

ARM BASED AUTOMATIC ENERGY METER READING USING GSM

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ABSTRACT

In this paper, we discuss Automatic Meter Reading system using GSM. This system is used with 32-bit LPC2148 ARM microcontroller used for reading power consumption and communicates this data to the utility center. In utility center power data processing is done. The communication between utility center and an ARM based embedded system is done with the help of GSM. Measurement of static parameters such as current, voltage and power, bill management are done with the help of power data. The control system includes relay circuit and breaker which are used for disconnection or resume the power supply.

Keywords-ARM based system, Automatic Meter Reading, GSM, Relay controller

1. INTRODUCTION

Electrical power has become very necessary to human survival and progress. Apart from attempts to meet increasing demand, automation in the energy distribution is also essential to enhance human's life standard. Conventional meter reading by human operator is incompetent to meet the future residential development needs. Hence there is increased demand for Automatic Meter Reading (AMR) systems which gathers meter readings automatically, and its use is extending over industrial, commercial and utility environment.

Automatic meter reading systems are an important step towards automating the utility metering process. Automatic meter reading systems have improved features that help to reduce the cost of utilities to customers and the cost of the delivering utilities to the utility provider. The onset of rural electrification provides opportunities for new and more capable metering technologies to be implemented. Until traditional electro-mechanical meters are widely used today. Meter reader has to physically be onsite to take the readings because of this collection of meter readings is inefficient. This method of collecting of meter readings becomes more erroneous and costly when readings have to be collected from wide area, and often scattered rural areas. Meter readers are unwilling to make the attempt to travel to such areas and will often submit wrong approximations of the amount of electricity consumed. For households at the top of high buildings and specious housing plots, conventional meter reading is highly inefficient. There is possibility of missing bills, absence of consumer etc. These traditional meters were replaced with more efficient automatic meter reading systems. So a system which will provide the bill in users mobile will be more suitable in today's world.

The purpose of this Automatic Meter Reading system is to remote monitoring and control of the Domestic Energy meter. This system allows the Electricity Department to read the meter reading orderly without the person visiting each house. This can be attained by the use of ARM unit that continuously monitors and records the Energy Meter readings in its persistent (non-volatile) memory location. This system also makes use of a GSM network for remote monitoring and control of Energy Meter. The ARM based system regularly records the readings and the live meter

reading can be sent to the Electricity dept. on request. This system also can be applicable to disconnect the power supply to the house in case of non-payment of electricity bills. A committed GSM network with SIM card is required for each energy meter. Remotely reads customer meters and then transmits the data into the billing system. Reduce the need for meter readers to manually gather utility meter readings each month.

2. LITERATURE SURVEY

Wireless ARM –Based Automatic Meter Reading and Control (WAMRCS) [1] in this paper 32 bit ARM microprocessor is used for reading power consumption & communicates this data to the utility server for power data processing. But in this paper power cut information is not provided. In our system buzzer is use to give power cut information.

Ashna K. and Sudhish N. George [2] proposed the design of a simple low cost wireless GSM energy meter and its associated web interface, for automating billing and managing the collected data globally. In this paper if consumer fails to pay the bill before due date then this system does not cut the power supply. But in our system relay is used to cut the power supply if consumer fails to pay the bill before due date.

SMS-based Reconfigurable Automatic Meter Reading System [3] suggested GSM is used as wireless communication medium between AMR interface and center. In this paper if consumer fails to pay the bill before due date then this system does not cut the power supply. But in our system relay is used to cut the power supply if consumer fails to pay the bill before due date.

Champ Prapasawad, Kittitach Pomprasitpol and Wanchalerm Pora [4] proposed a development of an automatic meter reading system focusing on the design for an energy meter implemented with Zigbee wireless communication protocol conforming to IEEE 802.15.4 standard. They use a microcontroller STM32L152VBT6 to manage energy data and Zigbee to enable communication between the energy meter and data centers. In this paper Zigbee is used as a wireless communication medium but the range of Zigbee is less. Hence in our system we use GSM as a wireless communication medium. In our system we use the LPC2148 and PIC16f690 microcontrollers instead of microcontroller STM32L152VBT6.

3. ARM BASED AUTOMATIC ENERGY METER READING SYSTEM USING GSM

This system consists of ARM LPC2148, PIC16f690, GSM, Current transformer, Power transformer, Burden resistor, Voltage divider, Filter, LCD Display, Relay, Buzzer, MAX232, Resistors, Capacitors, Diodes, Voltage Regulators, LEDs and DB-9 connector. This consist of with two modules meter and office units.

3.1 METER UNIT:

Meter Unit is used to calculate the units by using voltage and current and send the readings to office unit for calculation of bill.

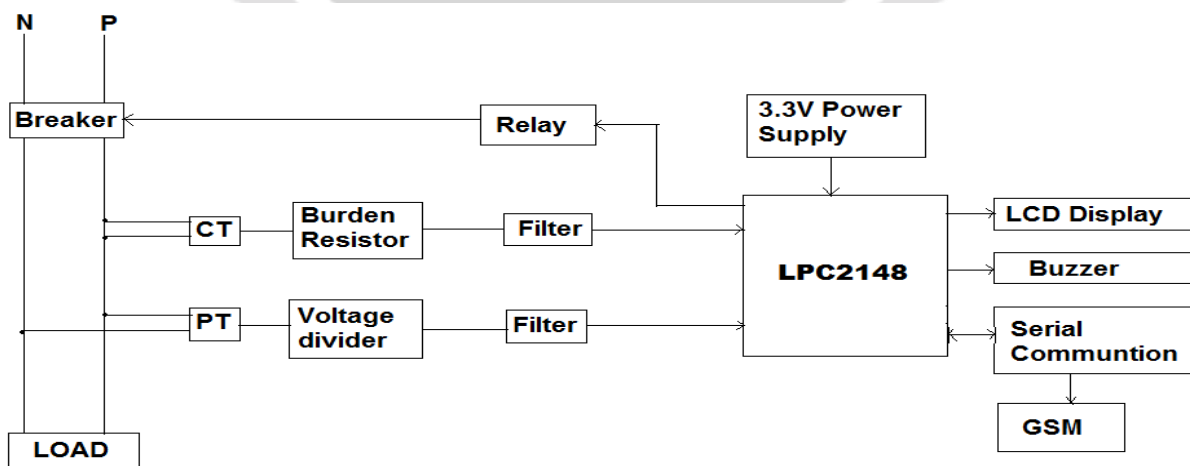


Fig-3.1: Block diagram of Meter Unit

OFFICE UNIT:

After receiving the readings from meter unit, office unit calculates the bill and send it to the consumer's mobile and also to the meter unit.

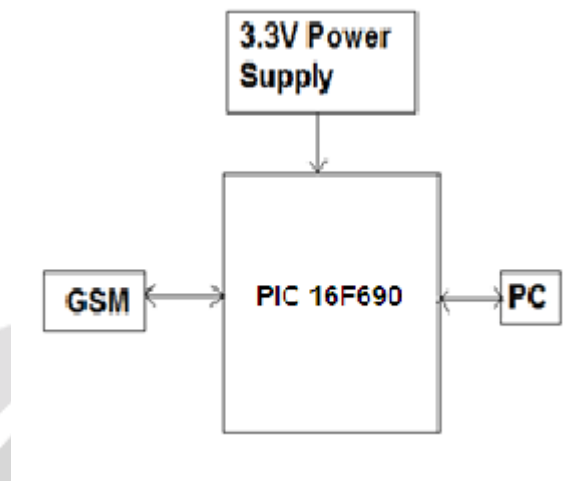


Fig-3.2: Block diagram of Office Unit

Automatic meter reading system Architecture is as shown in fig 1. As shown in figure, Automatic meter reading system is divided into five parts :-

- A. Signal Sampling Unit (SSU)**
- B. Relay Control Unit (RCU)**
- C. ARM – Based Embedded System (AES)**
- D. Global System for Mobile Communication (GSM)**
- E. Utility Control Center (UCC)**

A. Signal Sampling Unit:

It consists of

- a. Current Transformer (CT)
- b. Power Transformer (PT)
- c. Burden Resistor
- d. Voltage Divider
- e. Filter

a. Current Transformer (CT):

A current transformer (CT) is used for measuring the alternating electric current. Current transformers along with voltage transformers are known as instrument transformers. When current in a circuit is extra large to apply directly to measuring instruments, a current transformer generates a reduced current directly proportional to the current in the circuit, which can be kindly connected to measuring and recording instruments. A current transformer separates the measuring instruments from what may be very high voltage in the monitored circuit. Applications of Current transformers are metering and protective relays in the electrical power industry.

b. Power transformer (PT):

Production of electrical power in low voltage level is highly cost effective. So electrical power is produced in low voltage level. Theoretically, this low voltage level power can be transmitted to the receiving end. But if the voltage level of a power is raised, the current of the power is reduced which causes reduction in ohmic losses in the system. Decrease in cross sectional area of the conductor that is decrease in main cost of the system and it also civilize the voltage regulation of the system. Because of these, low level power must be increased for efficient electrical power transmission. Step up transformer at the sending side of the power system network is used for efficient electrical power transmission. As this high voltage power may not be extended to the consumers directly, this must be decreased to the desired level at the receiving end with the help of step down transformer. These are the applications of electrical power transformer in the electrical power system.

c. Burden Resistor:

Burden resistor is used with CT to set required voltage at the secondary side of CT.

d. Voltage Divider:

Voltage Divider is used along with power transformer to reduce the voltage to limits of ARM operating voltage range.

e. Filter:

It is used to remove impurities such as emf in DC signal before passing the signal to ADC of ARM microcontroller.

B. Relay Control Unit (RCU):

It consists of relay and breaker. Relay Control Unit is used to disconnecting the electric power supply when the signal from ARM embedded system because payable date is over. By using protective relay wired in series with breaker control circuit, electricity will resume automatically. This relay is controlled by ARM processor.

C. ARM based embedded system:

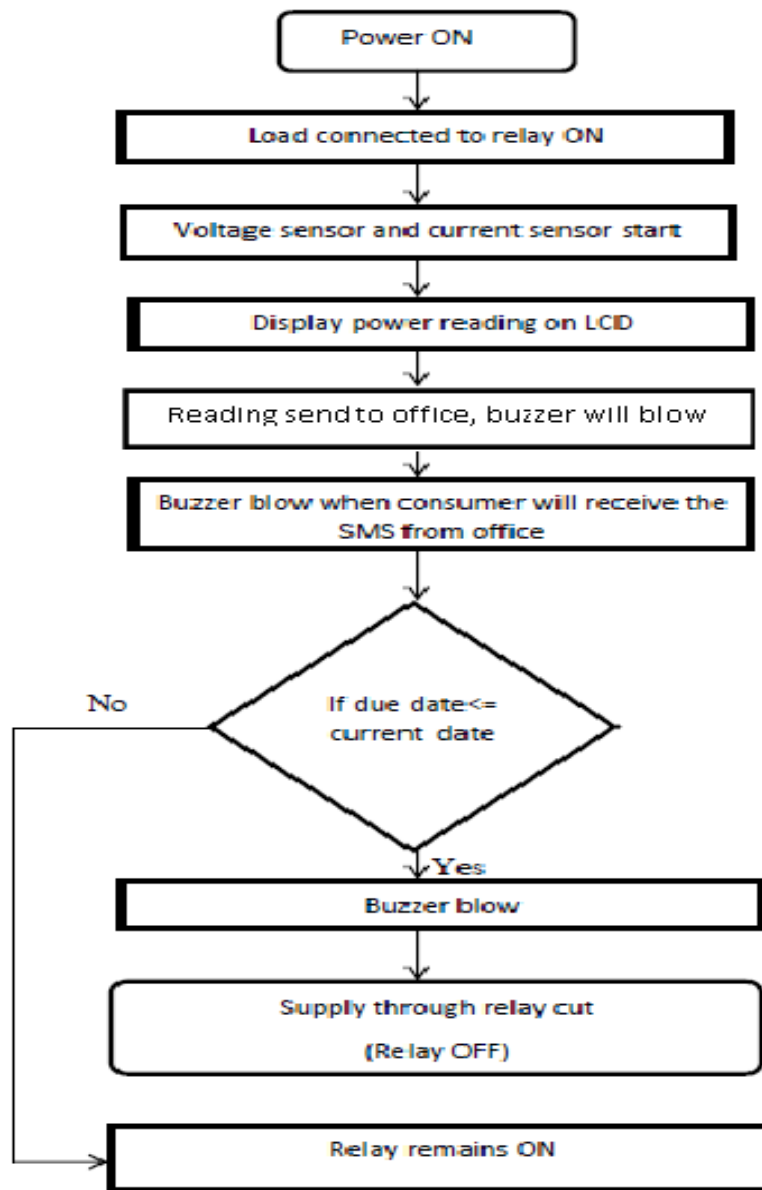
This system is used to calculate current, voltage and power. There are various microprocessor based digital power meters are available in market. These are bulky in size & having limited capabilities. ARM-based system occupies small space. It also supports most popular communication protocols. ARM based system is widely used in variety of network equipment such as mobile phone and PDA, and become popular and cheaper. It's also having on chip 10 bit ADC of successive approximation type. In this each analog input has a separate register to avoid interrupt handling & it is having global start command for both converter.

D. Global System for Mobile Communication (GSM):

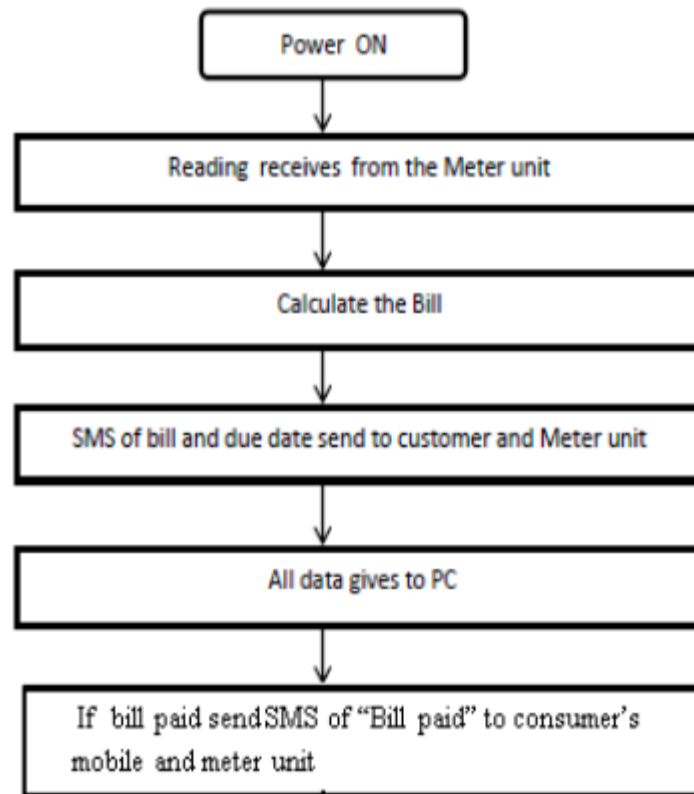
GSM is GLOBAL System for Mobile Communications. It's been clear for a long time that GSM would be used across Europe. A GSM module incorporate a GSM modem with standard communication interfaces like USB, RS-232 (Serial Port) etc., so that it can be easily interfaced with a automated embedded system. The power supply circuit is also built in such module that can be activated by using a suitable adapter.

E. Utility Control Center:

Utility Control System includes ARM based embedded system which is used for data processing and bill management.



Flowchart-1: Meter unit



Flowchart-2: Office Unit

4.SYSTEM IMPLEMENTATION :

The system is tested in place of traditional meter and achieved good results. In our system if 100W load is ON for 3 sec then 1 unit is calculated. In real 1 Unit=1KWH but we have taken 1 Unit =1Wm for demo purpose. ARM-Based Embedded System (AES) is interfaced with GSM Module, Signal Conditioning unit and Relay Control Unit. For demonstration purpose, 100W bulb is used as a load to check our system. The bulb is connected to load and Signal conditioning unit, which is used to measure the average real power information. This test is performed and power consumption is calculated. During the test, voltage & currents parameters are read for specified time interval to generate the bill. Based on this reading, Power is also calculated and voltage, current and units are display on LCD in ARM - Based Embedded system (AES) . After payable date, the ARM- Based Embedded System turned off the bulb through relay control unit, which proves the accuracy of our system in terms of the power Calculation & remote controlling.



Fig-4.1: Meter Unit Set-up

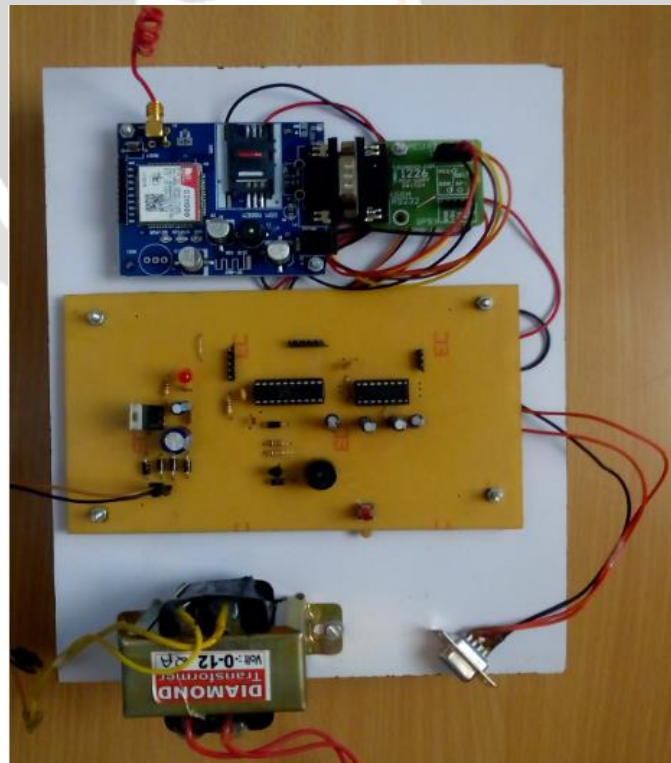


Fig-4.2: Office Unit Set-up



Fig-4.3:Parameters showing on LCD display

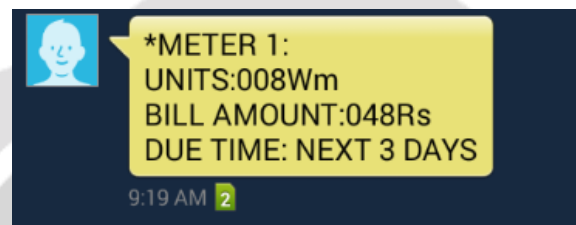


Fig-4.4:Message of Bill Issued on customer's mobile

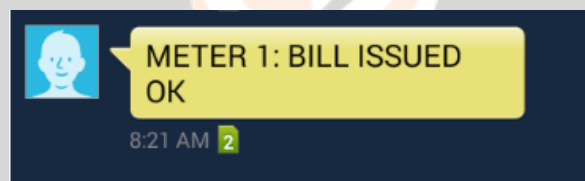


Fig-4.5:Message of Bill on customer's mobile

5. ADVANTAGES

- Accuracy in meter reading
- Improved billing process
- Accurate measurement and true costs applied
- Improved security
- Energy management
- In cases of shortages, utility will be able to manage/allocate supply.
- Improved billing and sailing of usage.

6. DISADVANTAGES

- Billing system fails if no GSM network coverage.
- Charges may be applicable for network use.

7. FUTURE SCOPE

- The present system is used for meter reading for electricity using power line communication. The system can be further modified to detect power theft between pole and individual subscribers by installing the units at each subscriber end.
- For the readings of Electricity, Water, Gas or any other meters in the customer premises to be transmitted to a

central base station for further processing, billing etc. With tens of millions of meters to be read periodically and regularly, this alone represents an enormous market.

- The present system is implemented to send non voice data only. The system can be further developed to transfer voice data through power line. But the system should be robust enough to handle interference in the power line.

8. CONCLUSION

By using this embedded system along with GSM module, provide automation for electrical distribution system. Along with this, it provides better accuracy in meter reading, better control over distribution & management.

9. REFERENCES

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