GSM Based Automatic Energy Meter Reading and Load Control

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Abstract: This paper reviews the various methods of Automatic meter reading (AMR) System. The AMR system enables remote access of existing energy meter by the energy provider. AMR system aims to move away from the traditional method of manual reading of electricity meters in which a meter reader visits every meter location periodically and read the meter value manually. In this we can monitor the meter readings regularly without visiting at the consumer site. This AMR system uses different connectivity module like Global System for Mobile (GSM), General Pocket Radio System (GPRS), Broadband carrier in power line and radio frequency. Different methods mentioned in this paper are used for transmitting the reading of energy meter from consumer site to the electricity board.

Keywords: Global System for Mobile (GSM), General Pocket Radio System (GPRS), Automatic meter reading (AMR) System, Radio Frequency.

1. INTRODUCTION

Today it has totally become a very difficult job to collect the meter readings as a meter reader has to be on-site physically to take the readings. Traditional meter reading by human operator is inefficient to meet the future residential development needs. So, the demand for AMR system has increased. AMR is a system in which the reading is taken automatically and the consumer directly comes to know how much electricity has been used by him. In traditional meter reading a person has to go from house to house for taking the reading. In this much manpower is needed as our commercial, industrial and residential area is expanding day by day. Automated utility meters have many new features that help to reduce the cost of utilities to consumers and the cost of delivering utilities to the utility provider. The automated utility meter system provides bill directly to the consumers which is more suitable in the current scenario.

One of the proposed methods for AMR system is based on GSM. GSM is a second generation cellular system standard. A GSM based wireless communication module is integrated with an electronic energy meter of each entity to have remote access over the usage of electricity. A PC is used with a GSM receiver at the other end, which contains the database that acts as the billing point.

A GSM channel is a very useful means of communication as sending data as Short Messaging Service (SMS) turns out to be a very handy tool due to its good area coverage capability and cost effectiveness.
GPRS is the world's most common wireless data service, based on GSM network; GPRS solution based on Internet protocol supports a wide range of enterprise and consumer applications.

For power or energy meter monitoring applications, the adoption of GPRS may be one of the quick and cost effective strategies such as revenue meter data collection, fault indicators or power quality monitoring which may have a lot of raw data as well. GPRS wireless data transmission service, can adapt to the actual environment of modern electricity sectors.

AMR system can also be taken using broadband carrier in the power line. It consists of four parts: energy meter, collector, concentrator and management center.

☐ **Meter:** recording user information, communicating with collector.

☐ **Collector:** collecting and storing the data of meters, communicating with meters downward, and communicating with concentrators upward.

☐ **Concentrators:** receiving and storing the data of meters, transmit real-time data information to management centre, communicating with collector downward, and communicating with management centre upward.

☐ **Management center:** through special software reading user information, monitoring power load condition, user fee management, print information, chart analysis, etc.
Radio frequency based AMR can take many forms. The more common ones are handheld, mobile, satellite and fixed network solutions. RF-based meter reading usually eliminates the need for the meter reader to enter the property or home, or to locate and open an underground meter pit. The utility saves money by increased speed of reading, has lower liability from entering private property, and has less chance of missing reads because of being locked out from meter access.

A WSN Structure A wireless data collecting system consists of flexible combinations of sensors, controller, and wireless communication devices. The WSN is formed by using "nodes". Each such sensor node is typically made up of several parts: a sensor for sensing the physical environment, a radio transceiver with an antenna for transmitting data wirelessly, a microcontroller for processing the data, an electronic circuit for interfacing with the sensors and an energy source. A WSN is formed by densely deployed sensor nodes in an application area. There can be from a few to several hundreds or even thousands of nodes and each node is connected to one or several sensors For sensor network applications, key design requirements revolve around long battery life, low cost, small footprint, and mesh networking to support communication between large numbers of devices in an interoperable and multi-application environment. The development of wireless communication technology in recent years resulted in evolution of for low cost equipment of wireless networking technology, called ZigBee. It is a short range, low-complexity, low cost, low power consumption, low data rate two-way wireless communication technology with high network capacity, short time delay, safety . There are numerous applications that are ideal for the redundant, self-configuring and self-healing capabilities of ZigBee wireless mesh networks.

Key ones include • Energy Management and Efficiency— To provide greater information and control of energy usage, provide customers with better service and more choice, better manage resources, and help to reduce environmental impact. • Home Automation—it provides more flexible management of lighting, heating and cooling, security, and home entertainment systems from anywhere in the home. • Building Automation—it provides centralize management of lighting, heating, cooling and security for whole building. • Industrial Automation—to extend existing manufacturing and process control systems reliability.

II. LITERATURE SURVEY

Babak Aghaei [1] presents a model for processes which are related to user of water, electricity and gas by using wireless sensor network in Iran. In this paper the amount of economy and optimization occurred in offices in Malekan those by proposed model are given. Li Quan-Xi1, Li Gang2 [2] propose household metering system design based on Zigbee and GPRS technologies, using PIC18LF4620 as the core processor and CC2430 chip as close communication function, using SIM300 chip as communication function in distance.

Md. Wasi-ur-Rahman, Mohammad Tanvir Rahman, Tareq Hasan Khan and S.M. Lutful Kabira[3] proposed technique for remotely reading electricity meter readings using Short Message Service (SMS) has been illustrated. Existing Global System for Mobile communications (GSM) networks have been used for sending and receiving SMS.

Dr. Mohd Yunus B Nayan1, Aryo Handoko Primicanta2 [4] propose hybrid Automated Metering Reading (AMR) system which is a combination of ZigBee and GSM technology. In this propose system ZigBee module is attached to the electric meter by using interface board and the data collector will be connected to the central computer by using GSM.

Gordan Štruklec1, Vedran Bilas2[5] propose a wireless automatic water-meter reading system founded on ZigBee technology . The wireless automatic water-meter reading system presented here uses ZigBee networking to avoid difficulties and problems inherent to other meter reading techniques In all above models either single parameter is used for developing AMR i.e. electricity and water or give general idea about designing of AMR. Designed model gives detailed design of AMR which will measure electricity and water and for each house and will forward recorded data to central station and will also send sms to user using gsm communication, regarding due dates ,bills etc.

III. METHODS

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.
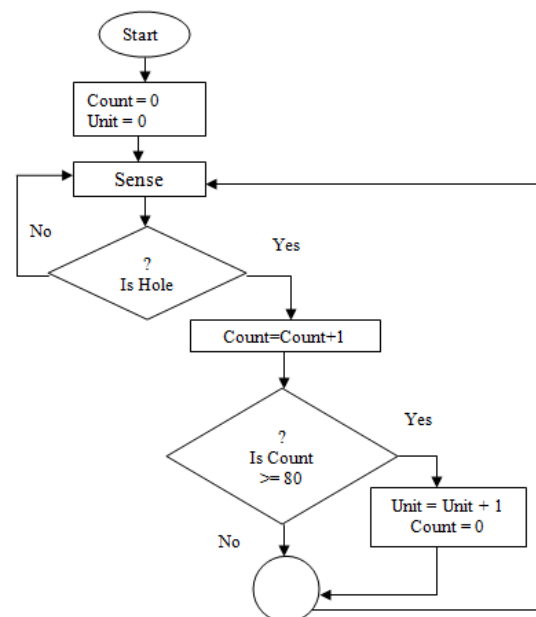

Figure: 1 flowchart to the code for counting the units.

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. 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.

The modulation used in GSM is Gaussian Minimum Phase Shift Keying (GSMK), 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 nearby channels.

4. SYSTEM DESIGN

This GSM energy meter is constructed using the microcontroller, a display, GSM modem and microchip. In this, meter is designed using embedded GSM modem and by using existing GSM network to send wirelessly its energy consumption value as SMS to energy provider. At the time of sending the message every time, this data is stored in the non-volatile memory (EEPROM).

We use RTC module also with meter to have all recording of usage details about energy consumption. In the office, the GSM unit will receive these collected data and local software will process on that data and calculate the total power consumption of each user. The system design can be discussed as two broad categories, Hardware implementation and software web portal design implementation.

4.1 HARDWARE IMPLEMENTATION

In this system power supply is provided to meter. A GSM unit shows the interfacing with the microcontroller. Transmission of usage details is send to office modem using user modem. Every consumer has unique number provided by corresponding authority. Hardware implementation includes following points as discussed below.
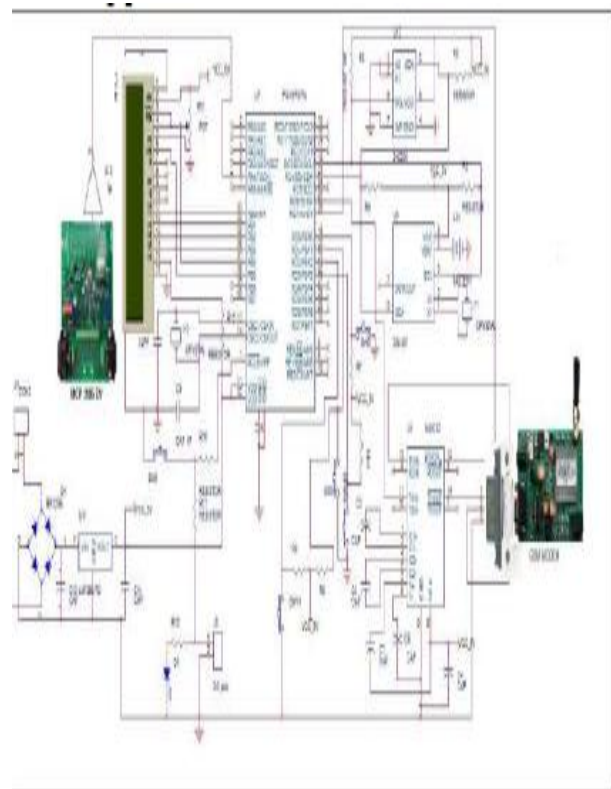

Fig.2 Circuit Design of Energy Meter

In The metering IC creates the output in the form of pulses which are counted using the default timer of PIC microcontroller unit.

5. SOFTWARE ARCHITECTURE

The system software is implemented by C language in the Keil MCB2130 software along with flash magic. All software development tasks including editing, compiling and debugging can be accomplished using the above mentioned software's.

5.1. Meter Reading Terminal Software Design
According to the hardware circuit design features, meter reading terminal software design flow chart is given and shown in Figure 3. First, the system initializes each module, and then reads the meter readings regularly, and stores them. When receiving the command, the meter sends in the current status along with the energy consumption.

In case of uncertain events such as reverse voltage, tampering, etc the WAMRS will generate error signals by enabling pre-programmed flags. The system is usually in standby mode. The controller may read the contents of the status register to monitor data transfer status.

5.2. Server End Terminal Software Design In accordance to the function of the hardware circuit design, the software programming idea of server end terminal is as follows: first, the system completes initialization, and then sends commands to the meter reading terminal through the GSM modem. When the host WAMRS receives the signal, it will select the data and update the database at the same time, send the consumption to the consumer via SMS.

6. CONCLUSION

The wireless automatic meter reading system (WAMRS) presented in this paper absorbed many advanced study results in computer technology and communication technology. The meter-reading task can be finished at the management department of residence area by using this system. Meantime, the energy resources management departments can monitor the consumption of power in order to improve the utility of power. It's the basic to realize automatic deliver of energy resources. The system has many significant excellences, such as wireless, low-workload, great quantity of data transmission high-

veracity and low-expenses. The using of embedded system improves the stability of wireless data transmission. For a long distance transmission GSM telecommunication has shown excellent performance at any conditions.

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