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IOT BASED REAL TIME ENERGY MONITORING AND THEFT DETECTION WITH DISCONNECTION USING AMI

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Abstract:- *With the advancing technology, every field is shifting towards making systems automated, portable and easy to use. Supporting the change in time, the project proposes a technique for real time monitoring of energy consumption using smart energy meters connected with each other in a smart network and for theft analysis using IOT. Here we present ingenious energy theft detection with the boon of predicting consumer's ungenerous consumption pattern. To bring awareness among the people, we alert the consumers by a notification. IOT operation is performed by Wi-Fi device, which sends the meter data to the web page through the IP address. This is used for Electricity board to continuously monitor the consumption of power and billing information that is calculated using microcontroller.*

KeyWords: **Internet of things, Arduino uno microcontroller, wireless network, relay, current sensor**

1. INTRODUCTION

In this era of energy crisis, energy management and monitoring which helps in effectively controlling of energy and avoiding energy wastage. Proper utilization of power is of immense important, as it is the soul of world, which is Electricity. The data collection of energy consumed by the consumer and monitoring of the distribution of energy are very necessary need in the energy visualization and analysis. The authorized person from the Tamil Nadu Electricity Board (TNEB) was being preceded by human operators at consumer's service location to note down the consumed energy units and calculates the usage charge. In this current scenario, many crises arise. There are various reasons for these crises. The problems which are firstly may be due to observational error, i.e., even a single digit change while noting down the energy consumed readings may totally changes the calculation of the cost for the consumed units and also there will a delay in taking the meter reading by the authority of TNEB due to bad weather conditions, shortage of authority persons. Next due to a case where there is a absences of consumer in the home which leads to a problem that the consumer will not be aware that the reading was taken and some difficulties for the authority persons. This process of traditional meter reading which is time consuming and increase in the labour expenses. Therefore to reduce the effort of TNEB, new technology can be incorporated (i.e.)., the IOT based real time monitoring of energy. As per the TNEB tariff, if the usage of units goes beyond certain threshold units such as 100,200 and 500 units, base tariff amount changes to new tariff, so this causes consumer to pay extra money than the normal payment. Moreover, many people are not aware of this type of calculation in Electricity billing. Therefore, to bring awareness in the energy consumption for the consumer here we brought a system of IOT based real time monitoring for the consumer.

In the current situation, electricity theft has created a major impact and severe problems in the developing countries. Due to this huge amount of revenue, loss is incurred. There are numerous ways using which electricity theft can be done, so it is difficult to track how a theft has occurred, and this issue has to be solved as early as possible. When coming to power theft, in earlier days the energy meters were analog, so the consumers use permanent magnets to slow down its rotation. To avoid such illegal consumption digital meters were implemented, but consumers looted power through by passing the meter. Therefore, the following mode of operation using smart meters can forewarn the power theft by locating the area. Smart meters, together with the communication network and data management system, constitute the automatic metering infrastructure (AMI), which plays a vital role in power delivery systems by recording the load profiles and facilitating bi-directional information flow.

2. OBJECTIVE

Contemporary electric power systems face a significant challenge of both protecting their own infrastructure and ensuring the continuity of their services. Moreover, especially a big problem for the Electricity board involves financial losses caused by electric energy larceny. This system would provide a simple way to detect an electrical power theft without any human interface. It would provide a digital record in case of any judicial dispute. Energy management and monitoring has a significant role for the proper utilization and better energy management. Therefore, we design an IOT framework where a consumer can screen the energy utilization continuously and for monitoring the energy theft by Electricity board.

3. EXISTING SYSTEM

In the traditional billing system, a person from Electricity board has to go each house and take the reading from each house's meter which is time consuming and also need lot of manpower. As in our state the electricity energy billing duration is at end of two months. Thus during the mid of month the consumer is not having the awareness of how much the power is consumed, they can only know at the end of one or two months when the bill is issued. Where the consumer cannot track the usage of the power on the real time. Thus users face trouble in managing power consumption. Another disadvantage of this system is theft and such practices which is one of the major causes of power crises.

4. PROPOSED SYSTEM

In the proposed system to eliminate the manual work and the human involvement in the meter reading we are using the concept of Internet of Things (IoT). This system which makes it possible for TamilNadu Electricity Board (TNEB) to collect unit readings without using the manual involvement. The data, the unit consumed by the consumer which is collected at the consumer premises is loaded to the separate TNEB official web server. A database at the server, that stores all the details including the consumer number, units consumed which will be only accessible to the authority. This is achieved by connecting the Arduino microcontroller with energy meter. In this paper we also suggests a method for effective energy management , to bring a awareness to consumer on billing pattern of TNEB and enables them to monitor the daily electricity consumption by using an android application and a website. The android application can monitor the power usage and can warn the users when power usage is getting close to the prescribed threshold energy level and alerts the consumer by a message if it exceeds. If the user fails to pay the electricity bill or if the is consumer is against of the rules and regulation of TNEB, then the TNEB server will automatically cut the power supply to the consumer.

Electricity theft is a social evil and which is increasing day by day that has to be completely eliminated. This paper suggests a method for power theft detection and disconnection using the automatic metering infrastructure (AMI). If there is any illegal connection it can be detected. The main advantage is that the power theft detected with the consumers number, which will be easy for the TNEB officials to take immediate actions on the consumer. If the power theft is identified in a locality the server automatically disconnect the illegal connection without human involvement.

5. BLOCK DIAGRAM

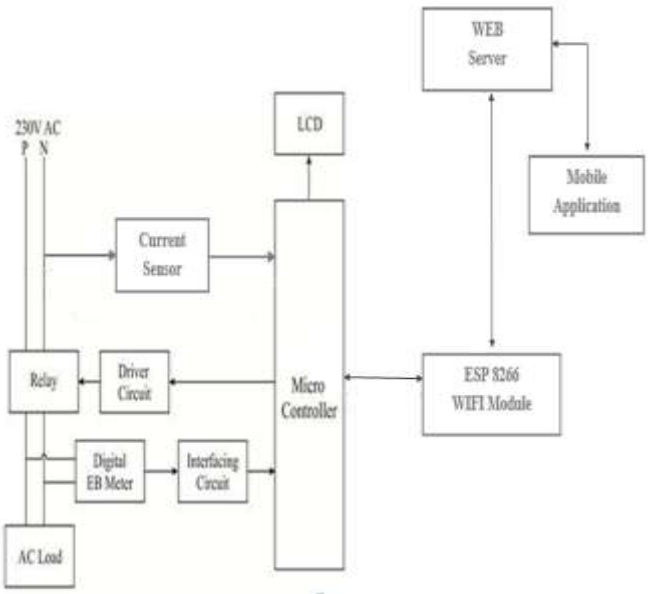

Fig 5.1

6. SYSTEM DESIGN

6.1 ARDUINO UNO

Arduino UNO is ATmega328P-8 bit AVR family microcontroller. Its operating voltage is 5volts. It has six analog input pins i.e., A0 to A5. There are fourteen input or output pins, which includes serial pins, external interrupt pins, PWM pins, SPI pins and in- built LED pin. Analog pin 4 is SDA and pin 5 is SCA, both are used for TWI communication using wire library. Generally, microcontroller consists of RESET, VCC, GND, clock signal pins.

6.2 CURRENT SENSOR ACS712

The current sensor ACS712 is a device that works on the principle of Hall Effect phenomenon and detects the current in the designed path and transfers the reading to Arduino board. It operates from the range of 5V and gives an analog voltage as output which is proportional to the current sensed on the terminals. Both positive and negative poles of the sensor are connected respectively to the required path. Here the poles are connected to the phase and neutral of the single phase line.

6.3 OPTOCOUPLER

An electronic component used to interconnect two separate electrical circuits by light sensitive optical interface is optocoupler (or) opto isolator. The photo-transistor device is used for DC circuits. This acts as an interfacing circuit for controlled pulse of voltage signal to the Arduino UNO

microcontroller. Optocouplers are the devices that provide the electrical isolation between the terminals.

6.4 ESP8266 WIFI MODULE

The ESP8266 is a low cost wifi module which is interfaced with microcontrollers such as Arduino UNO. ESP8266 contains a built-in 32-bit low-power CPU, ROM and RAM. It is a complete and self-contained Wi-Fi network solution that can carry software applications as a stand-alone device or connected with a microcontroller (MCU). The module has built-in AT Command firmware to be used with any MCU via COM port.

6.5 ENERGY METER

Energy meter is a device used to measure the amount of electrical load consumed by the users. They are calibrated by Kilowatt hour. Digital energy meters are mostly used for reading power consumption. The product of instantaneous current and voltage gives the instantaneous power. By integrating instantaneous power against time, the energy usage of the consumers is obtained.

7. METHODOLOGY

7.1 REAL TIME MONITORING OF ENERGY USING SMART ENERGY METER:

This system will provide the smart and secure infrastructure, where there is a provision for the supplier that they can monitor the power consumed by consumer. The electricity board maintains a server where each consumer is provided a smart meter. Smart energy meter is concerned with the automation of the electric billing system and provides a awareness of consumption of energy to the consumers. ESP8266 module and local network which are used by the server where the energy meter is interfaced with the Arduino microcontroller using an interfacing device, Opto-coupler. The pulses from the energy meter using the calibration LED is detected by an Opto-coupler and it converts the pulses to electrical signals acting as counting pulses for the microcontroller. Based on these pulses, Arduino will automatically generate consumed unit and cost. The generated data is automatically updated to a central data base.

7.1.1 FOR CONSUMER END:

On the consumer side, the major drawback is that the consumption of electricity is not tracked by the consumers and many times they are shocked, when they receive high bills. The cause of getting high bills is usually not the high electricity rates but is the unconscious overuse of electricity. The presented real time energy monitoring system which is suggested as the viable solution to this problem. As the billing system in Tamil Nadu for Domestic loads that tariff amount changes for certain threshold units such as <100, <200, <500 and >500 units. In this system to create an awareness to the consumer, they are alerted by a notification in a android application when the usage of power at previously of 20 units threshold value i.e., for 80,180,480. After that the consumer is alerted for every 5 units consumption till they reach their threshold value i.e., <100, <200, <500 and >500. Same case of notification is created for the commercial users.

The consumer can also monitor their electricity consumption on the real time through webpage which is possible to access from any place as well as notification on his mobile phone regularly whenever needed. Along with the notification bill at the end of two months, the TNEB electricity payment page can be loaded through a link. If consumer fails to pay their electricity bill amount within the time period mentioned by the electricity board, the power is disconnect automatically from the distant end.

7.1.2 FOR TNEB END:

As the power consumption of each and every consumer will be uploaded periodically along with the consumer number to the specific TNEB server and it's easier for the generation of bill. As it is bill is generated automatically, the manual work and errors involved in the billing system can be greatly reduced.

7.2. ENERGY THEFT DETECTION:

Now-a-days meter tampering is more common as the meter in the consumer side is made to malfunction making the energy meter not to read its original readings. So that the energy meter reads the different readings, usually lesser readings than the original ones where theft occurs. Usually this type of power thefts cannot by identified at the substation level and creates a revenue loss. This can be identified only when the authority of Electricity board finds the losses have greater value than the mapped losses, and then only the electricity theft is identified. In the energy theft detection, two current sensors are used. One at phase to measure the amount of current received and other at neutral of energy meter. In case of single phase energy meter, when there is no power theft the current at the neutral is equal to phase current. On the other hand on the three phase energy meter, the neutral current is equal to the square root of summation of phase currents and subtract each multiplied pair from the total summation current i.e., (A^2+B^2+C^2-AB-AC-BC)^(1/2). If the microcontroller detects a difference between the two current values, power theft is identified. As when the power theft occurred, the Arduino triggers the connectivity interface that alerts the electricity board at the webpage that theft has occurred. As soon as the theft as occurred the relay connected to the meter at the customer premises is get activated and disconnects the load. In this method of power theft detection which eliminates the involvement of manual work to disconnect the load. One more advantage of this method is security to the whole

system in which it is accessible only by the authorized person.

SIMULATION DESIGN

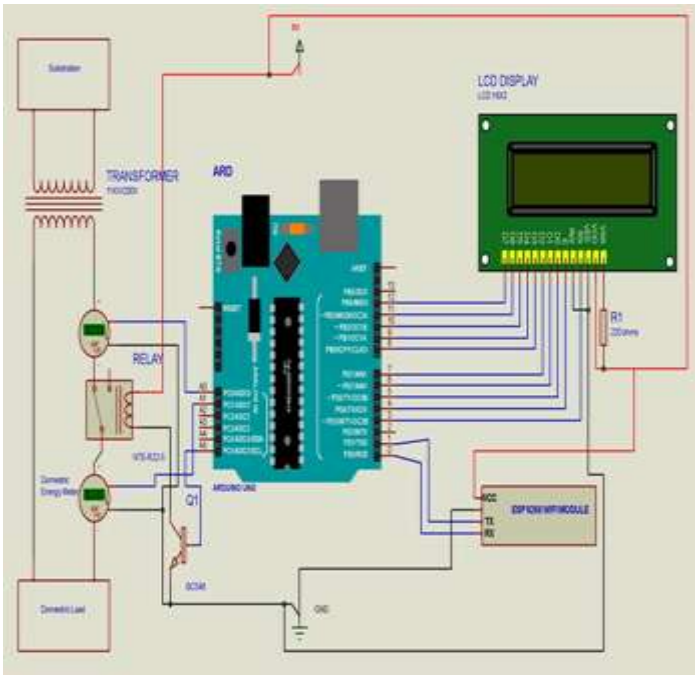

Fig 7.1

8. PROPOSED HARDWARE MODULE

Here the proposed module consists of hardware that was described above in system design hardware description.

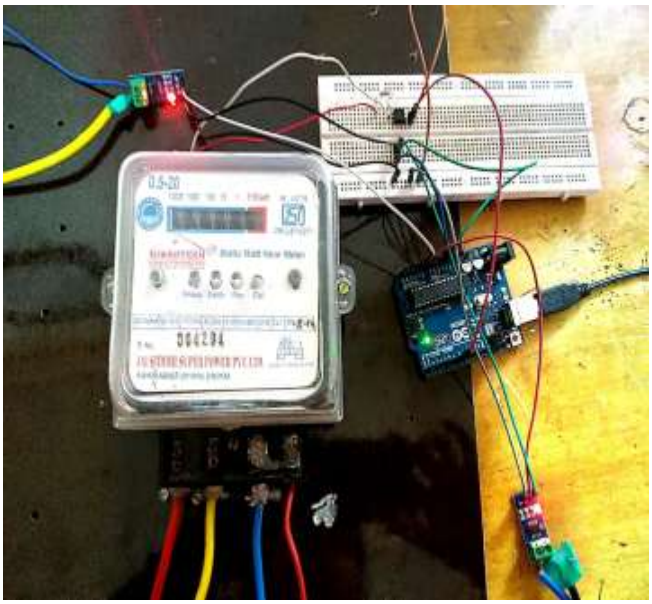

Fig 8.1

As when the load is ON energy is consumed and is measured using the energy meter. The consumed units are automatically uploaded to the web server and a mobile application.

Fig 8.2

Fig 8.2 shows the mobile application where the units consumed and cost of the units consumed is uploaded.

9. CONCLUSION

The integration of hardware and software in proposed system can switch on the user's power consumption for crossing the threshold of electricity usage through notification in consonance with TNEB tariff. The proposed system also comforts the TNEB for energy theft detection by tracking the location faster via current sensors and to disconnect the supply when the theft is identified. The system can be operated from long distances irrespective of time and more efficiently by IoT technology.

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