IoT based Automatic Reading & Billing using Smart Energy Meter

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Abstract: **We can see a person standing in front of our house from electricity board, whose duty is to read the energy meter and handover the bills to the owner of that house every month. This is nothing but meter reading. According to that reading we have to pay the bills. The main drawback of this system is that person has to go area by area and he has to read the meter of every house and handover the bills. Many times errors like extra bill amount, or from electric board even though the bills are paid are common errors. To this drawback we have come up with an idea which will eliminate the third party between the consumer and service provider, even the errors will be overcome. In this paper the idea of smart energy meter using IoT and Arduino have been introduced. In this method we are using Arduino because it is energy efficient i.e. it consumes less power, it is fastest and has two UARTS. In this paper, energy meters which is already installed at our houses   a feature of notification through SMS. One can easily access the meter working through web page that we designed. Current reading with cost can be seen on web page. Automatic ON & OFF of meter is possible. Threshold value setting and sending of notification is the additional task that we are performing.**

Keywords: **Smart Energy Meter, Electric board, UARTS, IoT, GSM, Wi-Fi, webpage.**

1. Introduction

In the present billing system, the distribution companies are unable to keep track of the changing maximum demand of consumers. The consumer is facing problems like receiving due bills for bills that have already been paid as well as poor reliability of electricity supply and quality even if bills are paid regularly. The remedy for all these problems is to keep track of the consumers load on timely basis, which will have held to assure accurate billing, track maximum demand and to detect threshold value. These are all the features to be taken into account for designing an efficient energy billing system. The present project "IoT Based Smart Energy Meter" addresses the problems faced by both the consumers and the distribution companies. The paper mainly deals with smart energy meter, which utilizes the features of embedded systems i.e. combination of hardware and software in order to implement desired functionality. The paper discusses comparison of Arduino and other controllers, and the application of GSM and

the consumer as well as service provider will get the used energy reading with the respective amount, Consumers will even get notification in the form text through GSM when they are about to reach their threshold value, that they have set. Also with the help of Wi-Fi modem the consumer can monitor his consumed reading and can set the threshold value through webpage. This system enables the electricity department to read the meter readings monthly without a person visiting each house. This can be achieved by the use of Arduino unit that continuously monitor and records the energy meter reading in its permanent (non-volatile) memory location. This system continuously records the reading and the live meter reading can be displayed on webpage to the consumer on request. This system also can be used to disconnect the power supply of the house when needed.
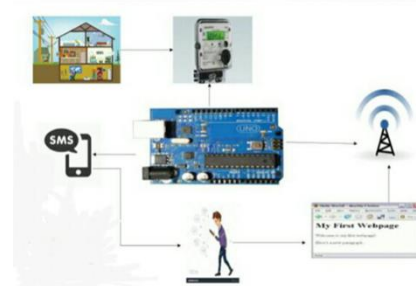
2. Architectural diagram

Fig. 1. Architectural Diagram

The explanation of the above architectural model is as follows
- When the various appliances of the household consume energy the energy meter reads the reading continuously and this consumed load can be seen on meter.
- We can see that the LED on meter continuously blinks which counts the meter reading.
- In our project we are trying to develop, a system in which Arduino Uno act as main controller, which

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continuously monitor energy meter
- As per the blinking of LED on energy meter the Arduino will measure the unit consumption.
- The measured reading with the calculation of the cost will be continuously displayed on web page that we have designed.
- Threshold value can be set on webpage with the help of Wi-Fi, as per the consumer's requirement. When the consumers reading will be near about to the set threshold value it will send a notification value to the consumer.
- This threshold value notification will increase the awareness amongst the consumer about the energy.
- When the consumer gets the notification he can visit the webpage and change the threshold value.
- If the consumer is not aware with the threshold notification, then the meter will automatically get off. Then the consumer has to visit the webpage again and increment the threshold value. By the instrumentation, the meter will automatically get ON.
- Finally the overall monthly bill with cost will be sent to customer as well as service provider in the form of text at first day of every month.
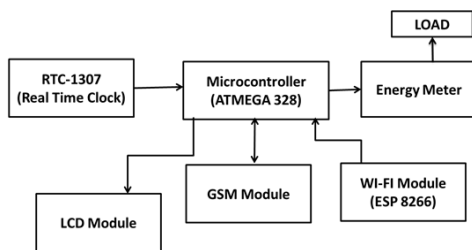
3. Block diagram

A. Transmitting side
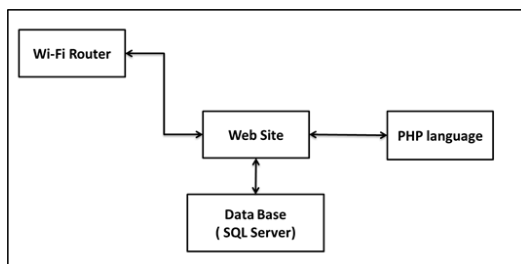

Fig. 2. Transmitting side

B. Receiving end

Fig. 3. Receiving end

C. Block diagram representation

The above block diagram represents our proposed "Iot Based Automatic Reading & Billing System" Using Energy Meter"

4. Energy meter

Energy meter or watt-hour meter is an electrical instrument that measures the amount of electrical energy used by the consumers. Utilities is one of the electrical departments, which install these instruments at every place like homes, industries, organizations, commercial buildings to charge for the electricity consumption by loads such as lights, fans refrigerators and other home appliances. Energy meter measures the rapid voltage and currents, calculate their product and give instantaneous power. This power is integrated over a time interval, which gives the energy utilized over that time period.

A. Arduino UNO (ATMEGA 328)

Arduino board is the heart of our system. Entire functioning of system depends on this board. Arduino reacts to the 5v supply given by opto-coupler and keeps on counting the supply and then calculates the power consumed and also the cost. This data, it continuously stores on webpage, so that users can visit any time and check their consumption. It even reacts accordingly as per programmed, to the situations like message sending during threshold value etc.

B. GSM MODULE (SIM900)

GSM stands for Global System for Mobile communication. It is widely used mobile communication modem system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHZ, 900MHZ, 1800MHZ, 1900MHZ frequency bands. It has ability to carry 64kbps to 120Mbps of data rates. In our system GSM is used to send the notification of threshold reaching to consumer and for sending message of total consumption of unit with cost to the service provider and consumer.

C. Wi-fi module (ESP8266)

Wi-Fi stands for Wireless Fidelity. We are using Wi-Fi which acts as heart for IoT. Through Wi-Fi the consumer can set changes in threshold value, he can ON and OFF the energy meter. Time to time the readings of units and cost are displayed on webpage. Consumer can access the Arduino board and meter with help of Wi-Fi.

D. Webpage (php)

We designed webpage for operating Arduino and Energy Meter with the help of php. php stands for Hypertext Preprocessor. It is a standard language for creating web pages and web applications There is no need to have a very special development environment with PHP, the block starts and ends with the tags & lt;? php and ?>. Certainly, PHP could be configured with tags and even in ASP format and it would deal with everything among those signs, but not in the same file.

E. Switching device

In our system we are using SSR as switching device even though we can use RELAY because SSR is highly

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advantageous. We are using switching device to switch the energy meter. For ON and OFF purpose of meter we are using switching block. SSR stands for SOLID STATE RELAY.

F. Abbreviation used

- IoT - Internet of Things
- LED - Light Emitting Diode.
- GSM - Global System for Mobile
- Wi-Fi - Wireless Fidelity

G. Unit

Normally, basic unit of electricity is Kilowatt hour (KWh) 1kWh = 1000 watt for 1 hour.

Example, ten 100watt bulbs used for 1 hour gives 1kWh.

Why ARDUINO board than other controller?

Well known, controllers to us are 8051, pic 16f/18f, ARM7, msp430, other latest boards like Intel Galileo Gen 2 etc. Out of all these ARDUINO is the best.

- We require two UARTS, but pic 16f/18f and 8051 has only one UART.
- Whereas ARDUINO has two UARTS as required, one in hardware and other in software.
- Msp430 has 3 UARTS but it is very costly than ARDUINO.
- ARDUINO is even less in cost as compared to another controller.

5. Conclusion

An attempt has been made to make a practical model of "IOT Based Automatic Reading & Billing System Using Smart Energy Meter" . The propagated model is used to calculate the energy consumption of the household, and even make the energy unit reading to be handy. Hence it reduces the wastage of energy and bring awareness among all. Even it will deduct the manual intervention.

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