Identification of Electricity Theft using PLC

Application of PLC in Monitoring of Electricity Supply and Demand, Reporting through IP-SMS and Tracing the Location

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Abstract: As in everywhere automation is required to reduce the work and curbing electricity theft in India, which accounts for 80% of the power losses. While the nation strives to mark a new golden era, the power sector suffers contributing to blackouts and costs $17 billion in lost revenue annually, according to calculations by Bloomberg. With the nation-wide production at over 250GW, as on August 2014[1], weak infrastructure accounts for various losses – transmission, distribution, aggregate technical and commercial losses. Considering that the loss at 25%, the amount accounts that 63.34GW i.e. nearly the load the grid carried during the July, 2012 blackout. If mitigation strategies were considered to half the slippage, New Delhi had enough power to lighten up for a week. In this write-up, proposed is a power line communication (PLC) based automated meter reading (AMR) that is used to monitor electricity demand and decide on the required supply by the power station control room (PCR). Along with this primary feature, the proposed system can be trigger SMS to the nearest authority about the location of theft, tracing with the help of consumer database detail.

Keyword: automated meter reading, power line communication, electricity theft monitoring, electricity demand-supply monitoring

Introduction

In the 21st century, power is the like the essence of the world and is related to the electricity and "electricity" is the word which now regulates the world. Hence, the appropriate consumption of this service is of significance to us. It is necessary to measure power consumption, monitor slippage and regulated various associated variables. In general, large scale industries consist of various units like production, storage, package, administration, transportation situated away from each other. For such organization, it is necessary to maintain record of daily power consumed by every unit to keep check on the overall unessential consumption.

Various losses have been a concern for the power sector, these losses have been very high when compared with other developed countries. The present transmission and distribution (T&D) losses including unaccounted energy are about 30% and there is need to reduce these losses through efficient management and maintenance practice of the transmission and distribution network through the grid. When we talk about T&D losses, it also includes the theft of electricity, although it is the part of commercial loss but there is no way to segregate theft from the T&D losses. Apart from T&D losses, aggregate technical & commercial (AT&C) losses contribute a major segment.

Electricity theft is at the epicenter of worries for developing economies worldwide, but electricity theft in India has substantial consequence onto the Indian economy. The loss on amount of theft is reflected in average rate of return of the electricity company. Thus, these costs are routinely passed on to the customers in the form of the higher energy charges. Electricity power theft takes place in a variety of forms and thrives with the support of people from different walks of life: utility staff, consumers, union leader, political leaders, bureaucrats and high level utility officials. The problem challenging power utilities worldwide is the electricity, in other words using electricity from utility company without the company's consent. Significantly, it is enough to destroy the entire power sector of country. This paper

discusses the problem of electricity theft as well as proposes method for preventive actions and seal the loopholes of electricity stealing.

Motivation and Literature Review

a. *Motivation*

In our daily life, we happen to observe that a prime reason for power shortage is power theft. As per the laws, it is an offense but due unavailable technical resources it is often very hard for the authorities concerned to validate their claims. We decided to work on a system motivated from other existing art, to help curb the nuisance of power theft.

b. *Literature Review*

The losses due to power theft, experts say, are currently 29% of the total generation, which equals a shocking ₹45,000 crore in the fiscal year 2009-10. According to experts, if not for these losses over a decade now, India could have built two mega power plants of around 4,000 MW capacity every year. Power loss in 2001-02 was 32.86% and increased to 34.78% in 2003-04. In 2008-09, it stood at 28.44% but currently the figure is again 29%. It is as high as 51% in Jharkhand, 45% in Madhya Pradesh and 40% in Bihar. In our search for prior art, we could find two close solutions, firstly power theft detection circuit, patent number: 4532471 (30.07.1985). This invention relates to a system for detecting the theft of power when a short circuit jumper is coupled across a line conductor passing through watt-hour meter. However, the method is costlier to be implemented and it has no way of alerting the authorities unless a regular survey is done. And the second invention, power theft detection system, patent number: US20080109387A1 (May 8th 2008). The system finds out the power theft by monitoring the total power consumption, receiving the delivered power data that includes data delivered to a number of users. Determining the amount of difference between them, thus finding out if power theft has occurred. But there lies no specific way to find out where the power theft has occurred. Our solution in the following text helps find a solution to both this problems.

Methodology

a. *Identification of electricity theft*

i. *Methods of theft*

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

1. 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
2. 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
3. using the external phase before terminals – this method gives subscribers free energy without any trace in the electricity meter
4. 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 energy consumption
5. 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

ii. *Identification and information*

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.[3]

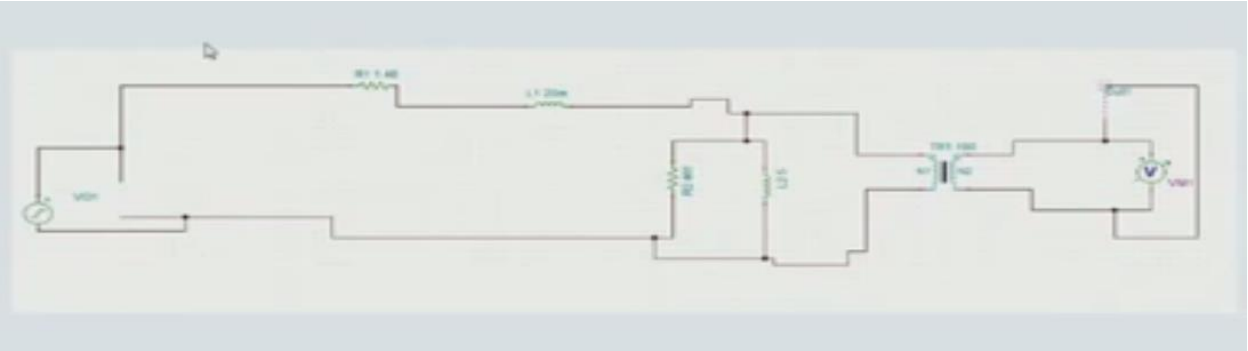

Figure: Circuit of functionary model

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 and help functioning the national power grid.

b. *Monitoring supply and demand*

i. Concepts of supply-demand

In this system, a backend software monitors the demand, and compute the required supply. Management at the power station control and power generation hub are able to act by diversion of supply on any needy segment of the zone.

ii. Communication of supply and demand

Communication of the supply and demand is done in real time using the PLC standard. Being monitored in real time, the hassle for telephonic activity and other radio medium shall not be needed. Action can be centrally governed and the grid can be developed to act smartly.

c. *Reporting through IP-SMS*

Using an internet based SMS gateway, the requirement of individual GSM modules is curtailed. All tracking, reporting and billing activities can be done through electronic medium, hence helping the nature. Electronic billing is currently available and we merely plan on integrating it to our system. By tracking we refer to intimation of theft to the concerned for the locality.

Resources

Resources required for the system are as follows –

1. human capital: computer scientists, programmer,
2. existing database
3. high-end server system

Testing/ Simulations

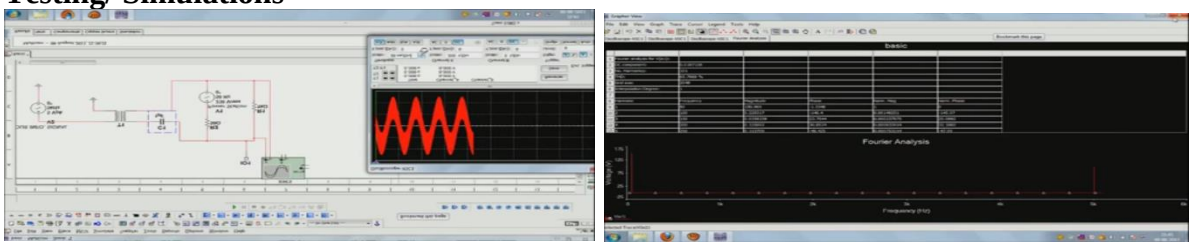

Figure: Simulation of communication and Fourier analysis for non-attenuated signal

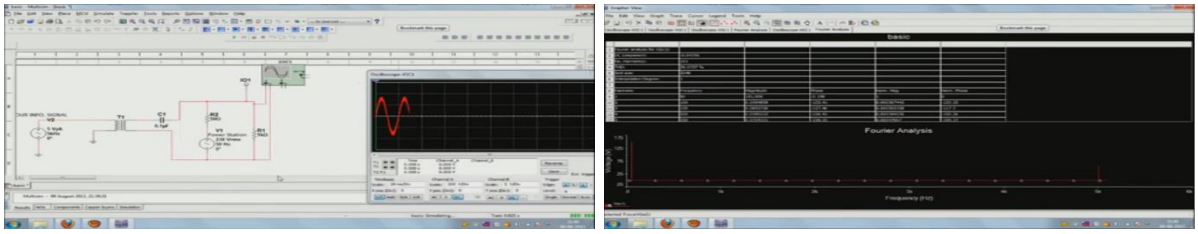

Figure: Simulation of communication and Fourier analysis for an attenuated signal

Implementation

For implementation of the entire system, we would require upgrading the previous consumer end meters to AMR based meters developed for this system. Another requirement of the system is to upgrade all previously used algorithm in the backend systems. Also, the system can be upgraded in-sync and with continuous working of the current system, thereby not hampering any current functioning.

Theme: Electrical Supply. Efficient Power Management & Theft Monitoring.

Results

We expect on implementation of this proposed system that a mass of theft incidents shall be reduced. As a consequence of implementing this system, the net loss due to power theft is expect to be reduced by a huge margin.

Conclusion

In a dire economic state, implementation of this system will improve the economic conditions of the utility companies and the state of electricity distribution throughout the nation shall improve. Moreover the population shall be able to enjoy better power conditions and environment.

Acknowledgement

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