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# Automatic Energy Meter Reading System Reviews

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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. Energy meter readings can be taken using Personnal Computers (PC)/Laptops and different connectivity modules.*

*Key words: Automatic meter reading system, GSM, GPRS, Broadband carrier in power line, Radio frequencies*

## 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.

## 2. Methodology

### 2.1. GSM System Overview

The complete system overview for GSM Automatic Power Meter Reading (GAPMR) system is shown in fig. 1. The complete system is made up of GSM power meters (GPM) installed in every individual consumer unit and SMS gateway, Application terminal, Database server, Email server, printer server, web server, and E-commerce server install at the energy provider side. The system is working in conjunction with the GSM network to retrieve power meter reading using SMS. The GPM is a single phase digital kWh power meter which utilizes the GSM network to send the power usage reading back to the energy provider wirelessly upon request from the energy provider SMS gateway. A Subscriber Identity Module (SIM) card with a unique special service number is required for the GPM to receive and reply its meter reading to the energy provider using SMS. The special service number SIM card is work similar with mobile phone number except it is not mean for voice service. The SIM card service number is also used to identify and retrieve the owner or customer details from the database server for billing purposes.
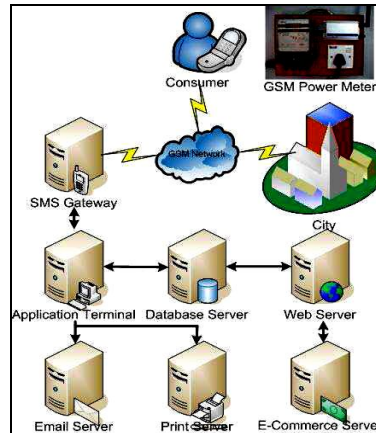


*Figure 1: Overview Of GAPMR System*

An automatic power meter reading took place upon request by the power provider using SMS at monthly intervals. Upon meter reading execution the SMS gateway performs cell broadcasting of request through SMS to all GPM to request for meter reading. Once each individual GSM power meter received the requesting SMS, it will immediately response by composing its consumption reading in six digit kWh with one decimal point unit in SMS format and revert to the energy provider SMS gateway. The gateway starts to receive the reply meter reading from all the individual GPMs and will store the meters reading information accordingly.

After completion of the meter reading request the application terminal will starts to retrieve the meter reading from the SMS gateway to store and update to the database server. So after that the application terminal e-billing system will start to calculate the billing amount for an individual meter based on the tariff rate from the energy provider. The billing notifications are later sent to all the owners through E-mail by the E-mail server. SMS to the owner through SMS gateway and hard copy printing through the print server for postal mail for owner who prefer hardcopy printing.

A web portal has also been setup at the web server to provide easy check and payment service. Once the owner received the billing notification from SMS E-mail or hardcopy printing bill, then the owner can access the web portal and able to log on to check their billing details since the web server is link to the data base server. The owner can choose to pay their bill online using credit as the web server is connected to the E-commerce server that is handling online banking transaction. The owner can also use their mobile phone to retrieve their power meter reading to verify the billing reading. This can be achieved by just sending a SMS to the owner GPM service number. Once the GPM receive the SMS it will compose the current meter reading and reply the to the owner mobile phone through SMS[1].

### 2.2. GPRS System Overview

#### 2.2.1. GPRS Module Design

GPRS [5,6] is a wireless transmission technology developed from Packet-Switched. Compared to the original GSM's dial-up data transmission mode which is circuit-switched, GPRS is a packet switching technology, which is high-speed and permanently online. It will be used in the machine-machine and human-machine applications, where are suitable for sending and receiving data (SMS,CSD, HSCSD, GPRS). The module has the following characteristics:

- It is an advanced module with the GPRS voice, data and SMS functions. It has high transmission speed, high resource utilization, short switching in time, and it is real-time online. GPRS uses packet switching technology whose maximum theoretical value of the data transfer rate can reach 171.2kbit/s, so it can greatly shorten the development cycle.
- This module can accomplish telecom services (TS) in accordance with ETSI, and ITU-T. Its function is achieved by AT commands via serial port.

### 2.2.2. GPRS Module's Interface Concentrator

The concentrator's core is the powerful and highly integrated Digital Signal Processor (DSP) TMS320F2812 chipset. Watt-hour meters' information is gathered by RS485 bus or pulsed collection mode, and it can collect voltage and current of power line through the multi-function watt-hour meters. The collected elementary data is transmitted through GPRS modules to the data center, and it can receive and execute tuning and remote control commands issued by data center through the GPRS network [7].
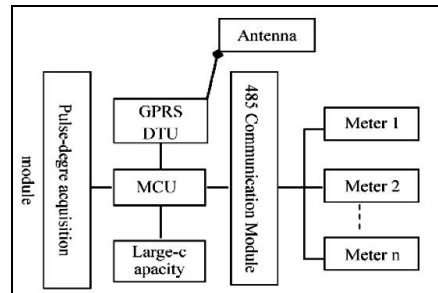


*Figure 2: GPRS Wireless Meter reading concentrator*

It has the following characteristics-
- Meter reading concentrator gets various information through the RS485, or collects meter information by pulsed acquisition modules. Its switching-in method is a flexible.
- Meter reading concentrator can read active and reactive, Demand, power, voltage, current and other data of multi-function watt-hour meter reading.
- The meters are frozen at the same time in a month, and the cost is precise.
- Safety: Concentrators use large-capacity memory, and it can keep the last 15 days' meter data. The data won't lose even when the power is down. In order to ensure the transmitting data is correct, multiple test validations are added to the data. It makes data transmission more accurate and reliable [2].

### 2.3. Broadband Carrier In Power Line system overview

### 2.3.1. Energy Meter

The energy meter in the system is a multi-rate energy meter, using RS485 bus or power line carrier to communicate with the collector. To realize multi-period control, it uses real-time clock chip PCF8563, which designs three rates, namely peak, flat and valley and is totally compatible with power industry standard "DL/T645-1997 Multi-functional Energy Meter Communication Protocol". Energy metering module mainly completes the measurement of electric energy; data storage module completes the timely storage of power energy's information, while RS485 communication module and carrier module achieve the data exchange between the collector and the energy meter; Liquid Crystal Display (LCD) module provides users with a clear and real-time electric quantity information; real time clock module provides multi-rate energy meter with accurate time information in order to achieve the measurement of electrical energy under different rates; send and interrupt electricity module can realize the function of overload interrupt of power supply as shown in fig 3.
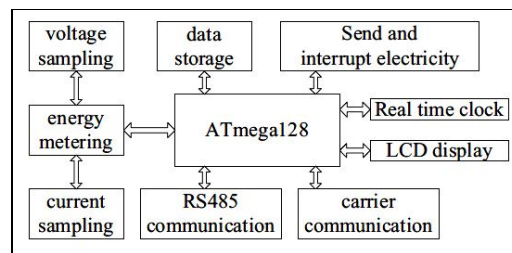


*Figure 3: Energy meter structure*

### 2.3.2. Collector

Collector communicates with concentrator up, mainly realize following functions-
- Receive meter reading instructions of the management center transmitted by concentrator.
- To transmit energy meter data collected from user to concentrator according to relevant communication protocol.

Collector communicate with energy meter downward, mainly realize following functions:
- Timing collect user data, freeze user electric quantity data at scheduled times according to set, as the basis of charge.

### 2.3.3. Concentrator

Concentrator in broadband carrier act as a connecting link between collector and management center and determines the overall system performance. It mainly realize following functions upward:

- Receive management center instructions, set initial parameters, meter reading time, path etc.
- Transmit the data by the collector to management center according to relevant communication protocol [3].

### 2.4. Radio Frequency Technology (RF) System overview

AMR system is designed based on the actual digital electricity meter available in each consumer residential. Figure 4 show the basic block diagram of the RF AMR system. Basically, this system use existing one phase digital electricity meter in consumer residential. The digital electric meter will display the amount of energy consumed by the consumer based on daily usage. At the digital electric the build in LCD will display the energy consumed according to the number of pulses generated by the Light Emitting Diode (LED) blinking. Therefore, the numbers of pulses generated by the LED are the proportional amount of energy used by the consumer [8].
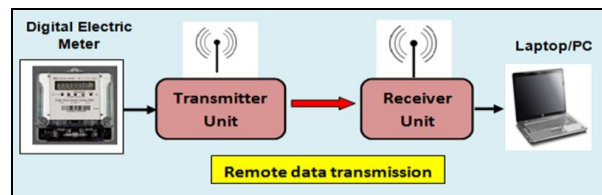


*Figure 4: Block diagram of RF AMR System*

The transmitter section consists of transmitter module, microcontroller PIC16F877A, LCD display, Real Time Clock (RTC), digital electricity meter and load. The pulses from meter are given to the microcontroller via optocoupler. The transmitter sends the amount of energy consumed in unit to the receiving end through RF module. LCD display is used to display the unit value, time and date as shown in figure 5.
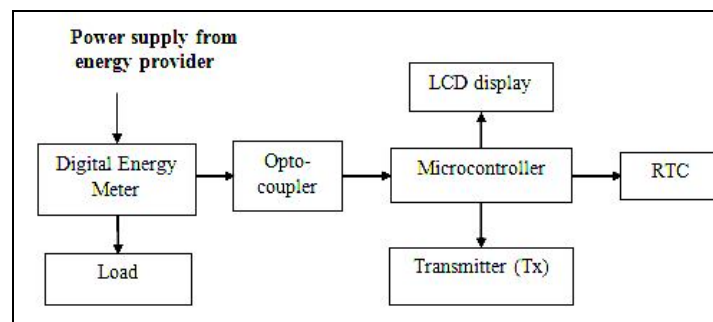


*Figure 5: Transmitter Block Diagram*

At the receiver end the data is received by a receiver module and the microcontroller will display the data over the LCD display. The PIC transmits these data to laptop/PC [4].

### 3. Conclusion

The use of different methodology in this Automatic meter reading system provides numerous advantages. GSM based AMR system is the most advantageous system than other as this system provides the consumer directly with the billing through SMS. This could make the process of meter reading quit easier. GSM infrastructure has full coverage of all houses in the country which makes the implementation of GSM power meter easier. Multiple transceivers used in automatic meter reading system incorporate no data loss. From all these proposed methodology it can be conclude that automatic meter reading system can be really proved as a boon for consumers and electricity board. The data collection and manipulation task becomes fast and easier. Any modification can be made to the code in less time. Changes in rate or unit calculation can be done very effectively.

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