

Automatic Electric Bill Generation System

***Syed Assra Shah**

Bachelor Of Engineering (Ece) University Of Kashmir J&K, Srinagar, India

*Corresponding Author: *Syed Assra Shah*

Abstract: *In the Modern world, intelligent control is adopted in every field like communication, home gadgetry, medicine etc. Unfortunately, the service providers of electricity are still using the conventional methods for getting the information of energy consumed by the customer. The traditional method of energy meter billing is a long outdated, inefficient and time consuming one. Technology of e-metering (Electronic Metering) has gone through rapid technological advancements and there is increased demand for a reliable and efficient system i.e. Automatic Meter Reading (AMR). This paper presents the design of a simple low cost dual mode wireless GSM based energy meter and its associated features for making the job of metering easier. The proposed system replaces traditional meter reading methods and enables remote access of existing energy meter to the energy provider. Also it enables the energy provider to monitor the monthly meter readings without the person visiting each house. A GSM based wireless communication module is integrated with electronic energy meter of each entity to have remote access over the usage of electricity. Hence this system has been designed keeping in view the system which is of paramount importance. The system will also enable the consumer to know his meter readings at the end of every month through a simple SMS to his subscribed phone number. This mode of the system provides flexibility to the customer to pay his due amount on the very day on bill generation.*

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I. Introduction

In the existing system, electricity meter reading for electricity usage and billing is done by human workers from home to home and building to buildings. This requires huge number of workers and long working time to achieve complete area data collection and billing. Human workers billing are prone to reading error as sometime the houses electric meter is placed where it isn't easily accessible. Labor billing job is sometime also restricted and slowed down by bad environmental condition. Paper billing has the tendency of losing in the post box. The increased development of residential housing and industrial buildings in the developing country such as for example, India require more human workers and longer working hours to complete the usage reading task. These increases the energy provider's operation costs for meter reading.

The underlying aim of every technology is to ease human efforts as far as possible, so with this objective in mind we set off to achieve another such goal. Electricity is the driving force behind the development of any country. Thus it has to be made sure that electricity that is generated by virtue of immense expenditure, hard work, labor is supplied to the consumers in an equally judicious way & by the aid of latest technology available. With science and technology leaving its footprint in almost every sphere of life, the field of electrical engineering needs equal attention as well. It is much needed that the field of electricity engineering evolves hand in hand with the latest available technology to cope up with the sophistication & automation in the systems nowadays. The process of electricity generation is followed by two processes i.e. transmission & distribution. At distribution level, the electricity is supplied to the consumers that can be domestic or industrial consumers. The process of calculating the electricity consumption at the consumer end is called Energy Metering & the device dedicated for this job is called an Energy Meter. Apart from the task of measurement of electricity usage, the distribution level imposes various other important duties on the electricity board like noting the meter reading, calculation of bill depending on the type of tariff & agreement, bill issuance to the consumer. However, the most important challenge faced by the department is to ensure that the process of Energy Metering is not manipulated by the consumer which involves the illegal practice of electricity theft. The electricity will not be recorded on meter if consumed by illegal means. This unbilled amount is responsible for huge losses to the electricity department. With the help of this device of ours, in addition to the electricity bill delivery by wireless means, many other features have been added to make the entire process of electricity metering easier, time saving & SMART as for in this busy world of ours, time & security plays a crucial role. An electricity meter or energy meter in simple terms would be a device that measures the amount of electric energy consumed by a residence, business house or an electrically powered devices or appliances. Electricity meters are typically calibrated in billing units, the most common one being the kilowatt hour [kWh]. Periodic readings of electric

meters establish billing cycles and energy used during a cycle, the cycle generally extending for a month. The kind of Energy Monitoring System which we are making is appropriate for industries, manufacturing plants, commercial Buildings, houses or any situation where an electrical system is used. The system provides the centralized Power Monitoring and Control for the electricity department and also ensures that the practice of electricity theft is eliminated. The Energy Monitoring System leads to savings in the overall cost. These savings may be from better utilization of manpower, no data tampering and time saving both for the customers as well as for the energy providers. This system has features in it that can prove helpful to the consumer as well, so this proposed system will be a boon to both electricity department & the consumer. It will bring a high level of automation & will improve the overall efficiency of the energy metering system which otherwise suffers from various drawbacks

II. Overview Of Proposed System

AEBGS (Automatic Electric Bill Generation System) is a prolog to digitize the paper work and the minimize human efforts for the energy provider and well as the consuming authority. It is an embedded system which will allow maintaining the data utilizing less man power with greater efficiency and accuracy. The main purpose of this system is to provide a robust and a handy tool for the energy provider’s administration who are concerned with the electric bill generation of customers. It will help them in generating the bill without taking much efforts and make things less cumbersome.

The overall idea and concept is to design a system which would help the authority to efficiently maintain and generate the energy bill automatically without much human efforts and maintenance. The proposed system consisted of Energy Meter, Microcontrollers (Arduino), GSM/GPRS shield, some server end technologies like PHP and MySQL and a server. In the proposed system, The Energy meter is embedded with an Arduino microcontroller with a GSM800 shield placed on top of it. The controller fetches the blinks from the meter and send it to the sever using GSM shield over GPRS network. On the server side, the sent data is read with the help of PHP and converted the blinks into the unit using a standard formula. Then Due amount is calculated for consumed units and generates an electronic bill accordingly and send back the link and the related data to the shield over same GPRS network. When data is received back on the shield it sends the received data and the link to the concerned customer via a SMS over GSM network.

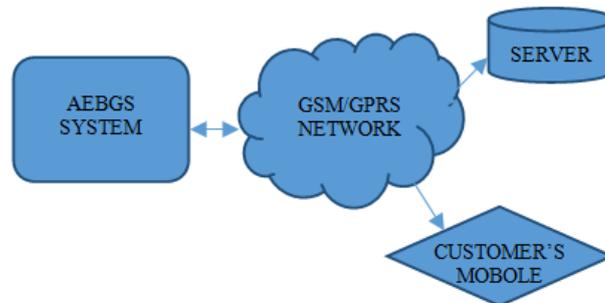


Fig.1 Overview of the system

III. System Components And Design

The system consists of some hardware as well as software components. The arrangement of the hardware part and it design will be displayed in the following block diagram of the system.

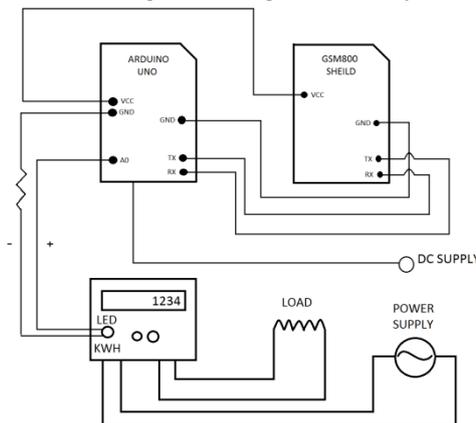


Fig 2. Block Diagram of System

MICROCONTROLLER (ARDUINO): Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board- you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program.

SIM800 GSM SHIELD: A GSM shield or a GPRS shield is a chip or circuit that will be used to establish communication between a mobile device or a computing machine and a GSM or GPRS system. The modem (modulator-demodulator) is a critical part here.^[1]

ENERGY METER: An electricity meter, electric meter, electrical meter, or energy meter is a device that measures the amount of energy consumed by a residence, a business, or an electrically powered device. Electric utilities use electric meters installed at customers' premises to measure electric energy delivered to their customers for billing purposes. They are typically calibrated in billing units, the most common one being the kilowatt hour [kWh]. They are usually read once each billing period.

SERVER: A web server is a computer system that processes requests via HTTP, the basic network protocol used to distribute information on the World Wide Web. The term can refer to the entire system, or specifically to the software that accepts and supervises the HTTP requests.^[1]

PHP: it is a server-side scripting language designed primarily for web development but also used as a general-purpose programming language produced by The PHP Development Team.^[3] PHP originally stood for Personal Home Page,^[2] but it now stands for the recursive acronym PHP: Hypertext Preprocessor.^[4]

MYSQL: MySQL is an open-source relational database management system (RDBMS).^[5] Its name is a combination of "My", the name of co-founder Michael Wideniu's daughter,^[6] and "SQL", the abbreviation for Structured Query Language.

IV. Working Of System

This system automatically takes the energy reading from the meter and sends it to a remote server for processing where that reading is processed and converted into units of measure. Then the due amount is calculated from those units and a PDF of the bill is generated by the system and is stored at the remote location. Then all the necessary details are sent back to the system by the remote location which then is sent to the concerned user/customer via SMS.

Firstly, the kwh power LED is connected to the Arduino module. Then blinks on that particular LED is continuously monitored. EEPROM has a space where the blink count is saved. As soon as LED blinks we the value in the EEPROM location is incremented. We are using EEPROM Here EEPROM is used because there is a need to have the record of blinks even if the Arduino board goes off. This way EEPROM will always have the current number of blink count. While doing all this, the current day of the month is also continuously checked as on 1st of every month these blink counts need to be sent to the remote server for computations. customer id is also saved in our Arduino program and is sent along with the blink count.

For sending the blink count and id to the remote server GSM module/shield is first configured with the network and then these parameters are sent via GSM module in the server URL as query string and then that URL is hit.

Before hitting the URL, a database is already created on a server and have details of that customer in that database. Some of the details are customer id, customer name, old reading, previous balance and customer number. A field of old reading and previous balance will be there, so that we can calculate the units consumed and the due amount of that customer. MySQL Database is used for database and basic SQL will be used for inserting, updating and deleting the items in the database. It would have a single relation (table) database because it has to store details of customer only.

When a URL is hit, the requested file on the server will check the parameter list and extract blinks and id from the URL. After extracting the details, it will fetch the old reading, customer name, previous balance and customer number from the database by executing SELECT query. After fetching all the details, it will calculate the units consumed by the customer in previous month by first converting the blinks into the units and then subtracting old reading from the calculated one. Then we calculate the amount for the consumed units by multiplying it with the price factor and will add to it the previous balance to get the total due amount.

After all the calculation is done it will make a sample layout of the bill pdf in html and will incorporate these details in that sample layout. After making the layout and putting details in appropriate positions we will generate the pdf using a pdf generation library, html2pdf.org, which matches the layout out the sample layout file. After generating the pdf, we will save it on some server location.

After all is done, now it will send back some details to GSM module which will contain the customer name, units consumed, due amount and the link to the generate bill pdf in from of message and number separated by a colon (:). It will also update the database with new reading and new balance. We will achieve all this by using a PHP on server side. Then when the details are received by GSM module, we will extract the message part is extracted from the number part of the response and this message will be sent via SMS to the customer using a number provided in the response from the server.

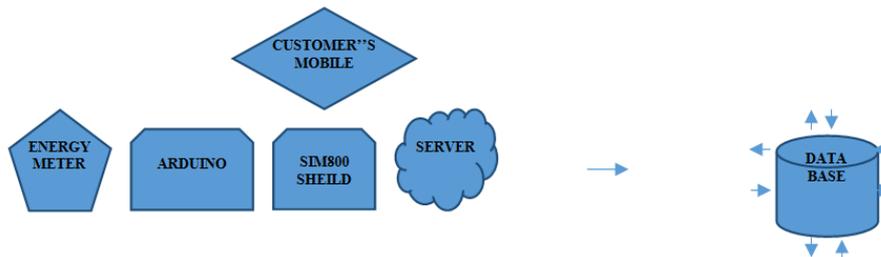


Fig 3. Working Model of AEBGS

V. Future Scope

The system designed reduces the efforts of manual data collection of energy meter. Also, data which is received at service provider side is easy to manipulate for bill generation and other such tasks. With this system we can collect the reading and will be able to control the supply to the user with more additions. Also with some addition in software at service provider side, the customer can be informed of current meter reading, bill for current cycle, status of the line and other parameters to the customer with message. The technology used in energy meter is expanding to the power distribution transformers. So that it can cut the power supply from anywhere in case of any emergency or maintenance, find areas with power distribution failure.

We are living in an era where technology is expanding and evolving at a rapid pace. Today, we talk about IoT and other such technologies. This system could be one of the advancements in the field of IoT. With the advent of IoT, this system can be implemented on whole new level where it can manage and control every information and action using smart devices. This system could fit in an environment where life runs on internet and technology. This system can also work well with the Wi-Fi technology and can communicate with the server over Wi-Fi, which is becoming more popular and is being used more widely now a days and will be easily accessible from anywhere in near future and with use of Wi-Fi, we won't be losing the advantage of notifying customer over SMS as we can use the SMS Gateways which are readily available in the market are easy to integrate with a web server to make to server more robust and easy for installation.

VI. Conclusion

In this paper, it has been proposed that a smart meter which takes advantage of the GSM/GPRS network that has virtually access to every household and area across different countries can be used as a smart solution for minimizing human efforts and maximizing the efficiency for an energy provider. GSM based energy meter is easy to install and beneficial for both energy provider and consumer. AEBGS not only solve the problem of manual meter reading but also provide additional feature such as automatic generation of energy bill, informing customer when and how much bill is generated and giving detailed summary of the energy consumption by him/her. This can help energy provider to use his human resource in more needed areas. Now, Service provider would not have to worry about the bill generation and meter reading process. Everything will be done automatically. This will also make sure that there is no hampering in the units consumed at the time of reading as it may happen in case of human involvement.

Moreover, with some additions, this system can be further designed to have the feature of automatic cuts if the customer has older dues or if he fails to pay his dues in the given time. Also it can have features like constant load check and alerts, with which, customer can be alerted every time he/she used the load more than that imprinted in his/her agreement. Also it can facilitate customer with information about current bill details, current meter reading, status of line and many more and let's conclude with that in this rapid growing world of technology this device will play a very important role in coming future.

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Biography

SYED ASSRA SHAH, is a B.E graduate in Electronics and Communication Engineering (ECE) from University of Kashmir (KU), Jammu and Kashmir, India. Her field of interest in microcontrollers and VLSI.

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