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Wireless Power Theft Monitoring System

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Abstract

The scope of this paper is to identify the most commonly adapted techniques of power tampering. We detect the tampering methods by means of respective embedded circuit and intimate it to the electricity board via sound buzzer alert, our microcontroller circuit controlling one relay which is transmitting power supply from main meter to sub meter if somebody tempered meter m/c switch of current supply. M/c display all the consumption unit of both meters on LCD. This tampering information is transmitted to electricity board via transmitter and receiver module which with further advancement can take a proper action to save electricity.

1. Introduction

Electricity theft can be in the form of fraud (meter tampering), stealing (illegal connections).The financial impacts of theft are reduced income from the sale of electricity and the necessity to charge more to consumer. In 2010, electricity losses in India during transmission and distribution were about 24%, while losses because of consumer theft or billing deficiencies added another 10–15%. The electrical energy demand for 2016–17 is expected to be at least 1392 Tera Watt Hours, with a peak electric demand of 218 GW. The electrical energy demand for 2021–22 is expected to be at least 1915 Tera Watt Hours, with a peak electric demand of 298 GW. If current average transmission and distribution average losses remain same (32%), India needs to add about 135 GW of power generation capacity, before 2017, to satisfy the projected demand after losses.

In this project we considered Real-time Power monitoring at houses, Sensing the power theft at the exact location and transmitting the information over wireless to substation. In this model we are using two meters one at consumer's house and other at pole (supply source to consumer).

2. Losses Description

Losses occur at all levels, from generation, through transmission and distribution, to the consumer and the meter. It is normally at the distribution level where the majority of avoidable losses occur. All electrical power distribution companies operate with some accepted degree of losses. This is no different from the scenario in Ghana. Losses incurred in electrical power systems have two components:

- Technical losses
- Non-technical losses (Commercial losses)

3. Technical Losses

Technical losses will always arise as the physics of electricity transport means that, no power system can be perfect in its delivery of energy to the end customer. Technical losses are naturally occurring losses (caused by actions internal to the power system) and consist mainly of power dissipation in electrical system components such as transmission lines, power transformers, measurement systems, etc.

Technical losses are possible to compute and control, provided the power system in question consists of known quantities, viz., resistance, reactance, capacitance, voltage, current and power. These are routinely calculated by utility companies as a way to specify what components will be added to the systems. Loads are not included in the losses because

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they are actually intended to receive as much energy as possible.

Technical losses in power systems are caused by the physical properties of the components of power systems. Example, I2R loss or copper loss – in the conductor cables, transformers, switches and generators.

The most obvious example is the power dissipated in transmission lines and transformers due to their internal impedance. Technical losses are easy to simulate and calculate; computation tools for calculating power flow, losses, and equipment status in power systems have been developed for some time. The instantaneous power loss, Ploss(t) in a transmission line can be expressed as:

$$P_{loss}(t) = P_{source}(t) - P_{load}(t)$$

Where Psource(t) is the instantaneous power that the source injects into the transmission line and Pload(t) is the instantaneous power consumed by the load at the other end of the transmission line. Thus the energy loss, Wloss, is given by:

$$W_{loss} = \int_a^b P_{loss}(t)dt$$

Where a and b are respectively the starting point and ending point of the time interval being evaluated. It must be noted that a fairly accurate description of Ploss (t) as a function of time is always needed to make a reliable prediction of loss.

Non-Technical Losses (Commercial Losses)

These refer to losses that are independent of technical losses in the power system. Two common examples of sources of such losses are component breakdowns that drastically increase losses before they are replaced and electricity theft. Losses incurred by equipment breakdown are quite rare. These include losses from equipment struck by lightning, equipment damaged by time and neglect. Most power companies do not allow equipment to breakdown in such a way and virtually all companies maintain some form of maintenance policies.

Other probable causes of commercial losses are:

- Non-payment of bills by customers
- Errors in technical losses computation
- Errors in accounting and record keeping that distort technical information.

Inaccurate or missing inventories of data on customers the most prominent forms of commercial losses in Ghana are electricity theft and non-payment of bills. Non-payment, as the name implies, refers to cases where customers refuse or are unable to pay for the electricity used. However, the other forms are not analysed thoroughly in this project. Nontechnical losses are very difficult to quantify or detect and are more problematic than the other losses.

Research has shown that, transmission and distribution costs in Ghana are calculated as part of the customers' bills, while in other countries, customers are usually charged a single flat energy rate that includes all services. This means that, the transmission and distribution losses that increased due to commercial losses would be charged either to the existing customer whose power lines are illegally tapped, or the utility, depending on the method of theft.

Non-technical losses can also be viewed as undetected load; customers that the utilities do not know exist. When an undetected load is attached to the system, the actual losses increase while the losses expected by the utilities remains the same. The increased losses will show on the utilities' accounts, and the costs will be passed to customers as transmission and distribution charges.

Both ECG and NED losses range from 24 to 30 percent of power generated, collection rates range from 75 to 85 percent of billing and arrears from government agencies significantly weaken balance sheets. In recent years, ECG has undertaken several measures to reduce losses. Figure 1 shows the total distribution losses of ECG from 1985 to 2003.

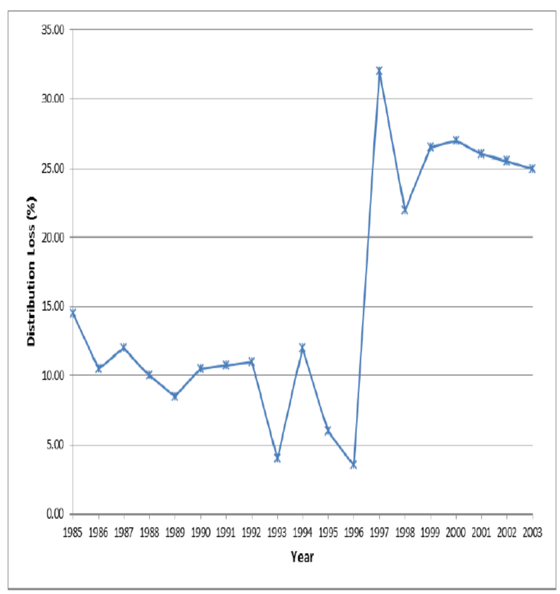
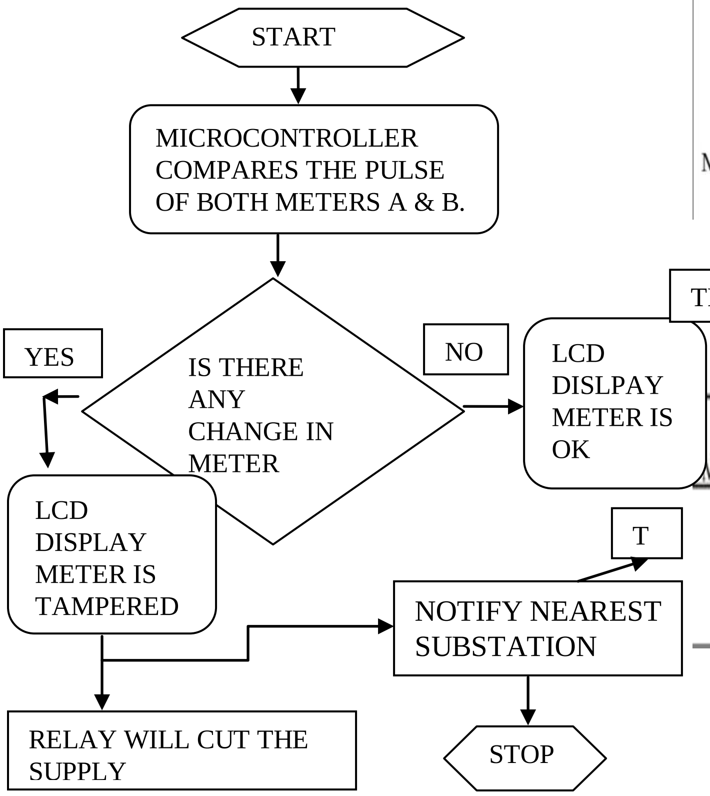


Fig: 1. Total Distribution Losses of ECG, 1985-2003

From the figure, it is observed that losses were relatively low between 1993 and 1996 but increased thereafter.

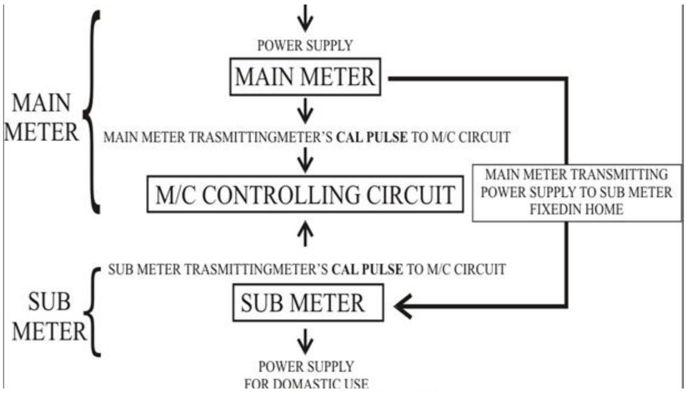
4. Theft Case Algorithm

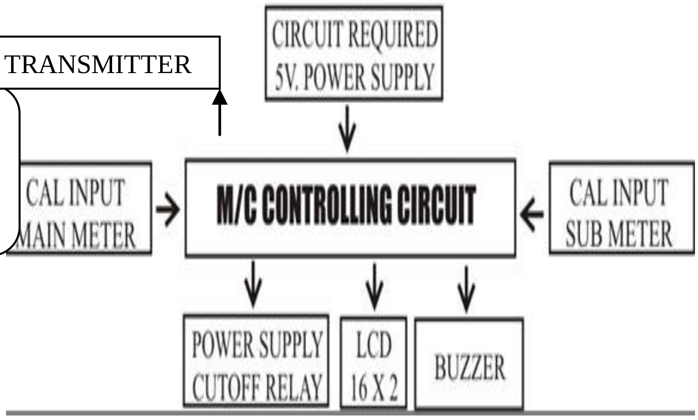


This flow chart shows that how the system is used to prevent the electricity theft i.e. it firstly the microcontroller 89C51 checks for the pulse from both the meters and if there is the change in the value of the pulse (calibrating pulse) the supply would cut off and LCD shows that the meter is tempered, but to operate the microcontroller via the relay there is a need of the amplifier circuit because there is no direct access of the relay to the microcontroller. When the load is made off by the
Microcontroller the Transmitter (RF transmitter) sends this result to the authorised officials.

5. Working of Model

In this system we use cal pulse output of both main and sub meter in our micro controlling circuit as shown in block diagram.





Our circuit is working on 5v power supply, which is regulated by regulator 7805. We are using 12v. Step down transformer for circuit. The calibrating pulse is given as an input to microcontroller from both meters. If any meter is tempered, the pulse from one of the meter is disturbed in this case the relay cut the supply within 1 minute and this information is transmitted to nearest substation.

6. Conclusion

This wireless power theft technique based system is much useful to detect the stealing of the electricity worldwide. To control the revenue losses the authorised officials needs to detect the theft of the electricity it means the theft of the bypassing is the most effective one over the whole world comparing to the other techniques used to steal the electricity i.e. the unauthorised consumption of the electricity. This system ensures the accurate billing of the electricity consumed hence to provide the best way to prevent from the electricity theft. The supply cut by this system can only be reset by the authorised person of the electricity authorised department therefore this system helps to reduce the manual error and provide an excellent way to detect the bypassing of the energy meter.

The low cost of the System makes it to deploy in most of the wireless system because it uses a RF transmitter and receiver module to send the information and due to the low power consumption. Hence further more and more improvements can be done to make the system much more efficient and excellent also for the long run. This wireless system provides much better results at short run.

This model is designed for domestic purpose, but can be extended to industrial purpose also. It gives a big hand to vigilance squad to control theft quickly and easily. With its usage, the crime of stealing power may be brought to an end. The prime limitation of the system in the present form is the distance coverage. To overcome this when applied in a large scale, repeaters can be employed at suitable intervals. To certain extent the power level of the transmitter may be improved. Our paper not only indicates the place of power theft but also the amount of energy being stolen that is, it gives the best of the expected results. The use of this technique gives a new hope and accuracy for the satisfaction to complete the work.

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