

An Efficient Approach to Electrical Power Theft Detection & Reporting using Smart Systems

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Abstract— Electricity theft can be defined as, using electricity from the utility without a contract or valid obligation to alter its measurement. It is a criminal practice and power utilities are losing billions of rupees in this account. Such activity provides loss for government and indirectly to the people also. In the proposed work, detecting the system is made over arduino nano programmer and ATmega328P_PU microcontroller. The system works with the concept of vibration. If someone tries to do any type of tampering to the electricity meter then automatically it's sending the information to electricity board and junior engineer. The system is highly implementable and can be used for real-time applications.

Key words: Electricity Theft, Non-Technical Loss (NTL), Smart Meter, GSM

I. INTRODUCTION

Non-technical loss (NTL) during transmission of electrical energy is a major problem in developing countries and it has been very difficult for the utility companies to detect and fight the people responsible for theft. Electricity theft forms a major chunk of NTL. These losses affect quality of supply, increase load on the generating station, and affect tariff imposed on genuine customers. This paper discusses the factors that influence the consumers to steal electricity. In view of these ill effects, various methods for detection and estimation of the theft are discussed. This paper proposes a system of smart meter, internal control, reporting system using SMS, automatic power shut off. Motivation of this work is to detect illegal consumers, and conserve and effectively utilize energy. As well, smart meters are designed to provide data of various parameters related to instantaneous power consumption. NTL in the distribution feeder is computed by external control station from the sending end information of the distribution feeder. If a considerable amount of violation is detected using vibration sensor.

A. Factors that Influence Illegal Consumers

There are many factors that encourage people to steal electricity. A common Notion in many people is that, it is dishonest to steal something from their neighbour but not from the state or public owned utility company. In addition, other factors that Influence illegal consumers are:

- Growing unemployment rate show severe effect on the customer's economic situation.
- Lower illiteracy rate in under developed communities has greater impact on illegal consumers, as they might not be aware of the issues, laws and offenses related to the theft.
- Weak economic situation in many countries has implied its effect directly on common man.
- In view of socio economic conditions of the customer, electricity theft is proportional to the tariff of electricity utilization.

- Countries with weak enforcement of law against electricity theft have recorded high proportion of theft.
- Corrupt political leaders and employees of the utility company are responsible for billing irregularities.

B. Effects of Electricity Theft

Negative effects of electricity theft are severe and dangerous. Primarily, electricity theft affects the utility company and then its customers. In addition, electricity theft overloads the generation unit. In energy market, utility companies expect their money back from the customers for the electricity supplied, most of which is lost by them due to the NTL. Electricity theft is a serious concern for utility companies as they are under threat of survival because of these incurring economic losses. It is evident that some utility companies in developing countries are losing about 10 to 30 percent of their total revenue, which shows that they could not invest on measures to reduce the electricity theft. These economic losses affect the utility company's interest in development of the devices in view of improving the quality of supply or for electrification process.

C. Methods of Theft

Methods used to commit theft fall into the following broad categories:

1) Connection of Supply without a Meter

Connection of supply without a meter following disconnection for non-payment or by "squatters" occupying empty properties.

2) Bypassing the Meter with a Cable

It coveted into the supply side of the metering installation (i.e. the meter terminals, the metering cables, the cut-out or the service cable).

3) Interfering with the Meter to Slow or Stop

The disc, including use of electrical devices which stop the meter or cause it to reverse (so-called 'black boxes).

4) Interfering with the Timing Control

Equipment used for two rate tariffs to obtain a cheaper rate. Methods (C) and (D) usually involve removal of official (certification) seals and/or company seals

D. Identification of Theft

1) Financial Rewards

Utility companies encourage consumers to report electricity theft, sometimes offering big rewards for information leading to conviction of anyone stealing electricity. Unfortunately, most cases are never identified in the apartment industry due to lack of timely information.

2) Periodic Checks

Electricity theft frequently takes place after service has been disconnected. Some utility companies periodically check disconnected meters if the customer has not contacted them to reconnect service. This labour-intensive, manual process has little chance of success given that the apartment industry averages 70% turnover of tenants annually.

3) Meter Readers

Utility meter readers typically suspect that electricity theft is taking place when they find a broken meter tag or other signs of tampering. But as more utility companies outsource the meter reading function to third parties, training meter readers to detect theft is becoming more difficult and less efficient. In addition, third party meter readers do not read disconnected meters.

II. REVIEW OF RELATED WORK

A. Electricity theft Detection using SVM, SMS

There are many methods which have been proposed for theft detection. Many of these methods include load profile analysis of customers to detect abnormal energy consumption patterns. But these methods cannot be used to detect energy thefts when there is a complete bypass of electricity meters. In such cases, electricity losses are calculated by using energy balance between the energy supplied from the distribution transformer and the energy consumed at the consumer's end. An effective way for estimating nontechnical losses in the electricity distribution network is correctly estimating the technical losses in the network and then subtracting it from the total loss in the network.

1) Theft Detection using SVM

This paper presents a novel approach for detecting non-technical loss in electricity transmission. An artificial intelligence based technique SVM (Support Vector Machine) is used. SVMs are one of the best-known techniques with computational advantages over their contenders. This method uses data mining techniques for feature extraction from old energy consumption data from consumers. The SVM method utilizes the load profile data of consumers and extra qualities to identify the irregular electricity usage. As the result of this method, some classes of consumers are produced who are shortlisted to be evaluated as suspects, for the purpose of inspection those consumers based on significant behaviour that arises due to deceptive activities. SVM does not need to be linear or even have the same function form of all data obtained. Its function is non-parametric and it operates locally. SVM provides a good result out of generalized samples, if the Gaussian and Kernel parameters chosen and provides a unique solution. But the SVM technique lacks the transparency of results.

2) Theft Detection using RF transmission

In this system, Radio Frequency (RF) transmission is used to establish the communication between the EB server side and the consumer end. RF signals are used to establish the wireless communication between EB server side and Consumer end so that server side can access the information about the measured units of consumed electricity at the consumer side. RF signals are used to make the system autonomous and reduce number of cables. When the current transits from the distributor side to the consumer end, if the total amount of power is not received by the consumer, then there is a possibility of electricity theft. Then this information about the system is displayed through the Wi-Fi space to the EB server side.

3) Theft Detection using GSM

A GSM based technique for Electricity Theft Detection is proposed in this paper. In electricity metering system,

tampering is done basically for the purpose of electricity theft. To protect the electricity energy meter from this theft, attempt a lever switch is used at the opening of the meter. The lever switch is connected to interrupt pin of the ARM processor which is configured as pull down. Hence closed switch applies 3.3V to the interrupt pin and opened switch drives the voltage to zero. The switch normally closed when the meter chassis is closed. If someone tries to open or tamper with electricity energy meter, that switch gets opened and the interrupt pin gets triggered as 0V is sensed by it. The ARM processor immediately sends AT comments to GSM for sending SMS. Upon receiving SMS, the authority can take further legal action against it and penalize the guilty person.

4) Theft Detection using IoT

An IoT based tamper or theft prevention system for electricity energy meter. This paper proposed an embedded system to prevent electricity theft with the use of Internet of Things, a recent technology. This embedded system consists of a Wi-Fi module attached to electricity meter for the purpose of connectivity, a microcontroller for controlling the major functions. The Passive Infrared (PIR) sensor is being used for the purpose of sensing the tampering attempt and Solid State Relay is used for the purpose of actuation on detecting the tampering attempt. In addition to this, there is an additional facility of sending the GPS location of the meter to the distribution company portal or Electricity Board server. Thus, the proposed system will reduce electricity theft and makes the electricity system smart.

III. PROPOSED WORK

The proposed approach deals with the tampering detection system for electric meters shown in fig 1. The meter at homes will be combined to vibration sensor so to detect and monitors electricity theft. Vibration sensor is used to detect the tampering. 16 x 2 LCD is used to display whole process. Power supply to power up whole system. Once the meter starts if any tampering is done the report will be immediately sent to the highest official and police station to take further access with consumer name, address, consumer id etc. We use SIM 800 GSM modem to send SMS and At mega Microcontroller for logic analysis. Vibration sensor is used to detect any changes in the position axis of the meter. The programming language used is Embedded C. If someone tries to damage the seal or bypass the meter then meter orientation changes and tampering is detected. This will be reported to officials in terms of SMS to any number of users. Overall Functionality will display in LCD display. This is 100% practically implementable in real-time.

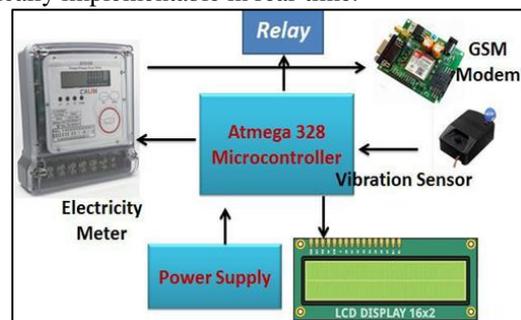


Fig. 1: Block Diagram of Tampering Detection System for Electric Meters

A. Input Design

In this input design, the vibration sensor senses the vibrations in the meter box. This vibration sensor sends information to transformer. It is used to run the Arduino IDE then Arduino IDE receives the message. Then the message send to the receiver is displayed in LCD display. The receiver details are already programmed inside microcontroller.

B. Output Design

A liquid crystal display (LCD) is a thin, flat electronic visual display that uses the light modulating properties of liquid crystals (LCs). LCDs do not emit light directly. Liquid crystal display (LCDs) is a passive display technology. This means they do not emit light; instead, they use the ambient light in the environment. By manipulating this light, they display images using very little power. This has made LCDs the preferred technology whenever low power consumption and compact size are critical. They are used in a wide range of application, including computer monitors, television, instrument panels, aircraft cockpit display, signage, etc. They are common in consumer devices such as video players, gaming devices, clocks, watches, calculator, and, telephones. LCDs have displaced cathode ray tube (CRT) displays in most applications. They are usually more compact, lightweight, portable, less expensive, more reliable, and easier on the eyes. The Short Messaging Services (SMS) is used to send text messages from the local transmitter to the remote receiver. The SMS is a feature from the evolution of the GSM standard over a few years into General Packet Radio Services (GPRS). This was developed to increase the data rate from the original 9600 bits per second up to 40 kilobits per second. The Short Messaging Services (SMS) is used to send text messages from the local transmitter to the remote receiver. The SMS is a feature from the evolution of the GSM standard over a few years into General Packet Radio Services (GPRS). This was developed to increase the data rate from the original 9600 bits per second up to 40 kilobits per second.

IV. CONCLUSION

A system of electricity theft detection and alert to Electricity Board was developed. It defines electricity theft in social, economic, regional, political, infrastructural, literacy, criminal and corruption points of view. illustrates various cases, issues and setbacks in the design, development, deployment, operation, and maintenance of electricity theft controlling devices. In addition, various factors that influence people to steal electricity are discussed. It makes the electricity theft almost impossible if implemented in real time. With minor attachment in Present electricity meter it can produce the reliable output. Vibration sensor we used is of commercial standard

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