



# SMART AND EFFICIENT ENERGY METERING SYSTEM USING GSM

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## Abstract:

Today electronic communication technology became more advanced to give solutions in real time.. In this paper use the smart and efficient energy metering system uses GSM network.GSM is most popularly used because of its vast coverage area and its cost effectiveness. It is wireless two way communication between utility company and energy metering system..GSM based smart efficient energy meter sends information of utility usage, power quality and outage alarm to utility company, tampering detection to the utility servers.

Here, we propose use of GSM network to transmit message of bill to the server and generates a soft copy which will be send via short messaging services, Email.

**Keywords:** 89C51-Based System, Automatic Meter Reading, GSM, Relay Control

## 1. Introduction

The rapid change in mobile technology here we tried successfully to develop GSM based smart automatic energy meter system whose goal is to help collect the meter measurement automatically and possibly send commands to the meters. Automation ranges from Connecting to a meter through an RS-232 interface for transmitting the meter measurements all the way from the meter to the utility company via GSM network.

### 1.1 Traditional Way

In existing system for collection of energy consumption data is that the representatives of MSEB monthly comes and visit every residential , take the snap shot and corporate and manually reads the consumption data from the meter. This collected data is recorded on a piece of paper along with a snap shot of the meter and finally submitted to the local MSEB office. There after the official's read the snap shot and meter readings and then gives it to the local software for bill calculations and generation of bill. We as a consumer then make the payment for the received bill. This process is so much hectic process. Man made mistakes can be countless. Human resources wasted and many other problems do occur. We finally thought of building a system that will do the above process automatically.

Recent developments in this direction seem to provide opportunities in implementing energy efficient metering technologies that are more precise and accurate, error free, etc. The implementation of GSM based smart automatic energy meter provides with many vital features as compared with the analog meter reading. Some of these features are listed below,

- Far faster.
- Load management.
- Automatic billing invoice.
- Accurate energy cost.
- Tamper detection.
- Bundling with water and gas.
- Operated using remote.
- Improved load efficiency.

- Alarm warning.

This system provides a two way communication between the electricity company and the load by sending in a lot of power parameters and control signal to reach the goal of load management and power demand control. Using GSM based smart automatic energy meter on distribution automation can supply many capabilities such as efficient meter-reading, distribution, power monitoring and control, load management and time-of-use rate. With rapid growth of mobile communication network, future application service will gradually concentrate on data transmission service. GSM has been developed maturely and has many practical applications at present. It has many advantages such as more stable network with robust features, covers virtually all parts of the world, maintenance and security of data transmission. It satisfies the need of speed for data transmission required for automatic meter reading system.

## 1.2 Message transmission using GSM

GSM is used by over 1.5 billion people across more than 212 countries and territories. Global System for Mobile Communications (GSM) is the world's most popular standard for mobile telephony systems. GSM also well known for low-cost implementation of the short message service (SMS) which allows parties to exchange delay-tolerant short text messages. Due to the low cost, wide coverage & convenient transmission medium, it succeeds to attracted researchers to consider the use of SMS service.

However there are some drawbacks regarding GSM network such as

- its scalability
- reliability and
- security

SMS delivery success rate was found to be 94.9%.

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.

The paper consists of following sections: Section II describes the proposed system architecture. The system includes a 32-bit ARM microprocessor to deal with power data processing and relay control, which transmits the power consumption values periodically, via an existing GSM network to a master station. Section III and IV describes the hardware architecture and software separately of GSM based smart automatic energy meter. Section V concludes the paper.

## 2. System Structure

The system structure of GSM based smart automatic energy meter system is shown in figure 1. The networked meter-reading system consists of terminal measure meters, sensors, intelligent terminals, management centre and wireless communication network.

- Intelligent terminal or AMR interface, a hardware connected to a meter or a network of meters, which gathers data from meter(s).
- Management Center, mainly a computer or a network of computers, which collects the data sent by the AMR interface.
- Communication medium or GSM network, which enables communication between the AMR interface and the center. □

Meter-reading, computation and charge can be finished at the management centre of each residence. The charge message i.e. SMS or Email would send to resident at regular intervals. The GSM network establishes a two way link in between the intelligent terminal and the management center providing useful features as mentioned above.

## 3. Hardware Architecture

The hardware architecture and appearance of GSEMS is as shown as Fig. 2. The energy consumption is being calculated using a standard calibrated energy meter. In order to prevent unauthorized connection, mismatch with the energy meter, a tampering detection unit is added in this block. The digital date generated from this block is then sent to ARM-based embedded system to compute power parameters.

The GSEMS can be divided into five parts; these five parts separately are power unit (PU), relay control

unit (RCU), and ARM-based embedded system (AES), wireless communication module (WCM) and utility control center (UCC). The hardware description of five parts is introduced as follows.

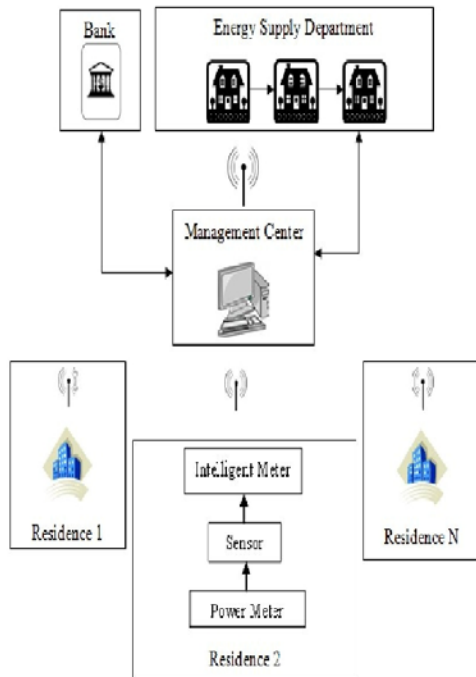


Figure.1 Structure of diagram of GSEMS

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#### 3.1. Energy measuring unit (EMU)

The energy measuring unit consists of a standard

calibrated energy meter along with the tampering detection circuit. If any variations other than the rated voltage or specified values are obtained, the ARM -based embedded system (AES) generates the necessary signals required for further operations.

In many countries, it is seen that the consumers attempt to obtain electrical energy illegally. These incoming losses of stolen power for utility companies are very high. It's necessary for utility meter to have the capability of tamper detection. The following events are considered for tamper detection by the method. Missing potential event

- Current unbalance event
- Current reversal event

If any above event occurs, the AES will record the meter status in database and inform UCC about tamper warning on the instant.

#### 3.2. Control unit using Relay (RCU)

The RCU is a vital part in GSEMS. It provides the useful functionality of remotely switching the power ON/OFF to the user. It consists of a protective relay, breaker control circuit & line breaker.

#### 3.3.89C51 microcontroller-based embedded system (MBES)

The MBES is termed to the heart of GSEMS. The AT89C51 is a low-power, high-performance CMOS 8-bit microcomputer with 4K bytes of Flash programmable and erasable read only memory (PEROM). The device is manufactured using Phillips's high-density nonvolatile memory technology and is compatible with the industry-standard MCS-51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Phillips AT89C51 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications.

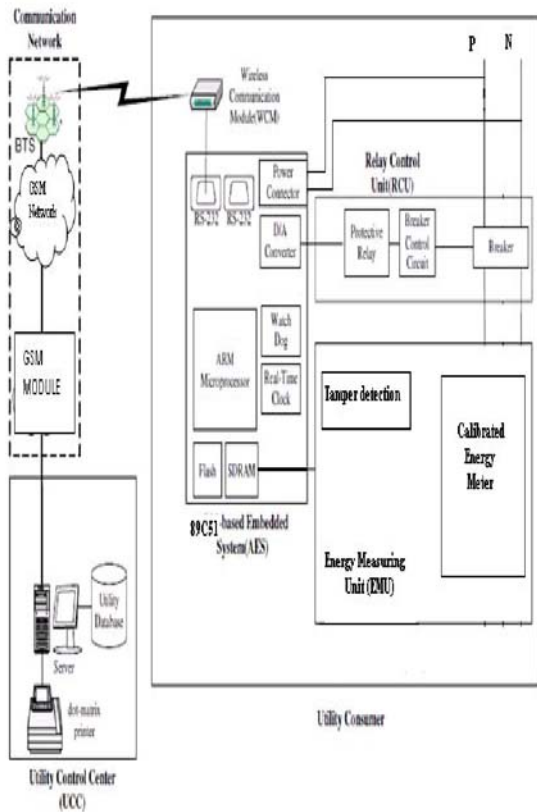


Figure. 2 Hardware Architecture 1

### 3.4. Wireless communication module (WCM)

The GSEMS adopts a SIM 300 GSM modem manufactured by SIMCOM limited as the wireless communication module. SIM300 is a Tri-band GSM/GPRS engine that works on frequencies EGSM 900 MHz, DCS 1800 MHz and PCS1900 MHz. The SIM300 is designed with power saving technique, the current consumption to as low as 2.5mA in SLEEP mode. The SIM300 is integrated With the TCP/IP protocol; extended TCP/IP AT commands are also developed for using the TCP/IP protocol easily, which is very useful for those data transfer applications.

### 3.5. Utility control center (UCC)

The UCC resides in the utility company and has a PC as control server with needed programs and storage to read and collect power parameters from MBES via communication network. The specifications of server are as follows:

- 2.4 GHz Intel Pentium IV processor
- 512 Megabytes RAM
- 80 Gigabyte Hard Disk
- 15" LCD Monitor
- DVD-Rom Drive
- 100 Mbps. Network Connections
- Dot-matrix printer.

### 4. 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.

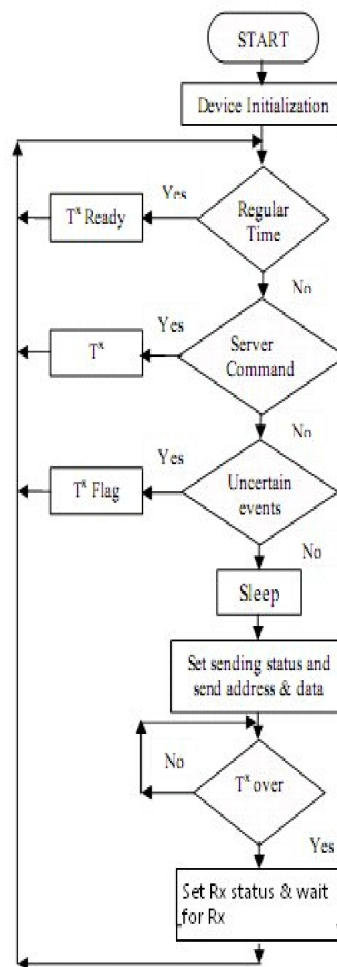


Figure 3. Flow chart for Meter Reading T terminal

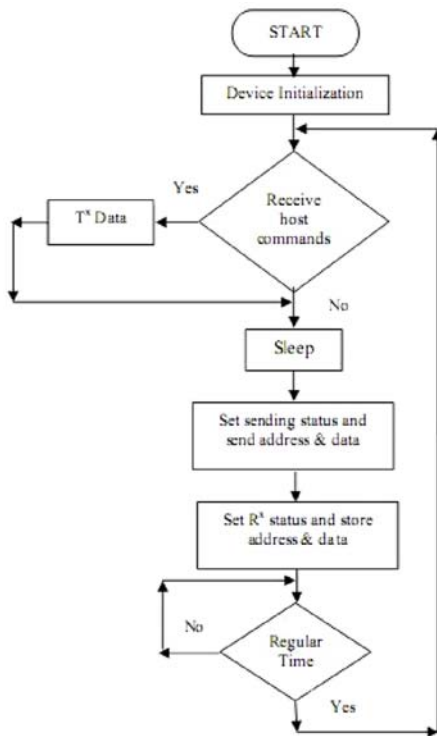


Figure 4. Flowchart for server end terminal

#### 4.1. Terminal Software Design

According to the hardware circuit design features, terminal software design flow chart is given and shown in Figure 3. In beginning, initialization takes place of each module followed by it reads the meter readings regularly, and stores them. When receiving the instruction, the meter sends the current status along with the energy consumption.

In case of uncertain events such as reverse voltage, tampering, etc the GSEMS 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.

#### 4.2. Terminal Software Design at Server End

In accordance to the function of the hardware circuit design, the software programming idea of server end terminal is as follows:

- The system completes initialization, and then sends commands to the meter reading terminal through the GSM modem.

- When the host GSEMS receives the signal, it will select the data and update the database at the same time, send the consumption to the consumer via SMS, Email.

The overall software flow chart is shown in Figure 4.

#### 5. Conclusion

The GSM based smart automatic energy meter (GSEMS) presented in this paper absorbed many advanced study results in computer technology and communication technology. The GSM networks plays an important role because it has good coverage facility and to manage fault tolerance The unit-reading task can be finished at the management authority by using this system. In the meantime, the energy resources 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 supports many significant excellences, such as security, accuracy at the higher level and low-expenses. For a long distance transmission GSM telecommunication has shown excellent performance at any conditions.

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## 6. References

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