IoT Based Energy Meter Reading, Theft Detection and Disconnection

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Abstract - *This is a PIC16F877A micro controller based design and implementation of energy meter using IoT (Internet of Things) concept. This design eliminates the human involvement in electricity maintenance. The energy meters are connected to the PIC micro controller through an interfacing circuit. The optocoupler sensor gives an interrupt each time the meter LED ashes to the programmed PIC micro controller. The readings of the main energy meter and sub energy meters are compared so as to identify the theft status. Whenever there is discrepancy in the two values, a message that theft has occurred will be displayed in the LCD display as well as in the web page. We can access the web page from anywhere on the globe at any time using the consumer number provided by the supply authorities. So the consumers can easily track their energy usage so that effective monitoring of power consumption is possible. The hardware interface circuit consists of PIC16F877A micro controller, MAX232, LCD display, and optocoupler.*

Key Words: IoT, PIC microcontroller, Energy meter, Web page, LCD Display

1. INTRODUCTION

Energy crisis is one of the major problems that the world faces today. The best remedy for this is not the increase in energy production, but the effective use of available energy. By properly monitoring our energy consumption and avoiding energy wastage, energy crisis can be reduced to a certain extent. But energy monitoring cannot be done efficiently mainly because consumers are not aware of their energy consumption. They will get an idea about their consumption only when the electricity bills are issued. In India, bill is issued only once in a month or two months. So the consumers will be in dark during this period of time about their energy usage. In this era of complete digitalization, no one will take the pain to go and check their electricity meter reading and compare it with the previous reading so as to get an idea about their consumption. This whole procedure has to be repeated several times in a month to efficiently control the energy usage. If consumers can check their energy consumption using their mobile phone or laptop instead of checking energy meter, it will be a great leap in the area of energy management. Since most of the

people are today 24*7 online, it will be really a boon if they can monitor their energy consumption online from anywhere on the globe. In this paper, we are describing a method of electricity energy meter reading using IoT concept.

This is a PIC16F877A micro controller based design and implementation of energy meter using IoT concept. The Internet of things (stylized Internet of Things or IoT) is the internet working of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. In the proposed system, energy meters are connected to the internet using IoT concept. So there is a provision for the consumers to track their energy consumption from time-to-time so that they can control their consumption as they desire. This method is useful for both the consumer and the supplier. This system allows the supplier to disconnect the connection from a distant server in case the consumer fails to pay his/her electricity bill. This method eliminates the need of human power during disconnection and reconnection of the load. Another major advantage of this method is that it will inform the supplier side about any theft that is happening in the system.

2. PROPOSED SYSTEM

In this system we are connecting energy meters to the internet i.e., IoT concept. This system eliminates the human involvement in electricity maintenance. The block diagram of the system is shown in Fig-1.

The major components used in the system are PIC micro controller, energy meters (main energy meter and sub energy meter), interfacing circuit (optocoupler), relay and relay driver circuit, LCD display and a PC. The main energy meters as well as the sub energy meter are connected to the PIC microcontroller using an interfacing circuit. The interfacing circuit consists of an optocoupler. Optocouplers are used for providing optical isolation between an input source and output load just by using light. The basic design of an optocoupler consists of an LED that produces infra-red light and a semiconductor photo-sensitive device that is used

to detect the emitted infra-red beam. The pulses from the energy meter are converted into digital signals by using an optocoupler.
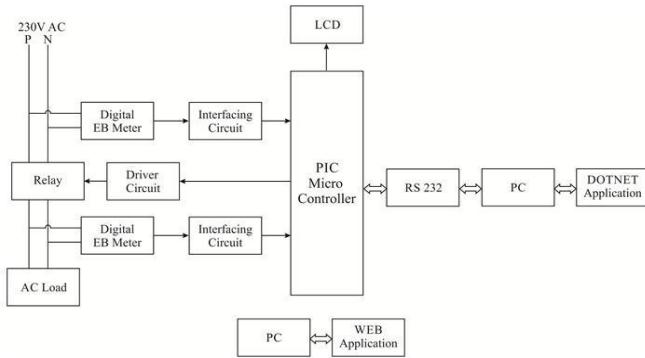

Fig -1: Block Diagram

The live readings from the energy meters are collected by the microcontroller. This can be viewed through an LCD display which is connected to the micro controller. The LCD display shows the readings of the energy meters and the theft status. During normal operation, the reading of the main energy meter should be equal to the sum of readings of sub energy meters. Since we are using only one sub energy meter the reading of both main and sub energy meters should be equal. A tolerance of 4 units is provided to account for the losses that may occur. The theft detection flowchart is shown in Fig-2.
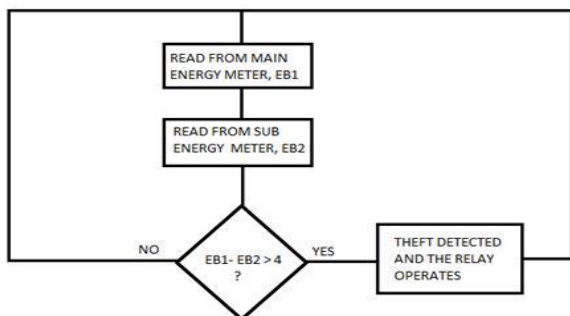

Fig -2: Theft Detection Flow Chart

If the readings of both energy meters are equal, the message "no theft" will be displayed in the LCD display as shown in Fig-3.

When energy theft occurs (i.e., a connection is tapped from the transmission line prior to sub energy meter), it will be read by main energy meter but not by the sub energy meter. This will result in discrepancies between the main and sub energy meter readings. When this difference is more than the tolerance provided, the message "Theft occurred" will be displayed in the LCD display as shown in Fig-4. Then the relay will operate and this can be used for disconnecting the load.

Fig -3: LCD Display During Normal Operation

Fig -4: LCD Display During Theft Condition

Using RS232 serial port, the PIC microcontroller is connected to a PC. Using DOTNET application, the readings from the energy meters are used for updating the contents of the web page. This web page can be assessed using the consumer number from anywhere on the globe at any time. The web page created is shown in Fig-5. The web page shows the readings of both main energy meter and sub energy meter and the theft status. Thinking from the consumer side, this web page is a real boon since they can monitor their energy usage efficiently. We can also use an android application for this purpose.
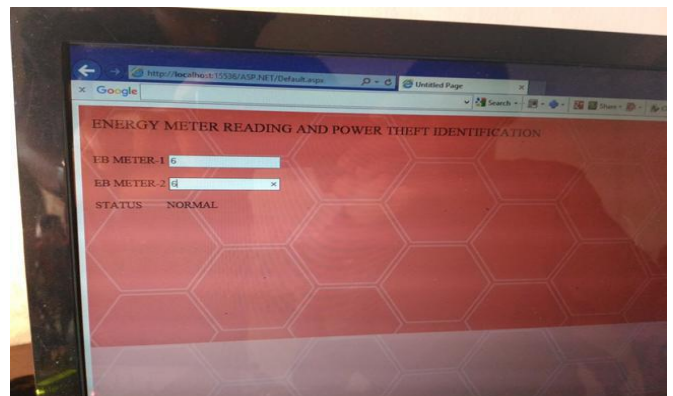

Fig -5: Web Page

3. ADVANTAGES OF THE PROPOSED SYSTEM

The proposed system eliminates the human involvement in electricity maintenance. The current system is inefficient in terms of monitoring our energy consumption. Also, the provision for generating bills automatically is limited and inefficient. At present, SMS is used for transmitting the data to a central server in Automatic Meter Reading system. But the proposed system uploads the readings periodically to a central public server through GPRS. GPRS is more cost effective than SMS. GPRS is also more efficient for frequently updating the data. Human involvement in metering can be avoided using this method. The users can also monitor their energy meter reading online from anywhere on the globe 24*7. By using this system, consumers will be aware of the electricity usage in their home which will leads to effective control of power consumption

4. CONCLUSIONS

In this era of energy crisis, devising strategies which helps in effectively controlling energy consumption and avoiding energy wastage is very important. This is a PIC16F877A micro controller based design and implementation of energy meter using IoT concept. Here energy consumption is calculated by counting calibration pulses from energy meter. In the proposed system, IoT based meter reading system is designed to continuously monitor the meter reading and transfer the data to a central server which can be accessed from anywhere on the globe at any time. The service provider can disconnect the power supply whenever the customer does not pay the monthly bill and also when a theft is identified. This system eliminates the human involvement in energy management.

The performance of the system can be further enhanced by connecting all the household appliances to the IoT. Online bill payment can also be implemented so as to make the system more user-friendly. We can further incorporate a system where the user will receive warning messages when he/she crosses the threshold of electricity usage slab.

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