

Real Time Smart Meter Data Reading and Energy Monitoring System

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Abstract— In this project deals with automatic meter reading and theft control system that measures and transmits the total energy consumption by GPRS technology provided by GSM network. Current Sensor is used to measure the total power consumption for house or industrial purpose. For transmitting the reading of energy meter GSM module is used. The GSM module provides a mode of communication between the user/meter and the EB Station. The GSM module will also get real time electricity rates and enable the utility to keep a check on electricity theft. To avoid theft, infrared sensor is placed in the screw portion of energy meter seal. Any human error is placed on the load a message is sent to the electricity board. The measuring of energy meter and monitoring of IR sensor is done with a PIC microcontroller. It also present how the meter reading, disconnection and reconnection can be controlled from server end. This model reduces the manual manipulation work and theft control.

Keywords— Current Sensor, IR Sensor, PIC Controller, GSM Module, Relay Control.

I. INTRODUCTION

The traditional meters, in which the pendulum rotates for a predefined times and it calculates the consumption of unit power in terms of Watts. Those meters are economical ones and installed at home and as well as in industries. The traditional meters are non-real time ones so calculation of bills is slow in process. Now a day's a computer operated meter are used but they are also non real time system operated device. There is no proper way to know the consumer's maximum demand, usage details, losses in the lines, and power theft.

Hence, with the rapid development of wireless communications, microelectronic technology, integrated circuit and sensing technology, the wireless sensor network (WSN) has achieved a great progressed, which is now most of the WSN's node had combine sensing, computation and communication into a single device, so to use wireless communication is not impossible anymore.

In the existing methods wireless communication system of energy meter used with Zigbee, relay control and PLC [1],[2]. The cryptographic method is used to secure the communication channel and Zigbee for the transmission of data in a serial process. For high speed data control we have to

use fiber optic communication but in rural area distribution system with more dispersed distributed energy resources, it is not economical to deploy fiber optic communication [6],[9]. Hence, wireless communication technologies are more feasible. Wireless communication reduces the hassle of making a new connection and will increase the network range.

In wireless communication, GSM plays an important role for transmitting data at a favourable price from residential buildings to central billing centres and providing extra services for the user. Due to high speed, unlimited transmission range, GSM is very appropriate for the power applications. This cellular network consists of cells, which are formed by many low power wireless transmitters. With the moment of mobile devices having cellular modem, transmission of data is also exchanged between cells to cell, which facilitates non interrupted data flow. This way it forms point to point architecture. This technology offers extensive data coverage, no maintains costs and network fully maintained by carrier.

In this proposed system focus on the Wireless Energy Monitoring system where the development of a hardware device and software application that can be used by the users to monitor their power usage at home. The user can obtain the status of energy consumption and the billed amount by sending the corresponding commands from the mobile phone to the GSM modem. Then it sends commands to the PIC microcontroller and the required information is sent to the user mobile through the GSM modem. Also they can obtain their consumption and billing status from the specific website which is provided by electricity provider. This increases the efficiency of the distribution system.

II. RELATED WORKS

Nowadays, much research has been carried out to improve the energy monitoring system. From the previous research various methods had been introduced to improve the energy monitoring system and one of the important ways to improve the energy monitoring system is to change the wired transmission to the wireless communication because the major weakness of the wired connection is the limitation of network ranges and upgrading difficulty. Hence with the rapid

development of wireless communications, wireless sensor network has achieved a great progressed. Wireless communication reduces the hassle of making a new connection and will increase the network range.

A. Automatic Meter Reading

Automatic Meter Reading (AMR), is the technology of automatically collecting consumption, diagnostic, and status data from water meter or energy metering devices (gas, electric) and transferring that data to a central database for billing, troubleshooting, and analysing. This technology mainly saves utility providers the expense of periodic trips to each physical location to read a meter. Another advantage is that billing can be based on near real time consumption rather than on estimates based on past or predicted consumption. Radio frequency based AMR can take many forms. The more common ones are handheld, mobile, satellite and fixed network solutions. There are both two-way RF systems and one way RF systems in use that use both licensed and unlicensed RF bands. In a two way or wake up system, a radio transceiver normally sends a signal to a particular transmitter serial number, telling it to wake up from a resting state and transmit its data.

The meter attached transceiver and the reading transceiver both send and receive radio signals and data. In a one way bubble up or continuous broadcast type system, the transmitter broadcasts readings continuously every few seconds. This means the reading the transmitter broadcasts readings continuously every few seconds. This means the reading device can be a receiver only, and the meter AMR device a transmitter only. The RF based meter reading usually eliminates the need for the meter reader to enter the property or home, or to locate and open an underground meter pit. The utility saves money by increased speed of reading, has lower liability from entering private property, and has less chance of missing reads because of being locked out from meter access. Data travel one way, from the meter AMR transmitter to the meter reading receiver. There are also hybrid systems that combine one way and two way technologies, using one-way communication for reading and two way communications for programming functions. The technology based on RF is not readily accepted everywhere. The RF technology faces a barrier of regulations in place pertaining to use of the radio frequency of any radiated power. The radio frequency which is generally in ISM band is not free to use even for low power radio of 10 mW. The majority of manufacturers of electricity meters have radio frequency devices in the frequency band of 433/868 MHz for large scale deployment in electricity board.

B. AODV Routing Protocol

Ad hoc On-Demand Distance Vector (AODV) Routing is a routing protocol for mobile ad hoc networks (MANETs) and other wireless ad hoc networks. AODV belongs to the class of Distance Vector Routing Protocols (DV). In a DV every node knows its neighbors and the costs to reach them. A node maintains its own routing table, storing all nodes in the network, the distance and the next hop to them. If a node is not reachable the distance to it is set to infinity. Every node

sends its neighbors periodically its whole routing table. So they can check if there is a useful route to another node using this neighbor as next hop. When a link breaks a Count-To-Infinity could happen.

AODV is an 'on demand routing protocol' with small delay. That means that routes are only established when needed to reduce traffic overhead. AODV supports Unicast, Broadcast and Multicast without any further protocols. The Count-To-Infinity and loop problem is solved with sequence numbers and the registration of the costs. In AODV every hop has the constant cost of one. The routes age very quickly in order to accommodate the movement of the mobile nodes. Link breakages can locally be repaired very efficiently.

C. Wireless Communication Network

A sensor network typically consists of a number of sensor nodes which each acquire signals from a sensor or multiple sensors and a system to transmit and process the data acquired from sensors. The sensor nodes can communicate the data within one another or to a centralized location over a wired or wireless network. The sensor network can thus be classified as a data acquisition network and data distribution network. The data acquisition system typically consists of sensors and circuitry to handle the real-world information available and the data distribution network involves the communication protocols, network topology, and methodology to transmit and handle the data. The basic network topologies used are star, ring, bus, and mesh.

GSM (Global System for Mobile communication) is one of the standards for mobile telephony in the world. Although initially used only for voice communication, it has been adapted to include data capabilities by means of GPRS (General Packet Radio Service) and EDGE (Enhanced Data Rates for GSM Evolution). A GSM modem is a type of modem which accepts a SIM 900A (Subscriber Index Module) and operates like a mobile phone. With the boom in telecommunication equipment, the costs of GSM modems are dropping rapidly. Also, due to advancements in low power design capabilities of mobile phones, the current consumption of GSM modems is much less than it traditionally has been.

III. METHODOLOGY

The proposed methodology is developed with the Mesh Network topology algorithm to monitor the energy monitoring system monitoring using GSM wireless module in order to provide the energy usage to the user. The smart home wireless energy monitoring system has been divided into three part for a detailed optimization design. The first part is a smart home energy monitoring using current transformer, the second part is GSM wireless module as a access point and web page as a GUI for user.

A. Energy Meter Reading System

The power supply is given to the PIC controller and the Load. The unit readings from the load is calculated using the Current sensor and Voltage sensor and the value can be stored

in the PIC microcontroller. The code can be given using the MPLAB to the PIC microcontroller and it is displayed in the LCD. The data can be transmitted and received from PIC to the MAX232 through UART. The serial communication can be achieved through the DB9 to the GSM modem. The code is sent to the EB station and acknowledge is received by the GSM Modem. The total amount can be stored in the PIC microcontroller [14] and it can be viewed through the LCD. When the total amount reaches 80% by consuming the electricity, the user will get a warning message to pay the amount of power usage. The following f

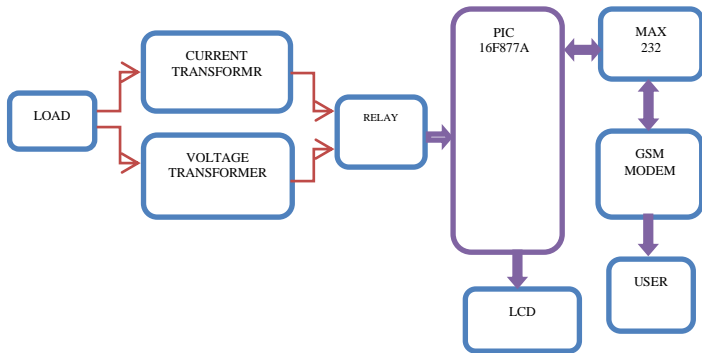


Fig.1: Block Diagram of Energy Monitoring System

When the total amount gets over, the household power supply will be cut off using the relay. When household again recharge their account, then further microcontroller send a message via SMS to the user. In this project load is connected to PIC microcontroller through the Current transformer and voltage transformer. This system is low cost and highly reliable. With help of this system we can improve the system capability and reduced operation cost and theft activity of electricity. The fig.2. is the simulation result of the energy meter data reading system.

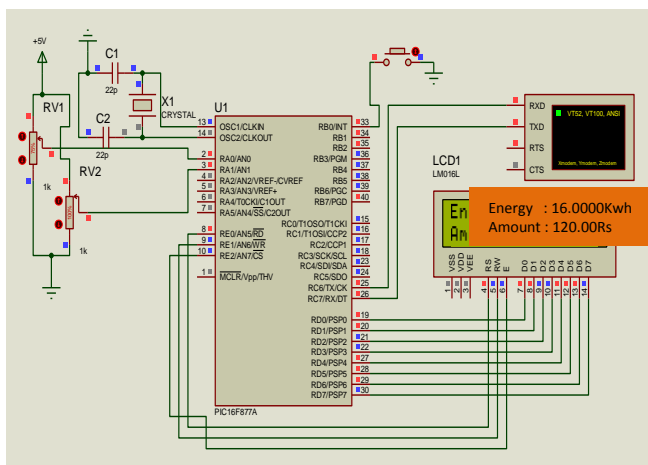


Fig.2: Simulation Output of Energy Monitoring System

B. Tampering Detection System

The metering of electric energy meter is mainly according to the relationship with voltage, electric current and power

factor angle. Un-hooking technology will electricity stealing. Secretly destroy the lead sealing of electric energy meter, open voltage hook of terminal in junction box and make no electric current through all using quantity of electricity steal.

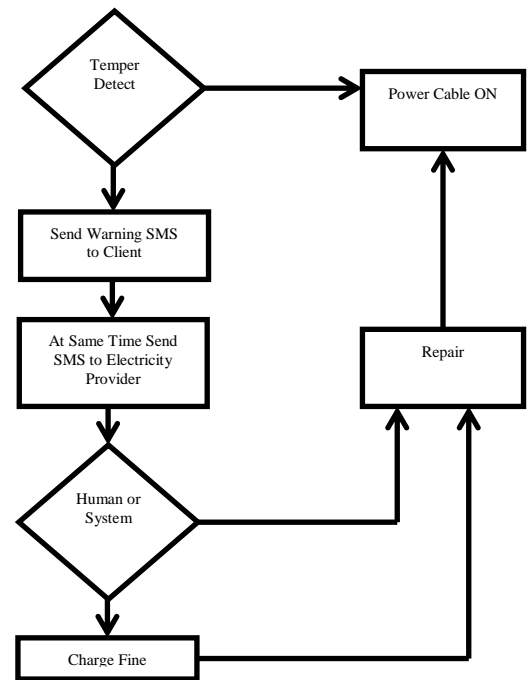


Fig.3: Flowchart of Tampering Detection System

Loop of short electric current, which makes the electric energy meter shift slow. So our project deals about the theft control in energy meter by using IR Sensor. To control the theft we use two types of theft controlling process namely tampering of seal in the load control, underground power theft control. The first process of theft control by using IR (infrared) sensor. IR sensor is fixed in the corresponding load screw with 12v rechargeable battery for identifying the tampering of seal. After identifying the theft IR sensor send the data to the PIC micro controller and then message send to the electricity board by using GSM.

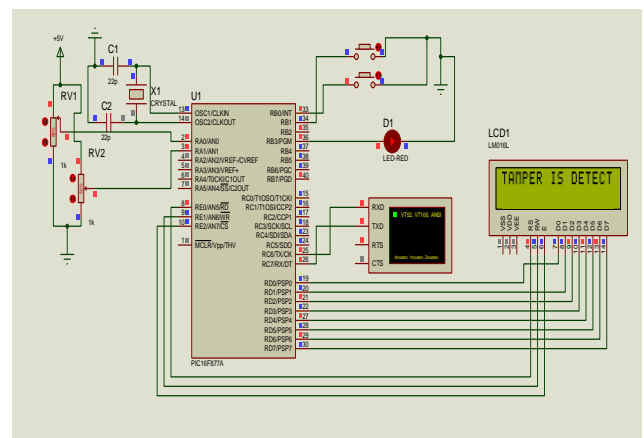


Fig.4: Simulation Output of Tampering Detection

The second process of theft control by using the step down circuit fixed between 50 meter gap to analyze the underground theft. If the intruder cuts the underground cable at the time of a power cut the connection of sensors also disconnected. Then the data transfer also disconnected between the circuit and send the information about the disconnection between the circuit to the PIC micro controller and then message send to the higher officer of the EB (electricity board). The fig.4 is the simulation result of the tampering detection system.

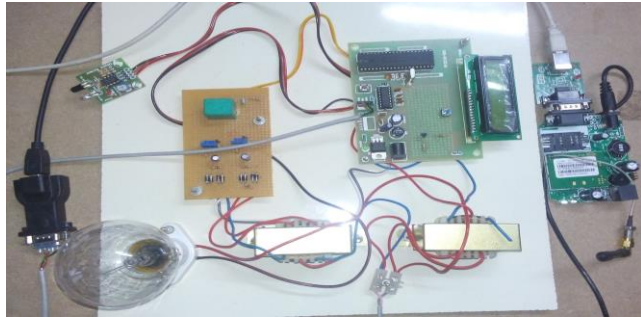


Fig.5: Hardware Interfacing of Energy Meter



Fig.6: Bill Details for Customer in Mobile



Fig.7: Tamper Detection Sends to Electricity Board

IV. CONCLUSIONS

In this proposal model , a real time smart metering system demonstrates how to replace old traditional meters. This new model eliminates the difficulties which are present in older system like saving of money and labour resources. The data is secured due to its unique ID technique. The proposed system used in this model is tamper detection and control system. Energy awareness enables new sets of interactive energy saving behaviours where devices control their power state to meet user needs while minimizing energy usage. The server can control the home energy use schedule to minimize the energy cost and also to control the smart metering system to the long distance communication.

The mesh network algorithm is developed using current sensor and the GSM module. To save money, the consumed energy corresponding price is displayed for the consumer benefits. This model work exposes the purpose of energy monitoring and controlling by implementing energy monitoring system.

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