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## A Novel Smart Monitoring and Metering System for Transmission and Distribution Network

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### **Abstract:**

*The main objective of the paper is to reduce the losses in the transmission system, make more reliable and flexibility in the topology network, increase efficiency, sustainability, compensation, market enabling, demand response support and a platform for advance in services. The computer also calculates the power that is misused. It can be implemented to retrieve and record energy consumption data in real time and send the data with tariff to the electricity board and the consumer mobile through GSM and Zigbee module. The time to go to the consumer side and time to read the meter manually can be curtailed. The imbalance is checked by the computers intelligence and power used illegally is detected and is corrective measure is taken from the control centre. In addition, the prototype designed aims to monitor the consumption records, send it periodically to the server to update to the relevant user profile, provide feedback alerts to the consumer on demand and also provide a better control to utility over individual user. With this proposed methodology, the end users are provided with proper awareness and they may plan their electrical consumption pattern.*

**Key words:** Electrical power theft, wireless data transmission and receiving, tapping, meter tampering

### **1. Introduction**

Generation, transmission and distribution of electrical energy involve many operational losses. Whereas, losses implicated in generation can be technically defined, but transmission and distribution losses cannot be precisely quantified with the sending end information. This illustrates the involvement of nontechnical parameters in transmission and distribution of electricity. Overall technical losses occur naturally and are caused because of power dissipation in transmission lines, transformers, and other power system components.

Technical losses in T&D are computed with the information about total load and the total energy bill. While technology in on the raising slopes, we should also note the increasing immoral activities. With a technical view, Power Theft is a non ignorable crime and at the same time it directly affected the economy of a nation. Electricity theft a social evil, so it has to be completely eliminated. Power consumption and losses have to be closely monitored so that the generated power is utilized in the most efficient manner. The system prevents the illegal usage of electricity. At this point of technological development the problem of illegal usage of electricity can be solved electronically without any human control .The implementation of this system will save a large amount of electricity, and thereby electricity will be available for more number of consumers than earlier, in highly populated country such as INDIA.

### **2. Objectives**

- This system would provide a simple way to detect an electrical power theft without any human interface.
- It would indicate exact zone and distribution line on which unauthorized tapping is done in real time.
- It would be time saving if distribution company personnel take reading by this wireless technique.
- It would provide a digital record in case of any judicial dispute.
- To maximize the profit margin of power utility company.

### 3. Proposed System

#### 3.1. Power Theft Detection

L1, L2	Single phase loads
M1, M2	Digital energy meters
P	Pole based system (installed on a distribution pole)

Table 1

Consider a distribution system [1] [2][5] shown in conceptual diagram. Two single phase loads L1 and L2 are supplied from two different phases. M1 and M2 are the energy meters that measure power consumed by these loads over a period. Pole based system (P) has been installed to detect power theft.

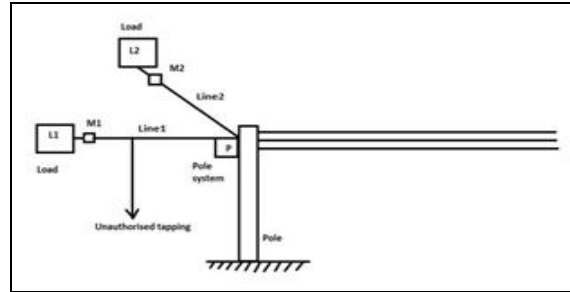


Figure 1: Conceptual Diagram

- Load Side Energy Meter (M1, M2)

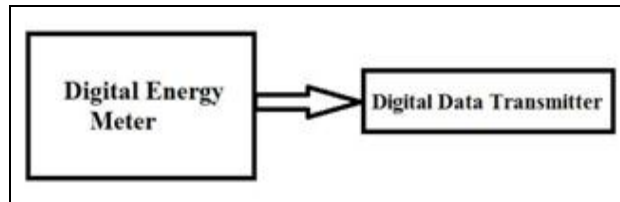


Figure 2: Load side energy meter

Meter is installed on load side to measure a power consumed by load over a time. Also it has an additional feature of transmitting that data to receiver using wireless technique [7].

- Pole Side Energy Meter

One energy meter is installed in a pole based system. This meter is capable to measure a power sent over each line connected to that pole.

- Pole based system:

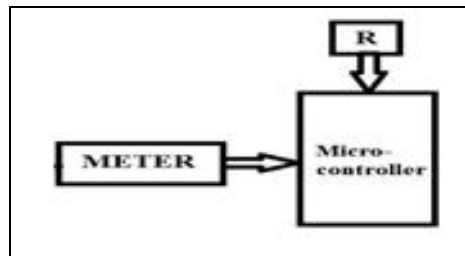


Figure 3: Pole based system

It consists of Wireless data receiver, Micro-controller, Digital energy meter. Digital energy meter will measure power sent over each line for a certain time period.

### 3.2. Wireless Meter Reading

The same data transmitter installed in a load side energy meter is used for wireless meter reading. Utility company personnel will have its data receiver.

## 4. Methodology

### 4.1. Power Theft Detection

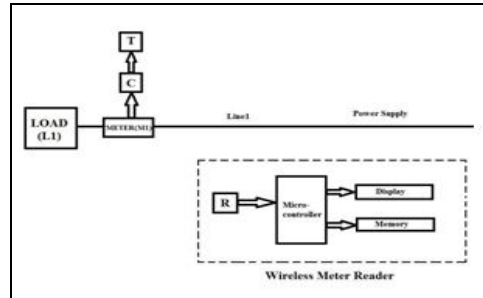


Figure 4: Power theft detection

Digital energy meter (M1) will measure a consumed power by load (L1) over a period. It will send a data in proportion with consumed power to receiver with the help of wireless digital data transmitter.

Receiver on the pole system will receive a data sent by transmitter in a load side meter. Receiver will send it to microcontroller. Also energy meter on pole will measure power sent over line1 and provide appropriate data to micro-controller. Now microcontroller has two readings one is power calculated on pole itself and another is power consumed by load (L1).

Suppose there is tapping done by any unauthorized person on the line to connect his appliance as shown in figure1. Over a certain period there will be difference between meter reading (M1) and pole based reading.

Microcontroller will compare these two values and if the measured value on pole is more than value send by meter (M1) by some tolerance then power theft is happening on line1. This theft signal generated on pole system can be transmitted to substation by power line communication technique or by wireless technique whichever is suitable an economical.

Tolerance should be provided for losses of line. Because over a long period there will be difference in reading of meter on load side and pole side due to loss of line between pole and load. Therefore, tolerance should be provided through programming of micro-controller.

### 4.2. Wireless Meter Reading

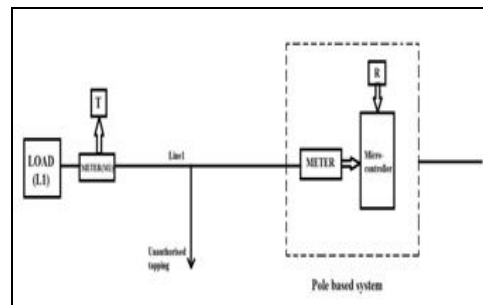


Figure 5: Wireless meter reading

Now a day utility company personnel goes at every house to take the readings of meters for billing purpose. It will create problem when consumer is out of Town or home is locked due to other reasons.

This system of wireless meter reading is based on the same principle of wireless data transmission that is used in power theft detection. Utility company personnel will have a device consists of wireless data receiver with micro-controller and display.

When that device is in the range of data reception it will receive the data sent by transmitter in the load side meter. For this one counter has to be installed in the load side meter (shown in figure). It will keep a record of power consumed by load over a given time (say one month). This recorded data will be send by transmitter wirelessly. Receiving device will receive the meter reading and keep its record with consumer serial number. For this device should be in the range of transmitter. Hence, utility company personnel don't have to check every meter. He can take reading without going to consumer's house. This is a time saving technique.

**5. Mathematical Model**

Whenever input power is passing from supplier to the receiver, at that time if the total amount of power is not received by the receiver then there is possibility of theft of energy.

$\sum P_{sent} = \sum P_{consumed} + Loss$	.....No Theft
$\sum P_{sent} \neq P_{consumed} + Loss$	.....Theft Occur
Here, $P_{sent}$ = Power measured by pole side energy meter	
$P_{consumed}$ = Power measured by load side energy meter	

Table 2

**6. Flow Chart**

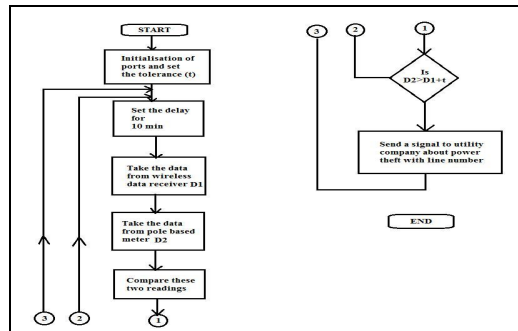


Figure 6

To program a micro-controller to detect a power theft on one line following flowchart is used. First of all initialize ports of micro-controller as input or output as per required. Set the tolerance in program depending on the loss of line for which this system is installed. Set the delay time (say 10min) which is depending on after how much time interval system scan the line for theft detection. Take the data from wireless data receiver at preset time interval (10min). It represents power consumed by load over given time. Take the data from meter installed on pole at the same time. It will represent the power sent over that line for preset value (10min). If power sent on line is more than power consumed by that load over a given time considering tolerance the power theft is occurring on that line. Send the signal of power theft with the line number and its area to utility company. For this wireless transmission or power line communication can be used. If power theft is not occurring on that line then again take the data after say 10min. It's an endless program.

## 7. Block Diagram

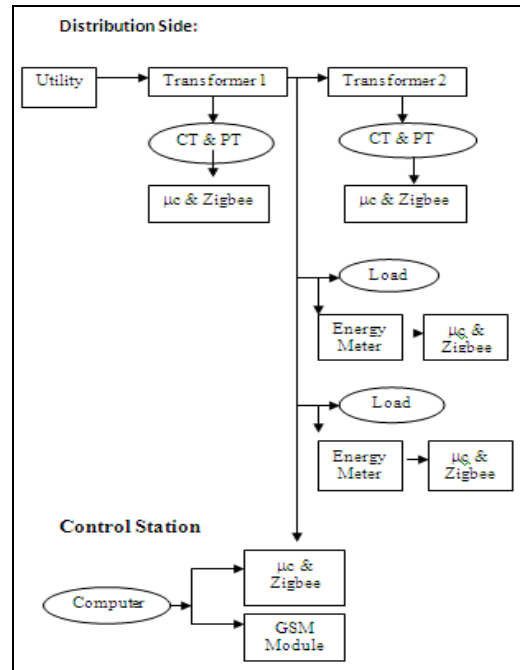


Figure 7

## 8. Modifications

- Instead of using wireless data transmission technique, one can use power line communication. In power line communication data signal is modulated on power signal and sent it through a same electrical distribution network. This will reduce the cost for separate communication line.
- One can decide the resolution of this system. Due to economic consideration, instead of installing this system for each consumer utility company can install one system for one colony. Then power theft on any line in that colony will be identified by this system.

## 9. Conclusion

The progress in technology about electrical distribution network is a non-stop process. New things and new technology are being invented.

The proposed system 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. Utility company can keep a constant eye on its customer.

## 10. Acknowledgement

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