Monitoring and Theft Detection in Utility Lines using IoT

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Abstract

This paper presents monitoring and theft detection in utility line with the help of an IoT module. Since electrical theft is illegal and should be strictly prohibited, so in order to eliminate power theft, the location of power theft is to be known so that appropriate action will be taken on the legal offenders. The circuit consists of ARM microcontroller, LCD, IoT module and Current transformers. So when the theft taken place the preferred module will show a change in their value and this difference will help us to locate the theft.

Keyword- ARM Microcontroller, IoT Module, Current Transformer

I. INTRODUCTION

Electricity distribution authorities loose a large chunk of income, due to illegal connections or dishonesty of customers for their personal gains. Various systems are introduced by researchers to detect the theft and diminish the non-operational loses. The methods like Support Vector Machine (SVM), Fuzzy C-means Clustering, and Fuzzy logic; User profiling, Genetic Algorithm, etc. are used to detect theft in electricity. There are two disadvantages associated with using these systems based on this methodologies is accuracy and also the infrastructure needed to employ them (like smart energy meter).With the help of IoT and ARM microcontroller a new system is proposed which tries to enhance the accuracy of the theft detection. The customers billing data is gathered through various sources like sensors, manually, etc. This data gathered is in raw form which is pre-processed. Pre-processing module is used to do data cleaning in which the problems like missing values are dealt with in customers billing data, Integration of data is done to represent the data in particular form needed to process data further. The detection module as the name suggest is used to find the abnormality in consumption pattern via different mechanisms Like in hardware based technique it is related to change of physical conditions in data based technique it is related to change in usage of electricity at particular point of time on the basis of these analysis the potentially fraud customers are identified. Data post processing usually deals with accuracy enhancement of finding the potentially fraud customers of the suspected customers generated in detection module and finally the output of potential suspected customers is generated.

II. OBJECTIVES

This system would provide a simple way to detect the possible faults which occurs in distribution power line such as electricity theft and earth fault detection by using CT and Energy meter in order to improve the performance of the traditional power line differential protection without any human interface. It would indicate exact zone where unauthorized taping is done in real time. It would also reduce man power and operational cost.

The developed system is simple and easy to operate. There is no requirement of complex circuitry for the measurement. The implementation of this theft detection scheme can be of cost efficient for the power utilities. In practical, people use the trial and error method to detect the fault (Line to line fault/line to ground fault) location in a transmission line. They feed supply to a single end at a time by dividing that transmission line into two parts and check the fault up to that section. This process will go on until they find the fault area. This paper is helpful for the KSEB for detecting the fault area if any fault occurs the current will rapidly increase and the CT will detect that. The information is suddenly passed through the PLC and KSEB can easily identify and locate the fault or theft.

III. HARDWARE SPECIFICATION

A. ARM Microprocessor

The LPC213x and LPC213x/01 microcontrollers are based on a 16/32 bit ARM7TDMI-S CPU with real time emulation and embedded trace support that combines the microcontroller with embedded high speed Flash memory ranging from 32 kB to 512

kB. Due to their tiny size and low power consumption, these microcontrollers are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. With a wide range of serial communications interfaces and on-chip SRAM options of 8/16/32 kB, they are very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power. Its features are:

- 64-pin High-Performance ARM Microcontroller
- Flash Program Memory: 512 kbytes
- SRAM Data Memory: 32 kbytes
- I/O Pins: 47
- Timers: Two 32-bit
- A/D Converter: Two 10-bit Eight Channel
- DAC: 10-bit
- Real-Time Clock (RTC): Independent Power and Dedicated 32 kHz Input
- I²C: Two Modules with Master or Slave Operation
- SPI: Full Duplex Serial Operation
- UART: Two Modules
- External Oscillator: up to 50MHz with integrated PLL for 60MHz Operation

B. IoT Module (NodeMCU)

NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems and hardware which is based on the ESP-12 module and some of its features are:

- Power-5v via micro usb port
- Dimensions-49x24.5x13mm
- Misc-reset and flash buttons
- Headers-2x2.54mm 15-pin header with access to UART, ADC, and Power pins

C. Current Transformer

A current transformer (CT) is a type of transformer that is used to measure alternating current (AC). It produces a current in its secondary which is proportional to the current in its primary. Current transformers, along with voltage or potential transformers, are instrument transformers. Instrument transformers scale the large values of voltage or current to small, standardized values that are easy to handle for instruments and protective relays. The instrument transformers isolate measurement or protection circuits from the high voltage of the primary system. A current transformer provides a secondary current that is accurately proportional to the current flowing in its primary. The current transformer presents a negligible load to the primary circuit. Current transformers are the current-sensing units of the power system and are used at generating stations, electrical substations, and in industrial and commercial electric power distribution. Current transformers reduce high voltage currents to a much lower value and provide a convenient way of safely monitoring the actual electrical current flowing in an AC transmission line using a standard ammeter. The principal of operation of a basic current transformer is slightly different from that of an ordinary voltage transformer.

IV. WORKING PRINCIPLE

In this innovative technique we are installing a NodeMCU type IOT device to the distribution transformer and to the electric post along with the arm –microcontroller and CT's in the main line and lines to each house. Consider two post and name them A and B, if post A has three house and post B have two house their readings will be taken by microcontroller through CT from each respective post and send it to the utility side where it will be recorded in their web page and it will be available for billing and even the costumer can view their bill. Now to detect theft, the device will record each calculated value from each post and when a huge amount of charge is drawn out the difference will be shown that is, when post A measures 40 kw from its connected houses and post B measures 30 kw from its connected houses and this data will be send to the utility side. If the theft is taking place between the A and B the total values of post A will be 40+x And B will be the same. From this way we can easily found out the exact zone or place where the theft is taking place.

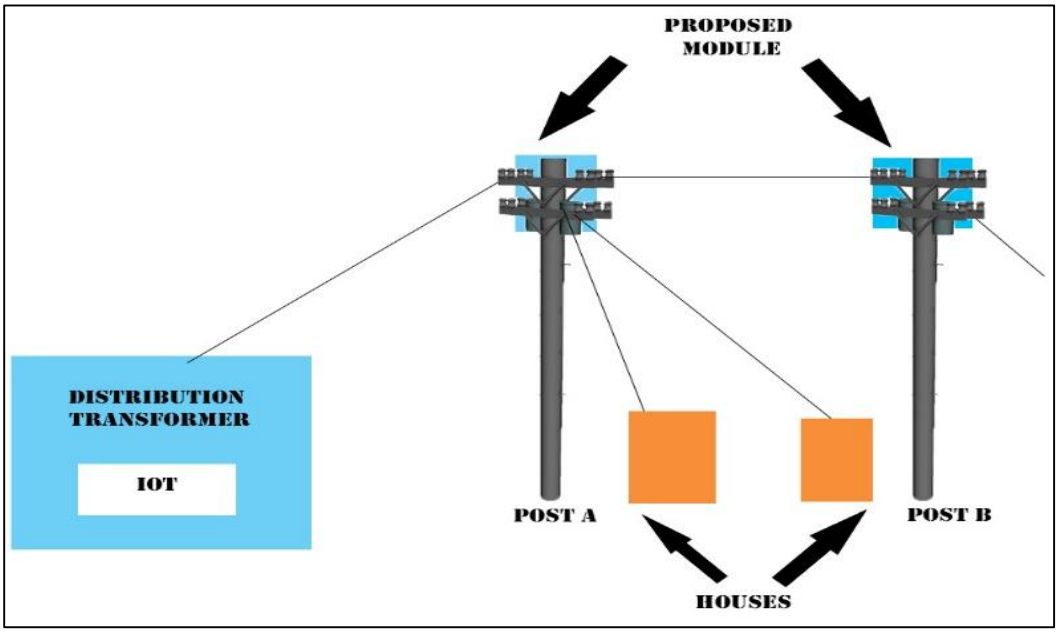

Fig. 1: Model of Proposed System

V. CONCLUSION

This project will help in reducing the heavy power and revenue loss that occur due to power theft by the consumers. This project helps in not only discovering fault and theft but also locating it to a limit Thus by the above mentioned design we can successfully and effectively address the problems related to power theft.

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