

# Smart Energy Metering Using GSM And IOT

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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 notification from electric board even though the bills are paid are common errors. To overcome 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, an energy meter which is already installed at our houses is not replaced, but a small modification on the already installed meters can change the existing meters into smart meters. The use of GSM module provides 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, MQTT.

## I. INTRODUCTION

It has become a trend to integrate automatic systems via wireless applications over network. Along with the advancement of technology development, research on wireless applications and remote control has become significant and popular today. An electricity meter, electric meter, or energy meter is a device that measures the amount of electric energy consumed by a residence, business, or an electrically powered device. A smart energy meter (SEM) is an electric device having an energy meter chip for electric energy consumed measurement, wireless protocol for

data communication (such as GSM Modem) and peripheral devices for security purpose, data showing, meter controlling etc. Energy meter systems [1-2] can be incorporated with embedded controllers such as GSM modem to transmit the data over the mobile network. Such data can be then fed and integrated into existing Energy Management Systems located at power companies and organizations. The problem of efficiently collecting data from a large number of distributed GSM Modems in the energy meters is still a challenging problem. GSM modem should need the terminal to control that part. Our Embedded

controller interfaced with energy meter reading systems and GSM modem to control both.

The Energy Monitoring System is appropriate for Industries, manufacturing plants, commercial buildings or any situation where an electrical system is used. The system provides the centralized energy monitoring and control. The Energy Management System leads to savings in the overall cost. These savings may be come from better utilization of manpower, servicing cost, savings in the energy consumption and non-breakdowns in the system. The smart energy meter Contains an energy meter, a GSM modem, a microcontroller (Arduino) and a relay circuit, which is connected between the energy meter and the load. The proposed smart energy meter is able to provide all the metering and billing services like Counting the consumed energy, sending the generated bill by the SMS (short message service) over the GSM network as well as the security services. Factually at present, the metering and billing system of our country is totally conventional and it is very much slowed, faulty and corrupted so our proposed Smart energy meter is highly deserved for national implementation. The overall operation of the proposed system is discussed in the next section.

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 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 Wi-Fi modems to introduce ‘Smart’ concept. With the use of GSM modem 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.

## II. ARCHITECTURAL MODEL

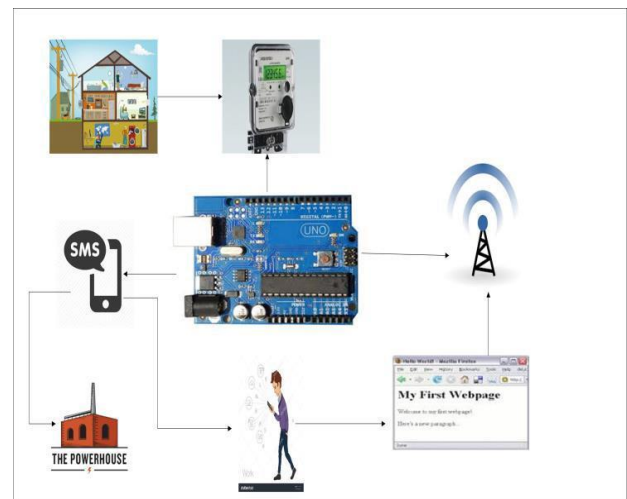


Figure 1. Architectural Diagram

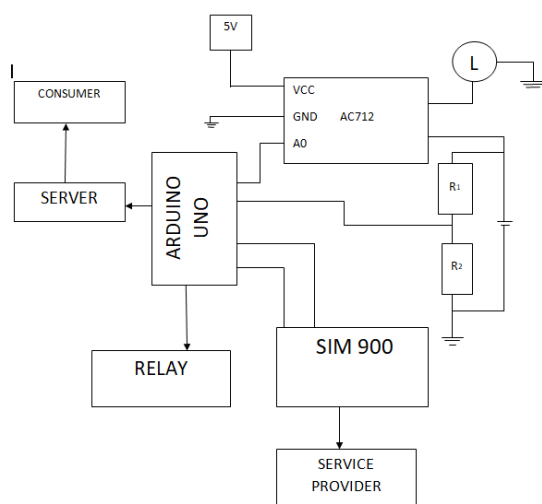
The explanation of the above architectural model is as follows

1. 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.
2. The measured reading with the calculation of the cost will be continuously displayed on web page that we have designed.
3. 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.

4. This threshold value notification will increase the awareness amongst the consumer about the energy.
5. When the consumer gets the notification he can visit the webpage and change the threshold value.
6. 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 incrementation, the meter will automatically get ON.
7. 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.

### III. EASE OF USE

#### BLOCK DIAGRAM



**Figure 2.** Block Diagram

#### A. 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.

#### B. 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 programed, to the situations like message sending during threshold value etc.

#### C. 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.

#### D. WEBPAGE (MQTT).

MQTT is a Client Server publish/subscribe messaging transport protocol. It is light weight, open, simple, and designed so as to be easy to implement. These characteristics make it ideal for use in many situations, including constrained environments such as for communication in Machine to Machine (M2M) and Internet of Things (IoT) contexts where a small code footprint is required and/or network bandwidth is at a premium.

The abstract of the MQTT specification does a good job in describing what MQTT is all about. It is very light weight and binary protocol, which excels when transferring data over the wire in comparison to protocols like HTTP, because it has only a minimal packet overhead. Another important aspect is that MQTT is extremely easy to implement on the client side. This fits perfectly for constrained devices with limited resources. Actually this was one of the goals when MQTT was invented in the first place.

### E. SWITCHING DEVICE.

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

### Why SSR instead of RELAY?

- Both are used as AC switching device, but if switching speed is high than SSR is suitable, if switching speed is slow than RELAY is used.
- Relay life decreases as number of usage time increases, but in SSR there is no change.
- For driving RELAY, current or power required is more comparatively to SSR.
- For switching SSR requires 15amp, whereas RELAY needs (30amp,50amp,90amp) as per requirement.

## IV. OVERVIEW OF INTERNET OF THINGS

The IOT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. In addition to reduced human intervention. When IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical system, which also encompasses technologies such as smart grids, virtual power plants, smart homes and smart

cities. Each thing is uniquely identified through its embedded computing system but is able to interoperate within the existing internet infrastructure.



Figure 3. IOT Representation

People also want to communicate with all non-living things through internet such as home appliances, furniture's, stationeries, cloths etc. The people already have a lot of technologies to interact with living things but IOT enables to communicate with non-living things with comfort manner. IOT is a convergence of several technologies like ubiquitous, pervasive computing, Ambient Intelligence, Sensors, Actuators, Communications technologies, Internet Technologies, Embedded systems etc.



Figure 4. IOT Working

## V. 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 other controller.
- Other boards like Intel Galileo gen 2 are very costly and complex to handle.
- The best part of Arduino usage is that its programming is very easy as compared to other devices.
- For the new start by students it's very feasible and easy to use.

## VI. CONCLUSIONS

Arduino and GSM based Smart Energy Meter for advanced metering and billing system is built which is able to read and send data via wireless protocol using GSM technology through GSM modem, capable of manage the meter as well as the line connection. However this project needs more modification for more reliable and higher degree of satisfaction and safety. For GSM module the network coverage of the SIM used is one of the important facts. The network strength should strong so that the GSM module can work well. One of the most important facts for this project is high cost of the component so that the overall cost of this project is high. Due to educational purpose and for research the equipment is provided with all pin connection, features and all possible events. As a result the manufacture cost is high. But when we implement this project commercially the cost may reduce by

two or three times or more than the demo project. In commercial production for this project all the necessary component should provide only necessary pin connection and features. As a result overall cost may reduce more. In spite of being high cost at first time that mean when buy or install the overall cost of the system will reduce for this meter. The human labor that is taking data from energy meter in present day has to pay a good amount of salary for every month.

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