DETECTION OF ELECTRICITY THEFT BY USING PLC TECHNIQUE FROM POWER CONSUMERS WHILE DISTRIBUTION OF ELECTRICITY

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Abstract— Now a day, Electricity theft is one of the major losses for department of electricity board. In the electrical power system, Electricity theft is Non technical losses which are created by illegal consumers in the distribution network. Distribution power losses arise from several areas including the power theft, un-billed accounts, and estimated customer accounts, errors due to the approximation of consumption by un-metered supplies and metering errors. Electricity theft can be in the form of meter tampering, illegal connections (stealing), billing irregularities, and unpaid bills. The detection of electrical theft by the consumers can be monitored by using the PLC technique which means power line carrier signal which is injected in the transmission line and this will detect the illegal usage of electricity in prior and maintains the power factor. The results will be monitored by using the MATLAB software, it shows simulation results and about the scheme as simple.

Keywords- Electricity theft, PLC (power line carrier communication), power line carrier signal.

I. INTRODUCTION

These days with emerging developments in all sectors and growing demands, electricity has become priority for every individual and every organization. The basic procedure for power supply includes power generation, power transmission and power distribution to the destinations. Naturally owing to few technical faults, losses may occur due to power dissipation by some devices. These losses can be minimized using the fast developing technology. Other losses which is caused deliberately by human beings for the sake of illegal access to the power distribution called power theft.

Power theft is also prevalent in developed countries like USA and Britain. According to Forbes’ report, in Canada, about $500million of electricity is stolen in Ontario and up to $6billion of electricity is pirated in USA. Many individuals who cannot afford paying the electricity bills often run wires directly to circuit breakers, tamper with meters or steal meters from vacant houses.

Power Tapping is Often power theft is done during transmission by illegal tapping of the power lines to divert the power to the required destinations. It is also done by illegal connections to the power grid stations, which are cut at the time of billing.
In many areas where manual reading of the meter is done, the person is often bribed to give false readings and thus the amount paid is for lesser amount of power compared to the power actually consumed. Also meters are tampered by obstructing the motion of the disk (usually electro mechanical consists of slowly spinning disks to record the power consumed) named as meter fraud.

**II. PROPOSED ANALYSIS**

The proposed system is to detect and monitor the theft of electricity using the principle of Power Line communication higher frequency can be transmitted in the power line along with the power frequency signal. The variation in the amplitude of this carrier signal can be monitored at regular intervals and

In developing countries like India, power theft is one of the most prevalent issues which not only cause economic losses but also irregular supply of electricity. It hampers functioning of industries and factories, due to shortage of power supplied to them. It causes shortage of power supply to homes. It leads to loss of revenue by Government as individual enterprises may opt to install their own power generators, increases corruption in form of bribes and many more. Ultimately it is the country’s economy which suffers along with the country’s political reputation the theft of electricity can be detected by the computation of the differential change in the amplitude of the carrier signal.

This PLC theft detection system is designed and developed for monitoring the substation for charging the line by power line carrier signal and clearing the line remotely, also controlling the supply of power for the feeder lines and maintaining the power factor.

The system has been designed such that master microcontroller monitor the load connected to the transformer and controls the feeders supply.

Switching the supply between the feeders on regular time basics, the slave microcontroller monitor the load current of individual load and total load consumption data is send to the master device by using the power line communication technology, the master compare the data with the exact load connected to the transformer if any mismatches happens the master will detect the power theft from particular feeder lines and intimate the vigilance team.

The slave controller monitor the low power factor at the consumer side and intimate the consumer by buzzer to maintain the power factor as per the standards. Also the slave controller in substation monitors the feeder power factor and switches the capacitor bank for particular feeder line for the Quality improvement.

A photodiode is placed on the shaft of the rotating disk on the meter and is illuminated with IR light from the IR LED. In normal operation, the output of the photodiode gives a logic low signal to the Microcontroller. However when the meter is tampered, i.e. the disk rotation is obstructed or the meter cover is removed, an obstacle is created between the LED and the photodiode, resulting in a logic high signal to the Microcontroller. The Microcontroller detects this change in logic signal and based on this, sends a message to the GSM modem through the level shifter Max 232. The GSM modem then sends the message about energy meter being tampered at the particular location, to the power distribution grid and appropriate action is taken accordingly.
Either the power supply to the organization or the house is cut off or energy meter is replaced in case of any damage. Power tapping can be detected by comparing the power distributed to the line and the power actually consumed by the load. This is done by installing an electronic energy meter at the load side and the meter readings are send wirelessly to the distribution unit.

This reading is received by the wireless receiver and is compared with the actual power given to the load. The difference in readings indicate the error and this error signal is given to a controller which in turn controls the secondary voltage of the transformer, thus causing the transformer to stop the supply of power. Thus power theft by tapping is detected and it is prevented by halting the power to the line totally.

**PLC design for electricity theft detection**
A. ENERGY METER

* Energy meter Tampering can be detected by using a simple arrangement of IPR led and photodiode. It is used where energy meters are used.

![Energy meter with GSM Power Tapping Detection and Prevention](image)

**Energy meter with GSM Power Tapping Detection and Prevention**

a. **POWER LINE CARRIER COMMUNICATION (PLC) IN ELECTRICITY THEFT**

A power line carrier (PLC) communication system operating on a conventional three wire (hot (H), neutral (N) and ground (G) wires) power line uses more than one of the several RF transmission lines that are defined by the three wire power line to improve communication between units of the PLC system. According to a first embodiment, a PLC system transmitter sends out of phase RF signals across the H and G wires and across the N and G power wires to the PLC system receiver, which receives and combines both of the out of phase transmissions, and so even if one of these paths is severely attenuated, the other path can deliver a sufficiently strong RF signal to the receiver for effective communications. Using the PLC communication system, an automated meter reading can be enabled reducing the walk by reading methodology, and with the mechanical subsystem in it shall be able to disconnect the main grid power supply. Our system monitors supply, computes demand, requests information on current consumption to all nodes in real-time, use an IP-SMS functionality to report of theft of power to concern individual of locality, able to remotely disconnect power supply of any connected system as well as building database of all activities.

![Schematic representation of power-line carrier in distribution network](image)
C. METHODS OF ELECTRICITY POWER THEFT

There are primarily four conventional ways of illegally using electricity, as follows –

- Mechanical object – one uses a mechanical object to reduce the rotation of meter, so that disk speed is reduced and the recorded energy is less than actual.

- Using a fixed magnet – one uses a fixed magnet to change the electromagnetic field of the current coils since the recorded energy is proportional to electromagnetic field, but the fixed magnet reduces the field.

- Using the external phase before terminals – this method gives subscribers free energy without any trace in the electricity meter.

- Altering the initial reference value of the meter – this is a very basic act, and can be done only at the first installation hence this act can easily be controlled.

D. DRAWBACKS OF EXISTING THEFT PREVENTION MODELS:

Though several methods are available, the percentage of power theft is not reduced because of the fact that these methods have their own disadvantages due to interpretation of data regarding power, efficiency and accuracy to pinpoint the place of theft.

- Under Fuzzy Logic technique of detection of power theft, the area where the power theft occurs can only be determined and not the exact location of the power theft.

- While considering the Energy meter method, installation cost is very high as each and every pole has to be installed with an energy meter.

- By the use of Automatic Metering Interface technique, transmission and reception of Meter reading is tough since digital signals are to be utilized which is not cost effective and maintenance cost is also high.

The proposed system overcomes these adversities to present an efficient and simple scheme to determine the point of power theft due to cable rigging with precision.

III. ELECTRICITY THEFT PREVENTION SIMULATION MODELS

Based on the modeling of Power line communication [5], the circuit diagram is designed in MATLAB. Normal power frequency signal and the high frequency signal are combined and transmitted into the distribution line through the line trap and coupling capacitor.
Simulation of the Output signal under theft less condition

(iv) switching the energy cables at the meter connector box – through this way, the current does not pass through the current coil of the meter, and the meter does not record

The input circuit consist of inductor in series with power frequency supply to block the high frequency signal affecting the generator. In the high frequency side, a coupling capacitor and a series resistor are connected so as to protect the oscillator circuit from power frequency supply. The series resistor is connected in place of line. The frequency of the carrier signal is chose to be 150 kHz to meet out the standard.

In each pole of the distribution system, a filter circuit along with the detection circuit is placed for the purpose of separating the signals and monitoring the high frequency signals respectively. The pole based circuit will consist of analog low pass filter which will pass the power frequency signal to the authorized customers and an analog high pass filter which will pass the high frequency carrier signal to the detection circuit.

Detection of electricity theft by using MATLAB simulation

Considering the occurrence of theft, due to the presence of impedance in circuit there will be attenuation in both the power frequency signal and high frequency carrier signal but due to the compensation in the power frequency signal there will not be any change due to illegal usage of electricity. But in the absence of any compensation in the high frequency carrier signal, due to the impedance there will be loss of signal power causing attenuation in the signal. If a theft load of ten 60W 120V incandescent bulbs are considered, then the entire load will be considered to be resistive. For that load, the load resistance is calculated by using the formula,

\[ R = \frac{V^2}{P} \Omega \]

Where 
\[ R \] – Resistance of the load
\[ V \] – Voltage drop across the load
\[ P \] – Power consumed by the load
By using the above formula, for ten 60W bulbs, the load resistance is calculated to be equal to 2400Ω. For such a theft load, the proposed scheme is applied and the simulation result is obtained.

**IV. CONCLUSION**

In this paper we proposed that the electricity theft detection by using the PLC techniques. The simulation model which is obtained during the theft without implementation of PLC technique and also with PLC technique model is clearly explained. In Future, it may be developed by using GPS or GSM techniques. For the detection and monitoring of power theft will reduce the economic loss which is faced by electricity board.

**REFERENCES**


