Electrical Power Theft Detection and Meter Reading by using IoT and Wireless Technology

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Abstract— This paper represents the concept of achieving efficient electrical power transmission using emerging technology of IOT and Cloud computing. It combines Electrical modules, Wireless transmission and specially designed Software for a user to interact with.

Key words: Wireless Data Transmission, IoT, Cloud Computing

I. INTRODUCTION

Electrical power system consists of three main components i.e. generation, transmission and distribution. Each part includes technical and non-technical losses to a considerable extent. In most of the developing countries, non-technical losses caused because of power theft is a major issue and results in huge revenue loss to the distribution companies.

The technology is advancing day by day, this can be used to prevent increasing activities of power theft. With a technical aspect into consideration, Power Theft is a major concern and directly affects the distribution companies and even economy of a nation. Generated Power has to be efficiently supplied to reduce losses and theft thereby increasing efficiency. The proposed system of using wireless meter reading along with IOT and Cloud Computing helps in preventing electricity theft without any human intervention, thereby saves time and electricity. This method has greater application and uses in developing nations.

II. OBJECTIVES

1) To detect power theft at the earliest.
2) To indicate specific area and line where unauthorized taping takes place.
3) To provide billing digitally for convenient payment.
4) To store collected data over a period of time and use it during judicial disputes.
5) To maximize the profit of IPP (Independent power producers) and power distribution company.

III. PROPOSED SYSTEM

A. *Theft Detection*

- L – Single/Three phase loads
- M – Web-enabled energy meter installed in every premise (load side)
- P – Web-enabled energy meter installed on an electrical pole
- Consider a feeder system of 11kv shown in a conceptual diagram. A load L is supplied from the phases. M is the energy meter that measures power consumed by the load over a period. This system forms important and initial part of power theft detection.

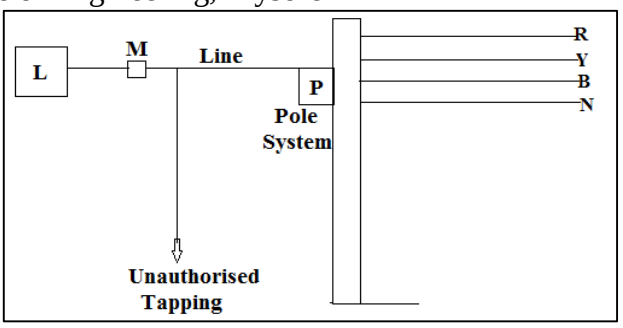

Fig. 1: Proposed system

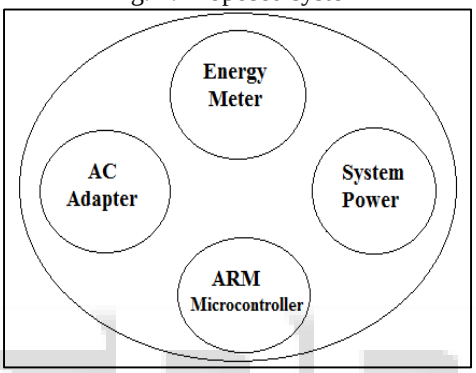

Fig. 2: Load Side Web-Enabled Energy Meter

B. *Electric Pole System*

One energy meter is installed on each electric pole. These meters are capable of measuring the power delivered by each line associated with the respective pole.

C. *Wireless Meter Reading*

Wireless meter reading is achieved by using the Web-enabled energy meter installed in every consumer premises. The measured power data is sent to the cloud server which is accessible by the utility company. This forms the final part of power theft detection methodology.

IV. IMPLEMENTATION

A. *Theft Detection*

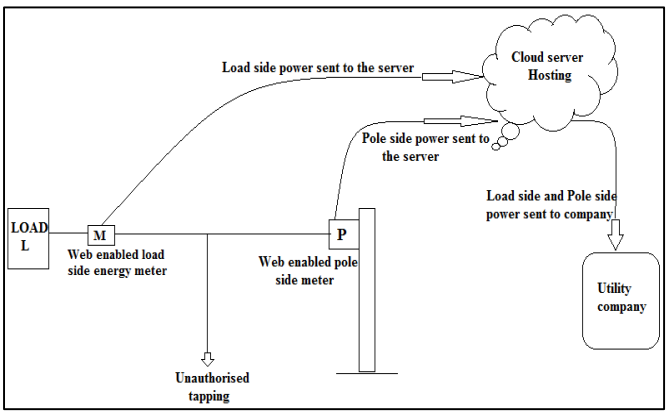

Fig. 3: Theft Detection

Web-enabled energy meter (M) will measure the power consumed by the load (L) over a certain period. Then this data is sent to the cloud server with the help of wireless data transmission achieved using IOT. Each meter on load side is provided with corresponding meter number and line address. Energy meter installed on the electrical poles will also send the data of the consumed power to the cloud server with their line address. These two reading are stored in the cloud server. This data stored in the server is accessible by the utility centre. Utility centre consists of a software installed in all the systems specially designed for reading the data from the server and capable of performing several operations. The software reads and compares the power sent by the load and power sent by the pole from the server. Suppose there is an unauthorized tapping on the line, then there is a difference between the readings of two meters i.e. pole based meter and web-enabled meter. The software will compare both the values and if the measured value of the meter installed on a pole is more than the value sent by load meter (including tolerance limit) then power theft is occurring on that line. Once the software detects the power difference, it gives an indication to the person in-charge. Tolerance has to be provided to account for line losses.

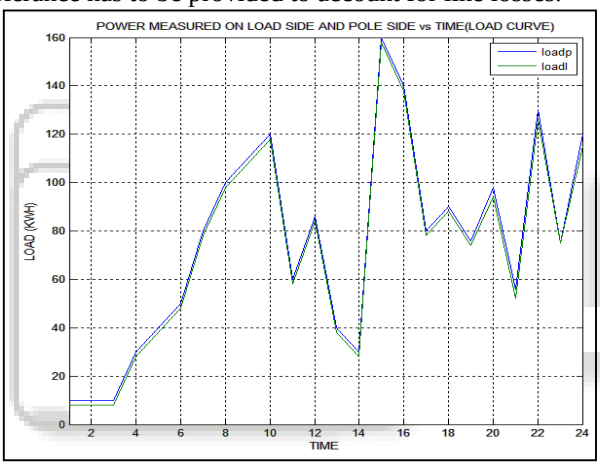

Fig. 4: Load Curve 1(without tapping)
Loadp=power delivered by the line (Pole system)
Loadl=power consumed by the load L

From the above graph, we can note that the power consumed by the load L and the power supplied by the line are equal with a certain tolerance. These values are stored in server and read by the software installed in the utility company. If the graph is coinciding then it indicates that there is no tapping on the line.

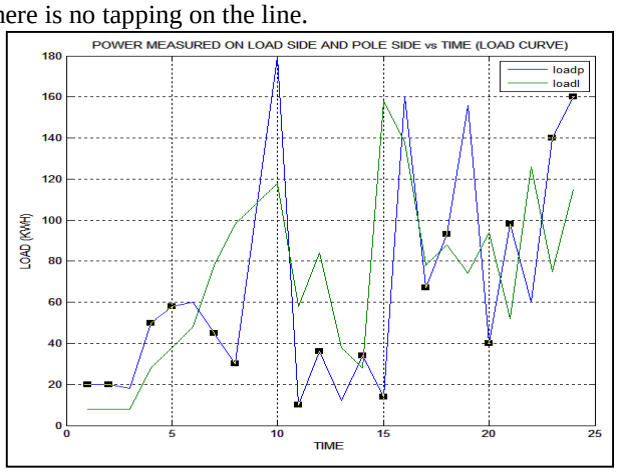

Fig. 5: Load Curve 2(with Tapping)
Loadp=power delivered by the line (Pole system)
Loadl=power consumed by the load L

From the above graph, we can note that the power consumed by the load L and the power delivered by the line are not equal. The power delivered by the line is huge but the power consumed is less as indicated. It means there is some unauthorised tapping in that line. This kind of mismatch in the graph immediately sends SMS or notification to the personal in-charge stating that there is tapping in the line. The software reads the IP address of the line on which the tapping is done and notifies the exact location with the complete address.

B. Wireless Meter Reading

The Web-enabled energy meter is used for wireless meter reading. This is installed on the load side. The measured power data is sent to cloud server which can be used for billing purpose and notifying the consumer of their usage and bill. This saves a considerable amount of time if a consumer is out of town or home. The software used by the utility company helps to perform these operations. The software will keep track of consumer usage along with their serial number. Hence, utility company personnel need not travel to every house for month end billing purposes. This helps to save a lot of time.

V. EQUATIONS

A. No Power Theft

Total Power Sent (pole side energy meter) = Total Power Consumed (load side energy meter) + Losses

B. Power Theft

Total power sent (pole energy meter) ≠ Total Power Consumed (load side energy meter) + Losses

VI. FLOWCHART

The flow chart represents the overall working of the above-mentioned system. The data stored in the cloud server measuring the load side power and the pole side power (power sent by line) is read and compared. If power consumed is more, then software alerts the personnel in charge to initiate necessary action and curb the ongoing power theft.

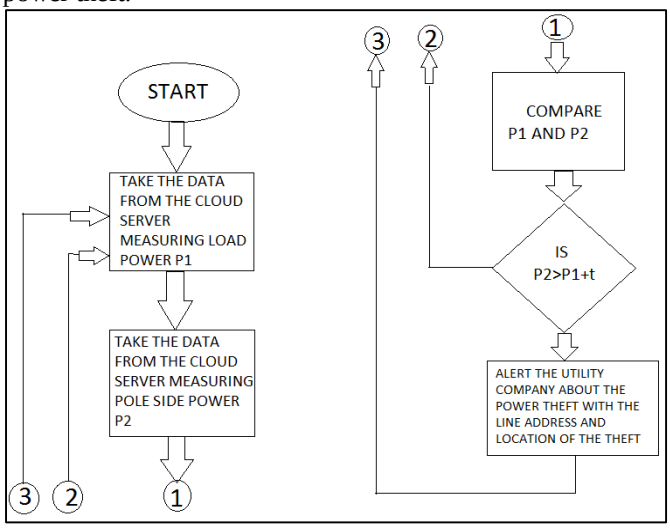

Fig. 6: Flowchart

VII. FUTURE SCOPE

The recommended system is bit complex to implement. As technology advances this system can be extended to domestic consumer lines from industrial lines and can be designed to check theft for a particular area or individual lines and houses based on requirement and expenses.

VIII. CONCLUSION

Advancement in technology has helped to solve many problems to a greater extent. New technology and advanced methods of its application are found day by day. The recommended system seems complex for the distribution network, but it is a highly efficient way to prevent electrical theft. It saves a lot of time and helps to maximize revenue and their by profit for electrical companies working in the distribution network.

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