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Power Traffic Monitoring, Controlling and Theft Identification using IoT Application

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Abstract: We know that electrical distribution system is a complex network which is connected to the large number of load centers. So it becomes very hard to monitor and manage the power supply at the distribution line, on that instant there may be some power thefts, which are mostly happening in these remote areas are also needed to reduce. The main reasons are huge manpower needed for power theft identification and manual billing. The proposed system detects and informs to the concerned authorities about the exact location of an unauthorized tapping of distribution lines and also how much energy and amount utilized, bill due date to the customer using a low power Wi-Fi module (ESP8266) and GSM in an Internet of Things (IoT) environment thereby achieving high accurate power management. The power usage of every user is calculated through Current Transformer (CT) , Potential Transformer (PT) and this data is displayed in user section and the base station through IoT.

Keywords: Overhead distribution line, electric distribution system, smart grid, wireless sensor and IOT network.

1. INTRODUCTION

Now a days electricity maintenance is precious. It is very essential to understand, monitor and maintain the behavior of power distribution system. Distribution line monitoring becomes an important issue that ensures useful and reliable distribution of electrical load centers, generally power theft or voltage sags are more in distribution system only rather than transmission system [1]. In case of the electric power, high voltage transmission line is responsible for the transmission system; their electric current is an important parameter for distribution and transmission [1]. IoT is used in smart grid and it proves as an immense solution by showing the development of information communication technology on to a certain stage [3]. It gives the information to communication services (CS) and also manages the usage of power system information for getting improved efficiency with respect to the existing system. Therefore, IoT technology may be used in various power grid monitoring systems. Generally, in a remote location, electricity generation takes place, which carries the load centers using a simple distribution network including substations [3]. In India, the power losses during entire power generation, transmission and distribution are in huge amount and may vary from 30-45%. The expected results of the losses are conducted impedance, leakage currents at transformer terminals and joints, power theft and low metering efficiency [6]. Therefore, for secured electricity flow, metering system in smart grid becomes an important part of intelligent power line monitoring. Thus, a large number of sensors are required to identify the power system losses in a distributed network.

2. PROPOSED SYSTEM

Considering, a general condition, where the power failure/theft occurs in a particular area and anyone observes that failure/theft of power, then their reports to Electric Support (ES) office. On the other hand, if the operator may require switching off the power in a particular area, where there is no direct remote

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control over the supply, the concerned staff has to switch off the system manually. These two issues are very critical in power grid connected system. To overcome these problems we developed an intelligent system that detects and informs to the concerned authorities about the exact location of an unauthorized tapping on distribution lines and also how much energy and amount utilized, bill due date to the customer using a low power Wi-Fi module (ESP8266) and GSM in an IoT environment. In this developed system we used ARM9E micro controller [7], which have stronger architecture software.

The block diagram showing generation of monitoring system is illustrated in figure.1.

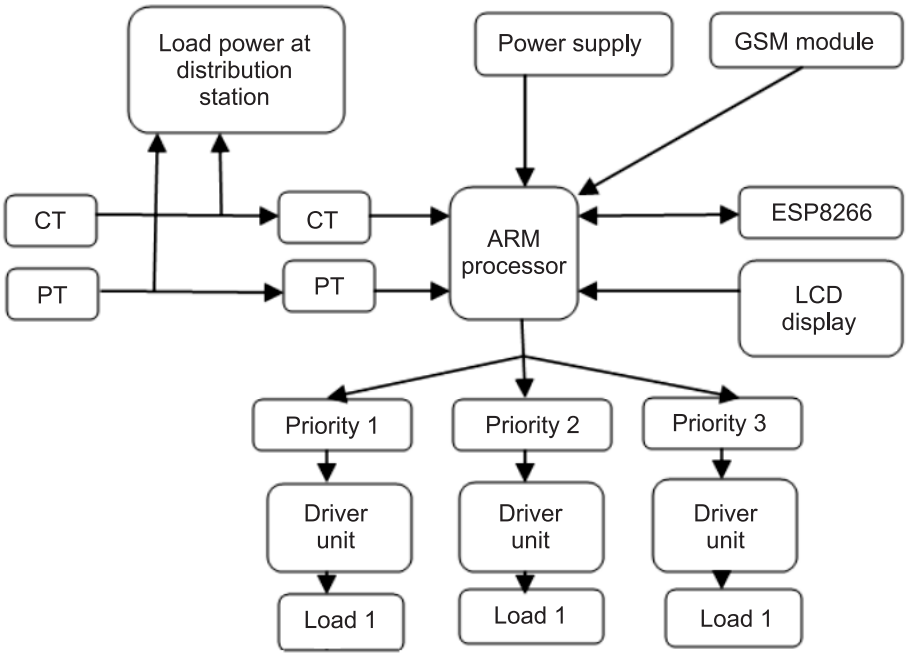


Figure 1: Power Flow Control and Monitoring System

This system is used to control the load and energy monitoring. The proposed system having two sections, one is Home section and another one is EB station, the communication between these two sections is done through IOT. Home section consists current transformer (CT), potential transformer (PT), LCD and Load all those connected to the ARM processor. CT and PT are used to measure the consumption of load, i.e. Energy and an amount will display on LCD continuously. The load will be assigned to home section based on priorities like priority 1, priority 2, and priority 3. The load will be controlled from EB station based on generation, If a generation is high, it will pass the energy to all the priority lines and if the generation is low it will disconnect according to priority and it will be controlled by using the commands on an HTML page, if anyone cross the limit of consumption then it is power theft and it will show on electric base (EB) office and LCD like power theft was occurring. If we want to send bills to the consumer just click on sending option from the EB station (HTML page). Then it will send the power usage, amount and due date to consumer mobile number and also to PC . The design will act as autonomous system which may be deployed at nearby or every electric distribution, to monitor the power supply state and thus controlling it based on the demand. Further, the system can use wireless cooperative communication, where the base station or the sensor head (cluster head) [8], will monitor the local distribution by communicating with nearby nodes.

3. IMPLEMENTATION OF PROPOSED METHODOLOGY

In this system we have RF transceiver modules, Electrically operated relays, Atmega16 Microcontroller module, Battery power supply, Connecting wires, Wi-Fi system & Switches.

4. OPERATION OF THE SYSTEM

(a) Interfacing with Microcontroller

It should wait for a minimum of 300 ms, after this initialize the microcontroller USART with 9600bps baud rate & to obtain the SELF ID, CC module must be configured.

(b) Channel Identification (ID)

Based on the requirements, configuration of CC module is performed for the baud rate which is 9600bps by default. After getting RID, we must start data transmission and data may be a byte or a packet of bytes with a maximum length of 64

5. RESULT ANALYSIS

Distribution lines are open with atmospheric conditions, that is, these are exposed to all weather conditions like smokes, rainfall, wind, heavy storm, etc. All these effects, like damaging of power transmission in distribution lines and other external factors resulting in the power line breakdown of that area [2]. For this we need an advanced monitoring system. Distribution is more important to measure the use of power line capacity. Therefore, to measure power line capacity, two important parameters are required which are electric current and line position in a transmission line. The primary aim of this paper is that to monitor and control the line spot at any area utilizing the concept of electrical distribution line for this we adopted WI-FI technology [7].

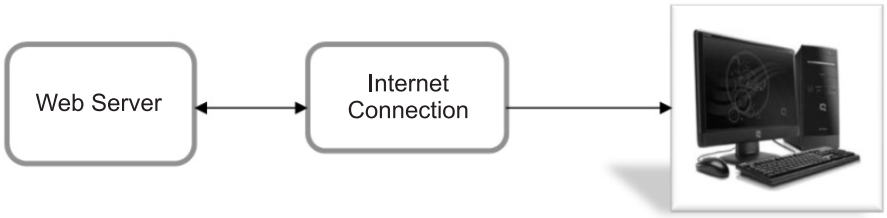


Figure 3: Control room section for power monitoring

(a) Circuit Hardware

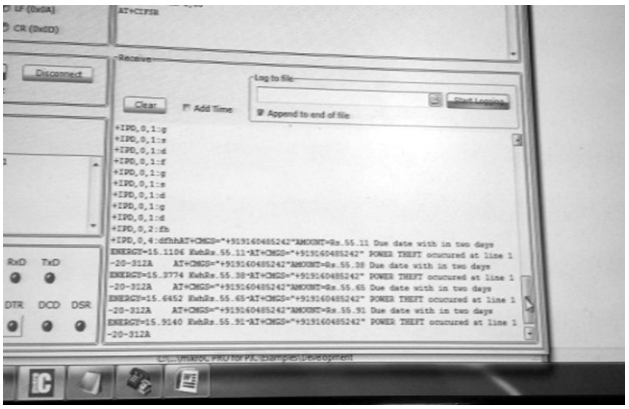
In the designed circuit, there are three poles; those are pole A, pole B and pole C. Here each pole is connected to relay circuit. These three relays are used to control and monitor the power supply in the distribution line. Beside the there are two connectors, these connectors are similar to wire. One adapter is used to switch ON the power supply and adaptor is used to send SMS from GSM. The LCD is used to display the information related to pole. Two RF is used to transmit and receive the message. By using Embedded C whole data is uploaded on the micro controller circuit.

(b) Software Photos

Step 1: To configure and connect a WI-FI network, open the mikroC PRO and enter some commands.

Step 2: To know how much Energy was utilized and its Amount, enter the IP number and the server number in the Hyper Terminal.

Step 3: If due to any reason power theft occurs in any area, it will display on PC at which particular line the power was theft and a WI-FI module send the SMS to the consumer through GSM with the exact position of the fault line and due date also.



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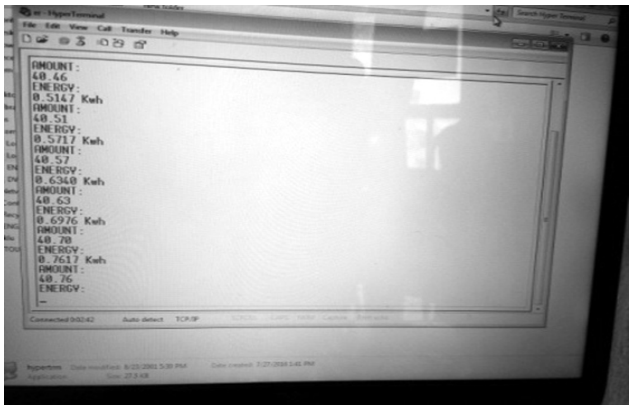

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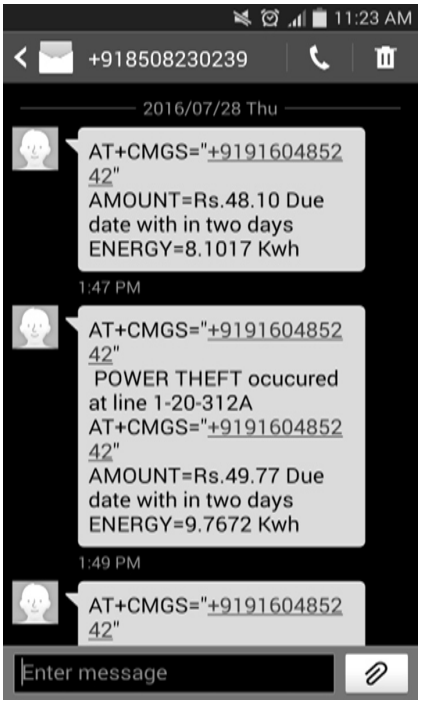

(c)

Figure 4: (a) Commands on mikroC Pro, (b) Energy Utilized & its Amount on HyperTerminal& (c) SMS received on mobile after Power theft

6. CONCLUSION

In this proposed work, we have presented a new approach to generate power bill automatically. The work also controls the power theft, without any human support and monitoring of a particular electrical distribution line. The design incorporates the use of advanced monitoring and controlling system, viz. ARM7 LPC2148 microcontroller, wireless sensor network, embedded software and IoT. The proposed system monitors the energy of load and controlling the load, according to priority. The controlling is performed from EB station, which performs according to power generation. When the power generation is high, the system will allow the power (electric) flow to all priority lines, and when it is low, the system allows power flow only to high priority lines. If any load crosses the power consumption limit, it will display on the LCD as like that of power theft. Therefore, one can find a continuous power utilization rate and its corresponding customer's unit-cost. In this work, the bill due date is displayed for the customers for timely payment or else they will be intimated by SMS through GSM module. Further, the work can be extended by implementing automatic monitoring and bill deductions in real-time systems.

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