomes fast and easier. Any modification can be made to the code in less time. Changes in rate or unit calculation can be done very effectively. The project model reduces the manual manipulation work and theft. Uses of GSM in

our system provide the numerous advantages of wireless network systems. The metering IC ensure the accurate and reliable measurement of power consumed. Hence we are trying to manipulate cost wise low when compared to other energy meter without automatic meter reading and theft control.

In this paper,[12] In this paper we are going to proposed GSM based Electricity theft detection system. The system would provide a simple way to detect an electrical power theft without any human interface. This project can be implemented and validated in remote areas. In this system we are looking forward to implement temperature sensor to avoid the short circuit in the system. In this paper,[13] In this proposed system, RF transmission is used to transmit the meter(M1) reading to PIC microcontroller and second reading from pole side meter(M2) directly taken for comparison. If PIC result is negative then theft is occur. This then send consumer meter number with pole number through a message to authority by using GSM technology.

Energy theft is a notorious problem in electric power systems, which causes great economic losses and threatens the reliability of the power grid. Recently, the Smart Grid has been proposed as the next-generation power system to modernize the current grid and improve its efficiency, sustainability, and security. Key technologies of the Smart Grid include smart meters, which allow system operators to collect real-time power consumption data from users, and microgrids, which allow users to own and control renewable resources. However, the Smart Grid is vulnerable to cyber attacks, thus making stealing energy much easier in it. Most existing energy theft detection schemes require the collection of real-time power consumption data from users, i.e., users' load profiles, which violates their privacy.

In this paper, we first propose a centralized energy theft detection algorithm utilizing the Kalman filter, called SEK. It can efficiently identify the energy thieves but cannot protect users' privacy. Then, based on SEK, we develop a privacy preserving energy theft detection algorithm called PPBE, which privately finds the energy thieves by decomposing the Kalman filter into two parallel and loosely coupled filters. Finally, we conduct thorough privacy analysis and extensive simulations to validate our proposed algorithms.

[14] As one of the key components of the clever grid, advanced metering infrastructure brings many ability benefits which include load control and call for response. but, computerizing the metering machine additionally

introduces numerous new vectors for electricity theft. On this paper, we gift a singular intake pattern-based power robbery detector, which leverages the predictability belongings of customers' normal and malicious consumption styles. The use of distribution transformer meters, areas with a excessive probability of strength robbery are short listed, and by way of tracking abnormalities in consumption styles, suspicious customers are identified. Utility of suitable class and clustering techniques, in addition to concurrent use of transformer meters and anomaly detectors, make the algorithm sturdy against nonmalicious changes in utilization sample, and offer a high and adjustable performance with a low sampling fee. Therefore, the proposed method does no longer invade clients' privacy. Extensive experiments on a real dataset of 5000 clients show a high performance for the proposed technique.

[15] In superior metering infrastructure (AMI) networks, smart meters installed at the client aspect should record best grained electricity intake readings (every few minutes) to the system operator for billing, actual-time load tracking, and electricity control. Alternatively, the AMI networks are susceptible to cyber-attacks where malicious clients document fake (low) power consumption to lessen their payments in an unlawful manner. Therefore, it's far imperative to expand schemes to appropriately discover the customers that steal strength by means of reporting fake energy utilization. but, this great grained information that is used for energy robbery detection, load monitoring, and billing also can be misused to infer sensitive facts regarding the consumers which includes whether they may be on tour, the home equipment they use, and so forth.

In this paper, we endorse an efficient and privacy-keeping electricity theft detection scheme for the AMI community and we talk to it as PPETD. Our scheme allows system operators to perceive the energy thefts, display the masses, and compute energy bills efficaciously the use of masked best-grained meter readings without violating the customers' privacy. The PPETD uses mystery sharing to permit the consumers to send masked readings to the device operator such that those readings can be aggregated for the motive of tracking and billing. in addition, secure - birthday party protocols using mathematics and binary circuits are finished via the device operator and each purchaser to assess a generalized convolutional-neural community model at the suggested masked exceptional-grained energy intake readings for the purpose of electricity theft detection.

[16] Scikit-examine is a Python module integrating a wide variety state of the art machine trendy algorithms for medium-scale supervised and unsupervised problems. This bundle focuses on bringing gadget brand new to non-specialists the use of a preferred-reason high-level language. Emphasis is put on ease present day use, overall performance, documentation, and API consistency. It has minimum dependencies and is sent below the simplified BSD license, encouraging its use in both educational and industrial settings.

[17] Power robbery is a notorious trouble in electric powered electricity systems, which reasons extraordinary economic losses and threatens the reliability of the power grid. Currently, the smart Grid has been proposed as the next technology electricity gadget to modernize the modern-day grid and enhance its efficiency, sustainability, and safety. Key technologies of the smart Grid consist of smart meters, which allow gadget operators to collect real-time strength consumption records from users, and microgrids, which permit users to own and manage renewable resources. However, the smart Grid is liable to cyber assaults, accordingly making stealing electricity lots less difficult in it. Maximum current power theft detection schemes require the gathering of realtime strength consumption information from customers, i.e., customers' load profiles, which violates their privateness.

On this paper, we first endorse a centralized power theft detection set of rules utilizing the Kalman clear out, referred to as SEK. it can efficiently perceive the energy thieves however can't guard users' privateness. Then, based on SEK, we develop a privateness-retaining strength theft detection algorithm known as PPBE, which privately unearths the energy thieves by way of decomposing the Kalman clear out into parallel and loosely coupled filters. Subsequently, we behavior thorough privacy analysis and vast simulations to validate our proposed algorithms [18] A CNN model is used to detect fraudulent consumers. on this scheme, SMs send their encrypted energy consumption readings to two system entities. One entity, which is believed to be absolutely relied on, is chargeable for jogging a CNN version (i.e., power theft detector) after decrypting the purchaser's first-rate-grained readings, and then reports the output of the model to the SO. Another entity, which is assumed distrusted, aggregates the customers' encrypted electricity consumption readings in a positive residential place to obtain the aggregated reading for load monitoring without being capable of learn the character readings to hold privacy. Nearly, its miles difficult to ensure that an entity might no longer abuse

purchasers' information; similarly, this scheme cannot support dynamic billing.

[19] Present day clever grids depend upon superior metering infrastructure (AMI) networks for monitoring and billing purposes. However, such an technique suffers from strength robbery cyber attacks. Unique from the prevailing research that state-of-the-art shallow, static, and client-particular based power theft detectors, this paper proposes a generalized deep recurrent neural community (RNN)-based strength robbery detector which could effectively thwart these cyber attacks. The proposed model exploits the time collection nature latest the clients' strength intake to put in force a gated recurrent unit (GRU)-RNN, as a result, enhancing the detection overall performance. Further, the proposed RNN-primarily based detector adopts a random seek evaluation in its today's level to correctly high-quality track its hyper-parameters. Huge check research are executed to analyze the detector's performance the use of publicly to be had actual records modern-day 107,2 hundred electricity consumption days from 2 hundred customers. Simulation results show the advanced overall performance today's the proposed detector as compared with power robbery detectors.

III CONCLUSION

In this paper we have reviewed three schemes for controlling electricity theft. Advance metering infrastructure introduces a smart meter and communication path way between user and consumer which is an efficient work for controlling theft through data management and load controllers. Advance metering infrastructure is applied on a wider range of consumers which can somehow reduce the observability of each and every consumer in a short time period; therefore introduction of central observer meter can modify this broad range of consumers to number of grouped consumers. In this scheme each group will be observed by load controllers and if any miss act is found in consumption of electricity the user will be tripped from the circuit. This central observer meter scheme is better than advance metering infrastructure but before tripping the user it would be best if it first alert or warn the user .Therefore dwelling towards prepaid energy meters used for theft control are more efficient. Consumers are under supervision of prepaid energy metering scheme, and they get alerts on every instant and are coerce for recharging the cards for further energy usage. In this scheme theft is controlled in an affable way.

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