

GSM Based Monthly Energy Meter Billing via ‘SMS’

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Abstract- Electricity is one of the vital requirements for sustainment of comforts of life. IT should be used very judiciously for its proper utilization. But in our country we have lot of localities where we have surplus supply for the electricity while many areas do not even have access to it. Our policies of its distribution are also partially responsible for this because we are still not able to correctly estimate our exact requirements and still power theft is prevailing.

On the other hand consumers are also not satisfied with the services of power companies. Thus we are trying to present an idea towards the minimization of technical errors and to reduce human dependency at the same time. With the help of this project we are aiming to receive the monthly energy consumption from a remote location directly to a centralized office. In this way we can reduce human efforts needed to record the meter readings which are till now recorded by visiting every home individually.

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

1. Introduction

This idea is economically efficient as well because we can get the meter reading at a very low cost. The implementation is done in such a way that a SMS is delivered to the Modem whose reading is to be noted and then that meter replies to the server in the SMS format and it is known that SMS costs are very low. The purpose of this project is to remote monitoring and control of the Domestic Energy meter. This system enables the Electricity Department to read the meter readings regularly without the person visiting each house. This can be achieved by the use of Microcontroller unit that continuously monitors and records the Energy Meter readings in its permanent (non-volatile) memory location.

This system also makes use of a GSM modem for remote monitoring and control of Energy Meter. The Microcontroller based system continuously records the readings and the live meter reading can be sent to the Electricity department on request. This system also can be used to disconnect the power supply to the house in case of non-payment of electricity bills. A dedicated GSM modem with SIM card is required for each energy meter. The GSM based monthly energy meter billing system takes the advantage of available GSM infrastructure nationwide coverage and the Short Messaging System (SMS) cell broadcasting feature to

request and retrieve individual houses and building power consumption reading back to the energy provider wirelessly. The Store and Forwarding feature of SMS allow reliable meter reading delivery when GSM signal is affected by the poor weather conditions. The stored message is archive in the mobile operator and can be later retrieve for billing purposes[1,2].

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.

3. Methodology

The method used to carry out this project is the principle of serial communication in collaboration with embedded system. The project has a electric meter which will work and a GSM modem which is the latest technology used for communication between MODEM and embedded systems. The modem will send a message as and when desired to the electricity officials through Subscriber Identity Module inserted inside the MODEM.

4. System Overview

The complete overview of GSM based monthly energy meter billing system is shown below and consists of GSM energy meter with installed in every individual unit. On the other hand SMS gateway, application terminal and database server are present at the energy provider side. This based monthly energy meter billing system works in conjunction with the GSM network to retrieve the power meter reading using SMS. The GSM energy meter is an integration of an electric meter with a GSM modem. A SIM card with a unique special number is required for meter to receive and reply its energy meter readings to the energy provider using SMS. The SIM number is identical to the one used for mobile phones except it is not used for voice communications. The SIM card is also used to identify and retrieve owner or consumer details from the database server for billing purposes.

An automatic power reading takes place automatically on request by the energy provider. SMS gateway performs cell broadcasting of request through SMS to all meters to request for meter reading. The meter will immediately respond in the form of meter readings upon receiving the request from the energy provider.

5. Messaging Over GSM Network

Global System for Mobile Communication (GSM) is the world's most popular standard for mobile telephony systems. GSM is used by over 1.5 billion people all over the world. GSM also pioneered the low cost implementation of the Short Message Service (SMS) which allows parties to exchange delay tolerant short text messages. The popularity and coverage of cellular networks allows the use of SMS service.

However there are certain questionable issues regarding the GSM network such as scalability, reliability and security especially under high load. According to the analysis of real data taken from a real GSM network in India, SMS delivery success rate is found to be 94.3%. Of these successfully delivered messages, 73.3 arrived to their destination within 10 seconds. About 5% of them required more than 1 hour to reach the destination.

Using SMS for automatic meter reading will certainly increase the flow of messages tremendously. GSM uses several cryptographic algorithms for security. The development of UMTS introduces an optional Universal Subscriber Identity Module (USIM), which uses a longer authentication key to give greater security, as well as mutually authenticating the network and the user[4].

6. System Overview

The complete overview of GSM automatic meter reading system is shown below and consists of GSM energy meter with installed in every individual unit. On the other hand SMS gateway, application terminal and database server are present at the energy provider side[5]. This automatic meter reading system works in conjunction with the GSM network to retrieve the power meter reading using SMS. The GSM energy meter is an integration of an electric meter with a GSM modem. A SIM card with a unique special number is required for meter to receive and reply its energy meter readings to the energy provider using SMS. The SIM number is identical to the one used for mobile phones except it is not used for voice communications. The SIM card is also used to identify and retrieve owner or consumer details from the database server for billing purposes.

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7. GSM Based Monthly Energy Meter Billing Via SMS

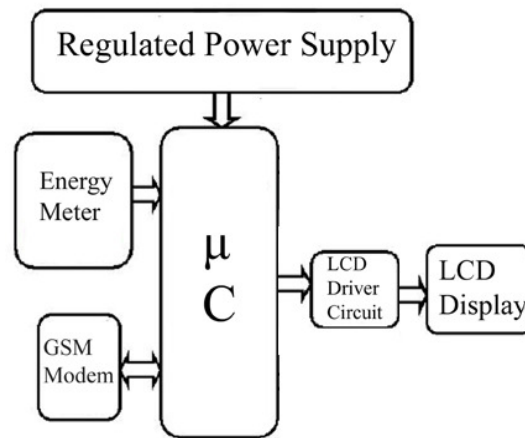


Fig 1. GSM Based Monthly Energy Meter Billing Via SMS

8. Introduction to GSM Network

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 was originally known as

Grouped Special Mobile but nowadays it is commonly referred as Global System for Mobile Communication. It is a set of standards developed by the European Telecommunications Standards Institute (ETSI) to describe technologies used for second generation digital communications, commonly referred as 2G technologies.

It was developed as a replacement to the first generation analog communications. It originally described a digital circuit switched network optimized for full duplex voice communications. The standard was expanded over time to include first circuit switched data transfer, then packet data transport via GPRS (General Packet Radio Service). Packet data transmission speeds were later increased with the help of EDGE (Enhanced Data Rate for GSM evolution) technology. The GSM standard is succeeded by third generation (3G) UMTS standard developed by the 3GPP.

Technical Details:-

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 viz. Macro, 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. They are typically used in urban areas.

Pico cells are the cells whose coverage area is a few dozen meters in diameter and are 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 gaps in coverage between those cells.

9. Modulation Used

The modulation used in GSM is Gaussian Minimum Phase Shift Keying (GMSK), a kind of continuous phase frequency shift keying. In GMSK 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 neighboring channels (adjacent channel interference).

10. GSM Carrier Frequencies Used

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. Where these bands are already occupied 850 MHz or 1950 MHz frequency bands are used e.g. in USA and Canada. In rare cases 400 and 450 MHz bands are allocated because they were earlier used for first generation communications. Most of the 3G GSM networks operate in the 2100 MHz frequency band. Regardless of frequency selected by an operator, it is divided into time slots for individual users to use. This allows eight full rate or sixteen half rate speech channels per radio frequency. These eight radio slots are grouped into a TDMA frame. The channel data rate for all 8 channels is 270.833 Kbps and the time duration is 4.615 ms.

11. 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. 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.

12. 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 nonpayment 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. Display System : LCD display

13. Implementation and Result



Fig 2: - Result of the Experiment

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[6]. 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.

14. Working of Project

The energy meter records the amount of power consumption. It does so by an electromechanical system. The system is provided with such a mechanism that an increment in amount of current flow through circuit causes the disc to rotate faster, means that the rotational speed of disc is directly proportional to the amount of current flowing through circuit. This rotation effect of disc causes the gear mechanism to work accordingly and in similar fashion rate of power consumption increases the blinking rate of LED

integrated within the meter. The pulses from this LED are fed to microcontroller for count operation i.e. these pulses are counted by microcontroller and readings are stored into external memory. External memory used here, is EEPROM. This memory is able to store previous database as well in case one needs to check past consumption status. LCD is connected with microcontroller so as to show the current status of GSM Modem. GSM modem is the means to communicate over wireless systems. GSM modem is connected with microcontroller via MAX 232 IC. GSM modem communicates at RS232 standard voltage levels while uC understands TTL logic levels so MAX 232 serves as voltage level converter. It converts Rs232 levels into TTL and vice-versa.

Whenever a command is sent to the GSM modem, it decodes the commands and works accordingly. e.g. if Meter Read command is sent to modem then it captures the status of memory and picks only integral value and sends the same information via wireless network to another modem whose address has been cited in the program written inside the ROM.

15. 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 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.

16. 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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