

Wireless Energy Meter and Billing via ‘SMS’

P.V. Santhoshi Roja¹, B. Kiran Babu², V. Samson Deva Kumar³

¹Electrical and Electronics Department, Koneru Lakshmaiah University
Vaddeswaram, Andhra Pradesh, India
santhoshi.roja@gmail.com

²Electrical and Electronics Department, Koneru Lakshmaiah University
Vaddeswaram, Andhra Pradesh, India
kiranbabu_eee@kluniversity.in

³Computer Science Departments, South Central Railway
Vijay Wada, Andhra Pradesh, India
vemusamson@gmail.com

Abstract: *The existing traditional method for retrieving the energy meter data and billing is not convenient and time consuming, hence in this paper we suggest a billing strategy via SMS which is convenient and reduces the manpower. This system is a boon for remote monitoring and automatic tariff updating. This system gives the information regarding meter reading, power cut, total load used and tempering on request or regularly in particular interval through SMS. This information is being sent and received by concerned energy Provider Company with the help of Global System for Mobile communication (GSM) network. Hence this system not only reduces the labor cost and also increase meter reading accuracy and saves both time and money.*

Keywords: GSM, SMS, automatic tariff calculation, energy meter, load scheduling.

1. Introduction

Electricity is the crucial requirement for leading a comfortable life. It is to be properly used and managed. No proper planning of power distribution is leading to tariff calculation problems. Many statistical errors prevail in monthly customer billing process.

This idea of wireless data transmission is being proposed to reduce the human dependency to collect the monthly reading and to minimize the technical problems regarding the billing process. This helps in considerable reduction of power thefts as well to calculate average power consumption of particular locality.

Automatic meter reading system is an effective way of data collection, that allow substantial saving through the reduction of meter read, greater accuracy, allow frequent reading, improved billing, reduced tempering. It provides better customer services, by sending alert of power cuts and consummation updates. AMR is the technology for remote monitoring and to control domestic energy meter and reduces power thievery. This paper presents a mobile communication technology which enables energy Provider Company to read the meter reading regularly without the person visiting each house by using GSM communication technology. This is very useful for remote area or small villages. This system can be very swift, accurate and efficient.

2. System Description

In this system we give a unique Id number for every energy meter. This ID number is interlinked to SIM card unique service number. This system continuously monitors energy meter, SMS is sent to the company as per

our requirement. We can set the period in the microcontroller for every meter reading daily, weekly, monthly and sends to the central server of the energy Provider Company. Here the SMS is sent to 3 specified phone numbers written in the microcontroller. The meter reading is stored in database server through SMS gateway. Now bill is sent to the customer by calculating the reading, as stored in the database. Bill issued by energy Provider Company can be sent by SMS. Alternatively we can also send through either by web account, by post and by email. This system provides flexibility to the customer for paying the bill. AMR also sends the information of the power cut, power load, and energy provider can also cut the connection if customer does not require the connection through SMS request. This SMS card service number is used to identify and retrieve customers detail for billing and identification purpose.

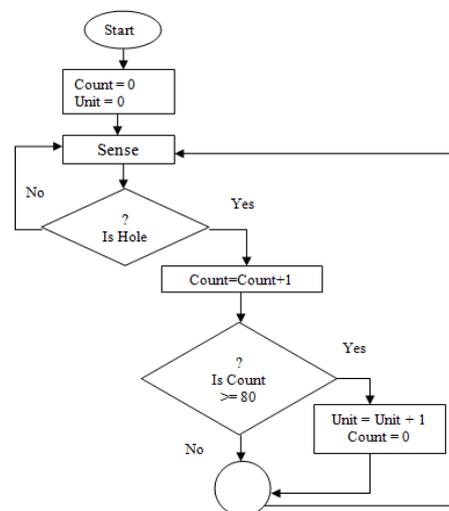


Figure: 1 flowchart to the code for counting the units

3. Communication Interface

To send SMS we need communication interface between the energy meter and database server. So we have two technologies for communication.

1. GSM Network
2. ZIG BEE system

Here we go for GSM network interface because it is best compare the ZIGBEE system because it more sensitive and can easily get affected to the noise in the communication network and data corruption can also takes place. So here go for GSM Network which highly flexible and easy for the transmission in the remote areas. It can also transmit the signal to long distance with out any data encryption.

GSM (Global System for Mobile Communication):

GSM has been the backbone of the phenomenal success of mobile communication in the previous decade. Now at the dawn of true broadband services, GSM continues to evolve to meet new demands. GSM is an open, non proprietary system with international roaming capability.

GSM is a cellular network which means that compatible devices connect to it by searching for cells in the immediate vicinity. There are five different cell sizes in a GSM network via Marco, Micro, Pico, Fenton and Umbrella cells. The coverage area of each cell varies according to the Implementation environment.

Macro cells can be regarded as cells where base station is installed on a mast or building above roof top level.

Micro cells are those in which base station is installed below the average roof top level. These are typically used in the urban areas.

Pico cells are the cells whose coverage area is a small and mainly used indoors.

Fenton cells are cells designed for use in residential or small business environment and connect to the service provider's network via a broadband internet connection.

Umbrella cells are used to cover shadowed reasons of smaller cells and fill in the gaps in coverage between those cells.

4. Modulation used

The modulation used in GSM is Gaussian Minimum Phase Shift Keying (GSMK), a kind of continuous phase frequency shift keying. In GSMK the signal to be modulated on the carrier is first smoothed with a Gaussian low-pass filter prior to being fed into a frequency modulator which greatly reduces the interference to nearby channels.

5. Frequencies used in GSM

GSM networks operate in a number of frequency bands (separated into GSM frequency range for 2G and UMTS frequency range for 3G). Most 2G GSM networks operate in the 900 MHz or 1800 MHz frequency bands. In rare cases 400 and 450 MHz bands are allocated because they were earlier used for first generation communication. Most of the 3G GSM networks operate in the 2100 MHz frequency band.

6. Design of Wireless Energy Meter

This fig shows block diagram of our system. In this system continuous monitoring and recording the data of energy meter is done. This is achieved by means of a micro controller (89S52). We will have an interface with LCD near the user for convince which displays the power used and cost until that period... Micro controller unit continuously monitor the energy meter and pulses display on LCD. For the information of power cur microcontroller unit is interface with RTC clock and relay and for communication it also interfaced with GSM modem by using MAX232.

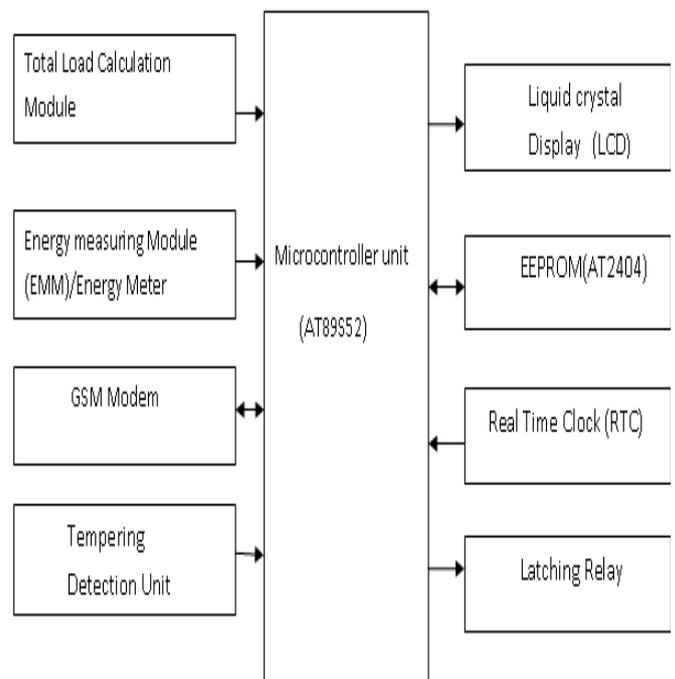


Figure 2: Block diagram

We have chosen the AT89S52 micro controller due to its low power, high performance CMOS. It is a 8-bit micro controller with 8K bytes of in-system programmable flash memory. It also provides 256 bytes on chip RAM, 32 I/O lines, Watch dog timer, two data pointers, three 16 bit timer/counters a full duplex serial port, on- chip oscillator and clock circuitry.

6.1 Data Storage Mechanism

We required this data storage unit so as to provide back up to the entire unit in case of power cut. Here we used

AT24C04 EPROM is a electrically erasable programmable read only memory. The capacity of the EPROM is 4KB Memory. It is interfaced with micro controller by means of two wire serial interfaces.

When there is a power cut the data stored in the RAM of micro controller must be transferred to the EPROM. When power supply is back the data stored in the EPROM is sent again to the micro controller and energy meter will start from its previous state.

6.2 Tampering Detection

Now a day's power theft is serious problem, due to energy theft heavy revenue losses are incurred by our country. This unit detects the power theft (if any occurred) and sent the alert to energy provider company. Tampering of power includes current reversal, CT reverse tampers, partial earth fault condition, by passing meter, magnetic interference, phase or neutral wire swapped, external tampers.

6.3 Load Calculation

This system gives information about amount of load being used by the customer. This is known to both customer and energy Provider Customer. As LCD Display is present in the system customer can also view the load used. Total load used in any house can be calculated by observed or record N number of pulse in T time that is described by equation number 1.

$$\text{Total load used} = \frac{K_h * N * 3600}{T} \quad \text{----- (1)}$$

Where

- KH = Meter constant
- N = Number of pulse
- T = Total pulse time of N pulses

7. Flow chart of the system

Energy meter continuously displays the amount of load used and cost for specified period. We will set the required time in the code of micro controller, hence after that particular period the load and cost will be sent to the energy provider company i.e., we have given numbers for security of the data. When SMS is sent to the energy provider company an alert will be given to the customer by means of a buzzer.

The power supply required for this unit is 5V D.C, 230V A.C is tapped from the single phase supply, stepped down to 12V A.C and then rectified to 5V D.C , regulated and given to the circuit. The supply will be provided for LCD display, micro controller and interfacing unit. When the load connected to the meter is ON then the meter will start counting the watt hour cycles being used, interface is provided b/w energy meter and microcontroller by means of a OPTO coupler and ASM or C program is embedded into the MC which helps it to calculate the number of units used by the consumer by means of input KWH

cycles taken by energy meter. The calculated units are displayed on an LCD which is connected to MC. By this user can manage his usage of power and save the electricity and plan his budget.

The purpose of OPTO isolator is to provide an electric isolation between input and output by means of converting the input electric signal into corresponding light and transfer it internally to output side by means of dielectric and again covert it into required electric signal.

Again the power used by the particular user will also be send to the electricity department by using GSM modem which is connected to the micro controller by means of a MAX232 interface and it is connected to the modem by DB9 connector (RS 232).

Serial RS232 communication works with voltages which are not compatible with today's computer logic, hence the MAX232 is the first IC to be developed which in one package contains necessary drivers to provide the require voltage levels for RS232. RS232 is the cable from which the serial communication will take place. Here in this project we are using a DB9 pin connector. Hence the modem receives the information from microcontroller in from of serial communication, as it can transfer the data faster when compared to parallel communication by means of respective communication equipment.

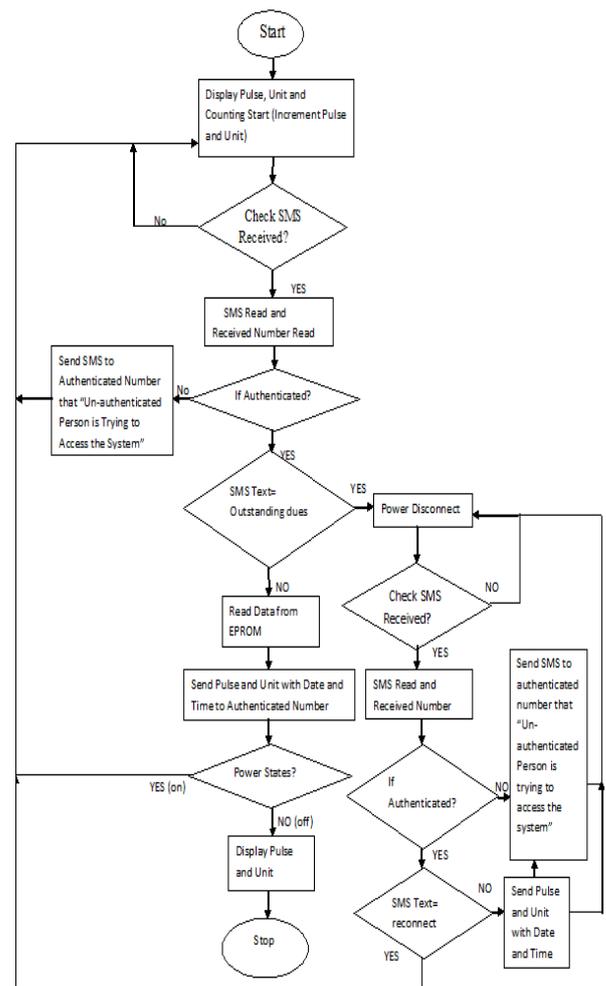


Figure 3: flow chart of the system

8. Specifications Preferred

The specifications used for the design and development of this wireless energy meter are given below. This system is also used to disconnect the power supply to the house in case of non payment of bill and also in case of heavy usage of load than specified.

1. Input voltage : 230V
2. operating frequency : 50HZ
3. GSM modem : Tri band GSM modem
4. MC input voltage : 5V
5. Memory : Non- volatile
6. Display System : LCD display
7. GSM Frequency : 400-450 MHZ
8. EPROM memory : 4 KB

9. Implementation and Result



Figure 4: Experiment Result

This is our system where energy meter is connected to the micro controller one side and on the other hand it is connected to the main supply. Here in the controller we write a code for retrieving the data from the energy meter. From micro controller we connect it to ADC which converts analog data to the digital data and vice versa, from here the data is given to the MAX 232 and RS232 which are used as interfacing unit between energy meter and the GSM network. RS232 is a connector which is used to transmit the electric signals between the system and modem. As per the code written in the micro controller, SMS is sent to the energy Provider Company. Whenever SMS is sent to the energy Provider Company then customer is given an alert alarm which also reminds customer about the bill. This is for the customer flexibility here we also provide LCD Display. This helps the customer for verifying the data when SMS is sent to the energy Provider Company. This reduces mistakes done by the workers during taking the energy meter reading.

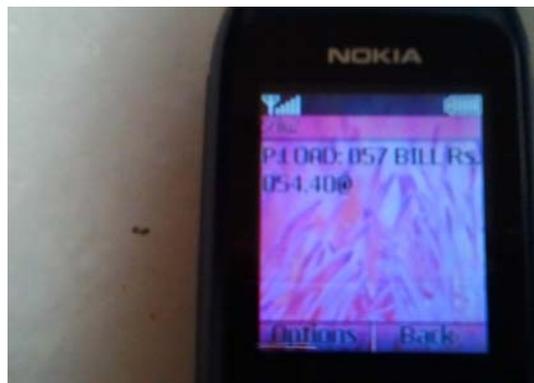


Figure 5: SMS to the energy Provider Company as per the time set in the micro controller

The above fig shows us the SMS sent to the energy Provider Company which contains amount of load consumed by the customer and the amount to be paid for the load usage. Now energy Provider Company will send the details to the customer either through email, by post, by web account and through SMS.

10. Conclusion

GSM based energy meter is easy to installation and beneficial for both energy Provider and Customer. This reduces the manual cost and also reduces the errors done by the humans. This also reduces the problems faced by customer like over running of the meter, over load, and also reduces thefts. Whenever fault occurs it indicates to the customer. Then customer can inform to the company then energy Provider Company can cut the power easily by sending the SMS to that particular ID number which is connected to the SIM number. The statistical load used and profile help the customer to manage their energy consumption. This helps them to reduce their outstanding dues. This system can be used even in the remote areas by changing the type of the modem, and its range of frequency for communication. This device reduces all cases of revenue problems to the country and helps us to improve our usage.

11. Future scope

In future we can also update the tariff within the energy meter by writing a program in the java and it must be connected to the energy meter using USB port which automatically updates the program in the micro controller. And we must also make easy to the customers for buying the watts using SMS request. This makes flexible for both user and the company.

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Authors Profile



P. V. Santhoshi Roja, B. Tech Final Year, EEE, (Koneru Lakshmaiah University, Vaddeswaram, Andhra Pradesh, India).

B. Kiran Babu, Assistant professor of EEE, (Koneru Lakshmaiah University, Vaddeswaram, Andhra Pradesh, India).

V. Samson Deva Kumar, Software Engineer, South Central Railway, Vijay Wada, India