GSM Based Energy Meter

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ABSTRACT: *Conservation of energy and its effective use have been the topic of debate among many stakeholders since the industrial age. Traditional metering methods for recovering energy data are not convenient and the data logging system costs are high. So this paper presents Automatic Meter Read (AMR) device design and development. AMR system is a remote monitoring boom and a domestic energy meter controller. AMR system provides meter read, power cut, total load used, power disconnection and tempering information on request or, in particular, periodically via SMS intervals. The related energy provider company sends and receives this information with the aid of the Global Mobile Communication System (GSM) network. Within a second the energy provider receives the meter reading without visiting person. AMR minimizes the number of traditional visits that energy provider company employs require. This device not only decreases labor costs but also improves the precision of reading meters and saves time on hugs.*

KEYWORDS: *Short message service (SMS), Automatic meter reading (AMR), Energy meter, Energy Provider Company, GSM.*

INTRODUCTION

In today's competitive world, any country's power and energy sector plays an important role in the growth of domestic, manufacturing, agricultural, telecommunications, and education sectors. Electricity is the key necessity to live a comfortable life and must be used and handled properly. The development of electrical metering instruments has come a long way from what it was, more than 100 years ago. There have been many developments from the originally bulky meters with large magnets and coils that have resulted in reduction of size & weight and also improvement of meter features and specifications. An electrometer or energy meter is a device that measures the amount of electrical energy that a residence, business or machine supplies or consumes. A kilowatt-hour-meter is the most common type. When used in retailing electricity, the utilities record the values determined by those meters in order to produce an invoice for the energy used. They can also record other variables like when the power was being used [1].

Modern electricity meters operate by continuously measuring instantaneous voltage (volts) & current (amperes) and finding the product of these to provide instantaneous electrical power (watts) which is then integrated against time to deliver the energy used (joules, kilowatt-hours, etc.). The meters fall into two fundamental categories: the electromechanical meter and the electronic meter. The most popular form of electricity meter, invented by Elihu Thomson, is the Thomson or watt-hour electromechanical induction scale. Measurement resolution and precision have seen major changes over the years [2].

Microcontrollers currently play an significant role in instrument metering technology. The Automatic Meter Reading system is designed to collect a locality's meter readings remotely using a communication system, without people physically going and visually reading the meters. Electronic metering (EM) technology has gone through rapid technical advances and the demand for a reliable and effective Automatic Meter Reading (AMR) system is growing. One of the methods proposed for AMR is Global System Mobile (GSM) based.

GSM

GSM is a function of second generation cellular network. A wireless communication module based on GSM is incorporated with each entity's electronic energy meter to provide remote control to electricity use. A GSM channel is a very useful means of communication, as sending data as a Short Messaging Service (SMS) turns out to be a very handy tool because of its good area coverage capability and cost efficiency. GSM networks run in four sets of distinct frequencies. Most GSM networks run in bands of 900 MHz, or 1800 MHz. Many nations in the Americas are using the 850 MHz and 1900 MHz frequencies, since the frequency bands of 900 and 1800 MHz have already been reserved. The rarer frequency bands 400 and 450 MHz are allocated in some countries where those frequencies were previously used for first-generation systems.

SYSTEM DISCRIPTION

Figure 1 provides complete overview of the device. In this device a different ID number is given for every meter. This ID number is supplied according to the specific service number of a SIM card. This program tracks every meter reading on a regular, weekly, monthly or on request, and sends it to the energy supplier company's central server. Via SMS gateway, the meter reading is stored in the database server. Energy Provider Company issues a bill after billing calculation which can be sent either by email, web account or by post. Using net Banking, customers can pay the bill. AMR also sends the power-cut and power usage information via SMS. This SIM card service number is used to classify and collect information about customers for accounting and identification purposes.
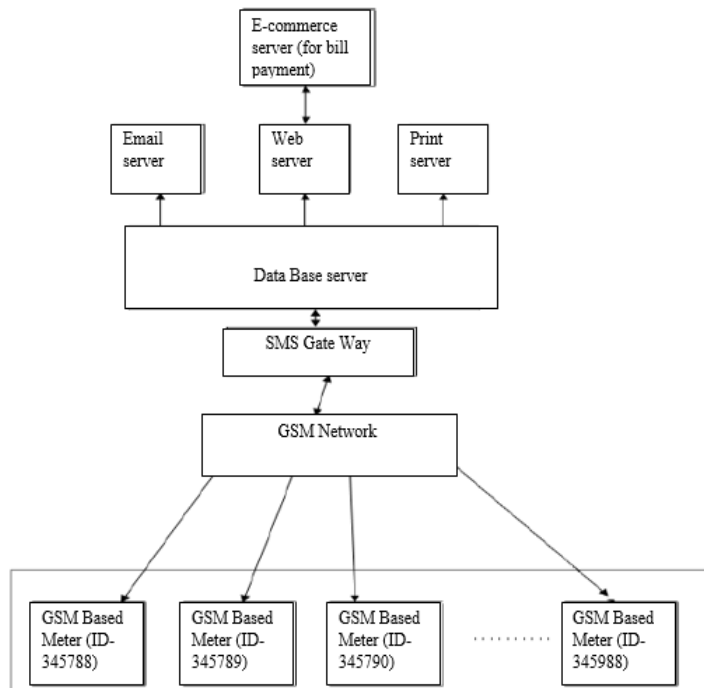

Fig. 1: Overview of GSM based AMR system.

TECHNICAL SPECIFICATION

Table 1 displays the basic requirements of an energy meter based on GSM. Those systems are used for energy meter remote control. This device can also be used to disconnect the power supply to the house in the event that energy bills are not paid / have significant unpaid dues. This device gives in specific area power cut details and power cut time so this function is useful for remote areas. Even a temperature control unit attaches to the meter and there's no tempering chance. When

tempering happens, the tempering device will be triggered, and an SMS will automatically be sent to the energy supplier company's central server, which will cut the house's electricity. So, tempering in AMR is not possible.

Table 1: Shows The Technical Specification Of GSM Based Energy Meter

Sr. No.	Parameter	Specification
1.	Operating voltage	230V
2.	Operating frequency	50Hz
3.	Pulses	3300Imp/KWh
4.	GSM modem	Tri band GSM modem (GSM900/1800 MHz) designed for data SMS.
6.	Power cut alert	This system provides power cut information.
5.	Automatic reading feature	It can be remote monitoring and controlling anywhere in the world.
7.	Auto disconnect feature	It provides remote shut-off facilities to customers that have large outstanding dues.
8.	Auto reconnect feature	It can be reconnect the power supply after pay outstanding dues.
9.	Total load calculation	This system gives information of total load used in particular house at any time to energy provider company through SMS.
10.	Full secure	If any person trying to access the system then it sent a SMS alert to energy provider company for this.
11.	Temper proof feature	Tempering unit used if tempering occurs and it sends SMS alert to the energy provider company.
12.	Memory	Non-volatile based energy reading system.
13.	Display system	LCD display system used for energy display, real time & date, instantaneous active load in kilowatt.

DESIGN METHODOLOGY

Figure 2 shows AMR block diagram. AMR Tracks and records the energy meter continuously. It can be done with microcontroller. Figure 2 indicates that the microcontroller unit is energy meter and LCD interface. The microcontroller unit controls the energy meter continuously and displays the pulses on LCD. That is giving details about a house's power consumption. Microcontroller unit is interface with RTC clock and relay for power cut information. By using MAX 232 microcontroller device is also interfaced with GSM modem for communication purposes.

Microcontroller unit

Microcontroller unit is used for complete AMR control. The AT89S52 is a low-power, high-performance 8-bit CMOS microcontroller with 8 K bytes of programmable flash memory in-

system. The AT89S52 supplies 256 bytes of flash memory on-chip RAM 8 K bytes, 32 I/O blocks, watchdog timer, two data pointers, three 16-bit timer / counters with full duplex serial port, oscillator on-chip, and clock circuitry.

Energy measuring module

Energy measurement module continuously measuring instant voltage and current and finding the result of these to give instant electrical power. It spouts the power in the form of pulses, and also provides the power on and off status information. This data is shown on the monitor of the liquid crystal.

Real time clock

DS1307 serial real-time clock is used to give the date and time of power cut information. The DS 1307 has RAM of 56 bytes. Address and data are serially transferred by two-way, bi-directional buses. The clock / calendar gives details about the seconds, minutes, hours, day, date, month, and year. The DS1307 has an integrated power sensing circuit, which senses power failures and switches automatically to the battery supply [3].

Relay section

Relay circuits are interfaced with microcontroller and energy meter. Relays allow one circuit to turn a second circuit which can be separated fully from the first one. The relay circuit is used to switch the main consumption line between cut-off and power-supply mode for the user. It has been proven to be a very useful function for the energy provider service, which can remotely turn to cut-off mode from any consumer's power on mode due to non-payment of electricity bills / has significant outstanding duties. Upon payment of duties it will reconnect the power supply [4].

Liquid crystal display

An LCD or liquid crystal display derives its meaning from its own name. It is a two-state mixture of matter, the solid and the liquid. LCD makes use of a liquid crystal to produce a visible image. Liquid crystal displays are super-thin display screens with technology that are commonly used in portable computer screens, TVs, mobile phones and video games. Compared to a cathode ray tube (CRT) technology, the LCD technologies allow displays to be much thiner. Liquid crystal display consists of multiple layers including two polarized filters and electrodes for the plates. In a notebook or some other electronic devices such as mini computers, LCD technology is used to display the images. The light is projected onto a sheet of liquid crystal from a lens. The colored image combines this combination of colored light with the crystal's grayscale picture (formed when electric current flows through the crystal). This picture would then show up on the phone [5].

Data storage unit

The AT24C04 offers 4096 bits of electrically erasable and programmable read-only memory (EEPROM) serial, arranged as 8-bit 512 words each. The AT24C04 is designed for use in many industrial and commercial applications where operations involving low power and low voltage are important. The AT24C04is a 512 Kilo Bit, 8-pin EEPROM IC. As it is know that EEPROM [6] stands for Electrically Erasable Programmable Read-Only Memory and can store information about this IC and it will remain there even when the power is turned off just like your pen drive. The details can then be recovered or overwritten, if necessary. It has a wide range of operating voltages from 1.7V to 3.6V, making it suitable for use on all 3.3V systems. -- IC comes with 512Kb storage space and, if expansion is needed, can be cascaded with 8 similar ICs. The IC operates

using the 2-wire protocol (IIC / I2C), making it easy to communicate with most MCUs and requiring less pins [7].

Temper detection unit

Today energy theft is a severe problem due to the country incuring significant losses in revenue from energy theft. A tempering device used to stop this energy theft that sent the warning when tempering occurs to the energy provider service. If any individual attempts to temper (such as current reversal or CT reversal tampers, partial earth failure state, bypass meter, magnetic interference, phase or neutral wire switched, external temperature meter, etc.) the tempering unit will be triggered and the central server of the energy supply company will be sent as SMS warning.

GSM modem

Intelligent GSM / GPRS quad band modem ideal for data transmission of long duration. A GSM modem is connected to a microcontroller to implement AMR system which would transmit data from a meter to cell phone and also receive commendation from cell phone to energy meter. On a daily interval or upon request, the modem can send unit or pulses (power consumption). The energy meter uses the collection of AT commands which stand for the attention terminal to communicate with the GSM modem [8].

Total load Calculation

AMR also offers, on request at any time, the total load information used in a building. The total load used in any house can be determined by the number of pulses observed or N reported in T time as defined by equation number 1.

Total Load used =   Kh*N*3600 /T   … (1)

Where

Kh =Meter constant

N=Number of pulse

T = Total pulse time of N pulses

Energy meter also sends the energy provider company and customers an SMS alert if any persons used more than specify load limit. The company supplying energy will disconnect the respective customer's electricity. And customers control their energy use at home.

RESULT

The pulse and unit (metre-reading) count in this project continuously according to the associated load. Sending an SMS to the respective meter according to their demand of meter reading energy provider business. This SMS is received by microcontroller via GSM modem, so that an interrupt signal occurred due to SMS. Microcontroller read EEPROM pulse and device and send the same to the approved number. Product design approaches aesthetic design, technological design, and ergonomic design in all three levels. The energy service business must send a notice to the customer either via e-mail or by post after due consideration. The customer can make payments online via the net-banking or credit card. The important feature of this system is that it provides the power-cut information. If there is a power cut in particular area AMR will send an SMS about the power cut to the energy supplier service. AMR operates by rechargeable battery in case of power loss.

Another feature of this program disconnects the control of the customer house that fails to make payment a few months earlier. In this situation, SMS will be sent to customer and energy provider that "Meters Power has disconnected duo on Date: Time:" to unpaid dues. If the customer pays the bill he will reconnect with his contact. With the aid of relay all this tedious operation happens. Energy meter sends an SMS warning to the energy provider if people who use more than specify the load limit in this format "Excess load use by METER ID —— Date: Time:." Power supplier also collects power charge information at any time. The last but not least important feature of this device is that it provides the tempering information, if any person tries to temper the energy meter, then a signal will be active and AMR will send an SMS to the energy provider company that says "Tempering takes place on Meter ID -------." Connections of the energy supply firm will be cordoned off of this meter without visiting site.

CONCLUSION

The GSM-based energy meter is easy to install and beneficial to energy providers and consumers alike. AMR not only solves the issue of manual meter reading but also provides additional features such as power disconnection due to outstanding duties, power reconnection after pay dues, power cut alert and tempering alert. AMR also offers, on request at any time, information on total load used in a building. It sends the energy provider company an SMS warning if a person who uses more than specifies load cap. The statistical load and profile used will help customers control their energy use. This device is secure and effective, since only an approved individual can access it. If an unauthorized individual tries to access the network, this device gives the energy provider a warning and also alerts the unauthorized person. This system has the potential to revolutionize the energy meter industry and, by stopping the current fraud and punishing fraudulent consumers, it can help with country revenue.

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