

A Low cost E-Billing and Supply control using Power Line Communication

Priyanka R Daware¹, S.S.Patil²

¹ M. E Eln, Tatyasaheb Kore Institute of Engg & Tech, Warananagar. Kolhapur, Maharashtra, India

² Professor in Etx, Tatyasaheb Kore Institute of Engineering & Technology, Warananagar. Kolhapur, Maharashtra, India.

Abstract - In every aspect of life automation is required to reduce the work. So we have designed Automatic Energy Meter Reading system using power line communication. This AMR will overcome the current old method of electricity billing process. AMR is a modern power measuring device which is also used to measure gas, water and electricity. This project eliminates the need for employing Electricity Board meter readers and this set of employees can be used elsewhere. The long queues in the billing counter can be avoided by implementing this model. Also the control of the system is fully automated by this technique. This system automatically collects the consumption and status of data from energy metering device and transfer the data to Electricity Board (EB) office by using Power lines. After verifying customer's serial number, bill will be issued and stored into database. The proposed system automatically disconnect meter either load crosses concern limit or payment periods exists. It also does provide accurate meter reading.

Key Words: AMR, EB, PLC, EEPROM, FSK.

1. INTRODUCTION

Traditional electricity billing process is very length and erroneous. Now a day energy meter reader goes to every premise and takes the reading manually then issues the bill. This requires huge number of labours and long working hours for billing. **Visiting every consumer's home** is something that causes a bit of inconvenience. Sometimes room/ houses is found locked this comes as an embarrassment for the employee on duty also. For manual reading in different houses conditions vary leading to somewhat erratic results, especially when the meter is inside the home or in a hard-to-access place. In the typing stage again there are chances of errors. All these lead to not so accurate billing. Which have some disadvantages like erroneous reading, easy manipulation, manual labour and time consuming. In case of failure in bill settlement by customer, the employee of EB office have to personally

visit the customers house and cut off the supply. Thus much of time and labour power is wasted in that. Consumer is not aware of the costs and service consumption until the statement charges are received. This might create problems for the customer at the time of payment. To avoid this difficult task, Automatic Energy Meter Reading (AMR) system is introduced [1]. Electricity is very essential in day to day life. Hence proper utilization of it must be done. An AMR system designed using GPRS is little costly [2]. The installation charges are high and GPRS is not more reliable way. Also a huge amount of investment should be done. An easy Home Automation System based on very cheap distributed microcontroller architecture, rather than on devices interconnected by an expensive commercial bus. A GSM AMR System was designed to demonstrate an automatic power meter reading using GSM network [3]. This system provides effective and efficient wireless automatic power meter reading, billing and notification through the use of GSM network. But cost of this system will also be more. Hence considering all the points a way is found which reduces the complexity and cost of system. The meter reading data is sent by the home unit to the EB office through power lines. [4] This saves lot of manual data entry needed for entering the data of meter reading into the central system. The power line communication used here is bi-directional. Sometimes the power lines may be noisy due to interference of external disturbances. During such cases the data transmission may be interrupted and error may get introduce in data. To avoid this noise a dedicated micro controller is used to enable data transmission even in the noisiest power line and also at any weather condition. Also Automatic supply tripping and restoring is done under case of failure in bill settlement by customer.[5] The automated EB billing procedure fulfills a set of needs for the user and the EB workers.

1. Automatic generation of Electricity Bill, consumed by the consumer.
2. Allow the user to get updated regarding the details of power used in his house.
3. The automated EB billing system eliminates the need to pay the bills at the EB office.
4. Automatic supply tripping and restoring under the case of failure in bill settlement by the customer.

2. SYSTEM DESCRIPTION

The electricity consumption and automatic billing through power line consists of main two sections as shown in Fig. 01.

- [1] Customer Section.
- [2] Vendor Section.

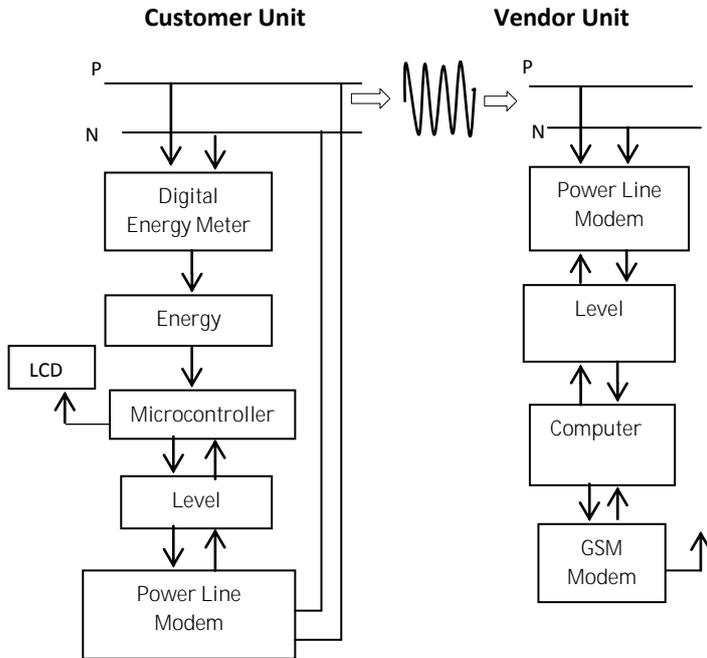


Fig 01:- Block Diagram

The first customer section consists of digital energy meter and control system. The current transformer (CT) and voltage transformer (VT) of the specified rating are used. The output of the processor IC is a digital pulse, which depends upon the load used. These digital pulses are given as the input to the second section through the optocoupler. Hence the energy consumed by the consumer is calculated digitally. The control system in customer section is the heart of the system which consists of the micro controller. For every 100 pulse the micro controller receives it increases the number of units consumed by the consumer by 1, which is stored in the EEPROM. This is then displayed in LCD. The vendor section consists of the MODEM which is a transceiver i.e. it can receive as well as transmit data. The modem receives the input from the microcontroller and transmits it to the EB side. These are received by the modem placed in the EB side and sent to the PC. The tariffs are calculated using VB software by the PC and sent to the micro controller through the same pair of MODEM. Hence the number of units consumed and the amount is displayed in the LCD.

3. HARDWARE ORIENTATION

1. Power supply:

- In the circuit using IC 7805, we can get +5V DC supply.

- In the circuit, +5V DC supply is required for:

- AVR ATMEGA16
- LCD Display
- Power line communication

2. AT89S52:

The AT89S52 is the heart of the system. It has low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. It controls the LCD display, generate interrupts, and the power line communication unit. Microcontroller is connected with optocoupler, interface, EEPROM, power line MODEM and LCD. The optocoupler being used is MCT2E. The optocoupler is optically coupled and electrically isolated. This prevents any transients from affecting the microcontroller. The EEPROM is AT24C04 is used to store the output of the microcontroller permanently. The interface used is MAX232. This is used to control the speed of data transfer between MODEM and the microcontroller.

3. Energy meter ADE7751:

The ADE7751 is a high-accuracy, fault-tolerant electrical energy measurement IC that is intended for use with 2-wire distribution systems. It is electrically fed and composed of electronic controllers. It incorporates an interface which allows data to be transmitted from the remote terminal to the isolator block.

4. LCD Display [16*2]:

LCD means Liquid Crystal Display. It is a display device which displays the information provided to it. Its shape and size varies from application to application.

5. EEPROM AT24C04:

AT24C04 provides 4096 bits of Serial electrically erasable and programmable read-only memory (EEPROM). It is two-wire Serial Interface. Filtered Inputs are present for Noise Suppression. Bidirectional Data Transfer Protocol is used here.

6. Power line Modem [SUNROM]:

Power line modem is useful to send and receive serial data over existing AC mains power lines of the building. It has high immunity to electrical noise persistence in the power line and built in error checking so it never gives out corrupt data. The modem is in form of a ready to use circuit module, which is capable of providing 9600 baud rate low rate bi-directional data communication.

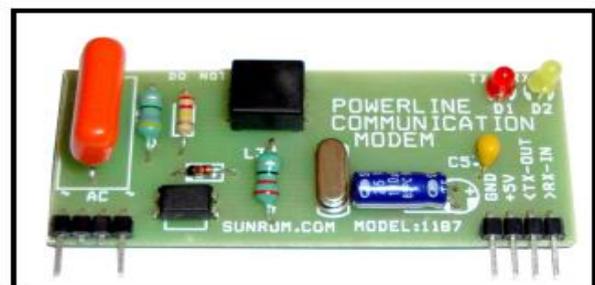


Fig 02:- SUNROM Power Line Modem

Due to its small size it can be integrated into and become part of the user's power line data communication system. Transmit and Receive serial data at 9600 bps. It requires 5V power supply. Low Cost & Simple to use, also built in Error Checking. Direct interface with microcontroller UART txd, rxd pins.

4. TESTING AND SIMULATION RESULTS

To test the AMR system, loads are required to be applied at the customer end. The loads needed to be different to show corresponding difference in the consumed power. The number of pulses produced at the output of ADE7751 is proportional to the power consumed by the load attached at the customer end. For testing purpose of the system, 100 pulses (ON & OFF pulses) to be considered as one unit and made the design. Hence bulbs of different watts (15W,40W and 100W) which act as loads at customer end are used to show the difference in the consumed power. Hence the difference in the number of pulses at the output of ADE7751 are shown in the Fig 03 and Fig 04.

In Fig 03 it is seen that output pulses are less when a 40 W LOAD is connected. Where as in Fig 04 it is seen that output pulses are more when a 100 W LOAD is connected.

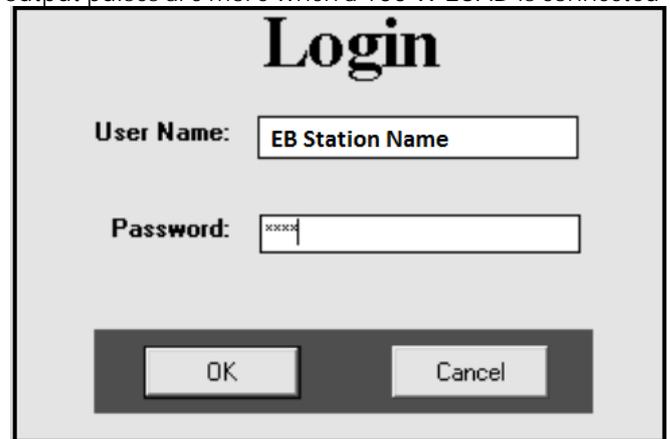


Fig 05:- Login Form

The circuit can receive data, modulate it, and then interface with the power line. The power line MODEM chip having FSK type modulation with power amplifier had used for the design. The receiver was also built using a FSK demodulating chip and power amplifiers to interface with the circuit. The last step was to build filters that would allow us to retrieve the original message from the unwanted noise.

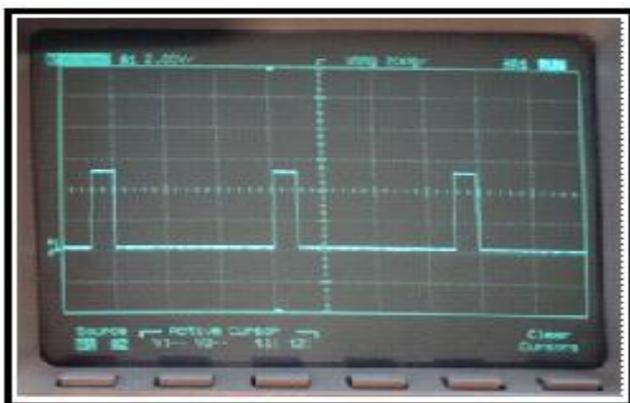


Fig 03:- Output Pulses at pin CF in ADE7751 when a 40 W LOAD is connected.

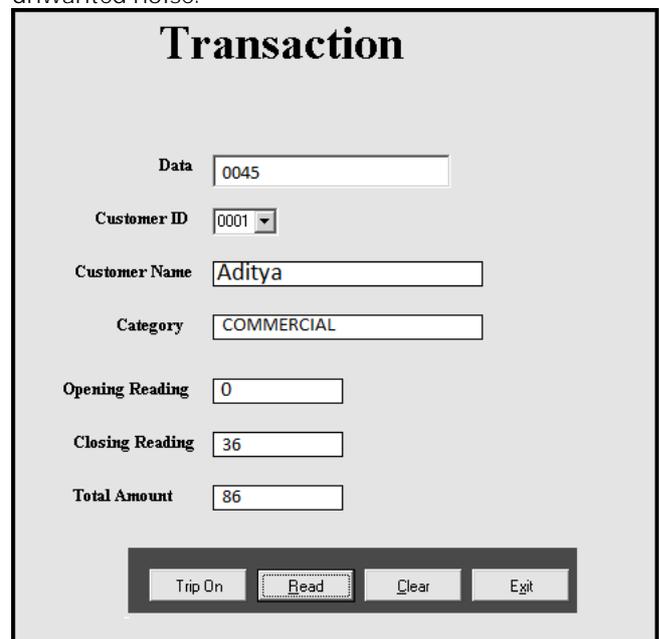


Fig 06:- Billing Form

The several problems had encountered during implementation but finally design had been successfully implemented, simulated, and results are taken. It is also researched several ways to improve the system. The GUI could be programmed in Microsoft Visual C++ or Java to communicate with the low level instructions in the Power PC micro-controller to give a user-friendly interface for both the transmitter and receiver. Here visual basic graphical user interface software 6.0 is used for receiving

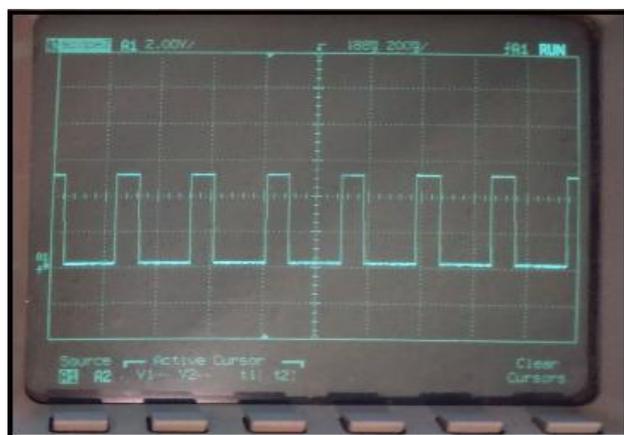


Fig 04:- Output Pulses at pin CF in ADE7751 when a 100 W LOAD is connected.

the digital EB meter reading data transmitted through power line using power line MODEM. After that the calculated amount in rupees proportional to EB meter data and the amount will be transmitted to the consumer's home through power line and displayed in the LCD display placed in digital EB meter. The real end system model output is displayed in the Fig.05 and Fig.06. The Fig.05 shows the application main login window of the PC in the substation, in that the user name and password of the particular substation has to be entered. After that it will automatically open second window shown in the Fig. 06. In that the Customer ID, Name and Category are selected. The corresponding power reading for the particular user will be displayed in the screen and also displays amount proportional to the power consumption. The whole system is checked and results are taken for single user model only.

5. CONCLUSIONS

The aim of this work was to demonstrate that it is not necessary to spend a lot of money to build an AMR system. The designed Automatic Energy Meter reading system based on power line communication is successfully simulated. AMR system automatically transmits readings to the server through power lines. It provides meter accuracy & reduced meter maintenance expenses. Also it provides some features of Remotely Connect / Disconnection of Power supply through power line communication Meter. It avoids the human intervention and provides efficient meter reading avoiding the billing error. The system is entirely designed to work on single phase, but this can be further extended to work on 3 phase also. Transmission distance for the designed power line modem is up to 300m, can be improved by upgrading the power line modem. Although there are new modern technologies of communication of billing data, the use of existing power line seems to be the most economical one and readily adaptable system, when compared to the other technologies. Hence this system proves to be very advantageous as well as efficient, the one which might become the bench mark in the history of automation.

REFERENCES

- [1] Chunjuan WEI ,Junjie YANG “Implementation of Automatic Meter Reading System Using PLC and GPRS” *Journal of Information &Computational Science* 8:16 (2011)4343 –4350.
- [2] Alauddin Al-Omary, Wael EL-Medany and Sufyan Allrhayim, “ Design and implementation of Secure Low Cost AMR System using GPRS Technology” 2011 International Conference Telecommunication Technology and Applications Proc of CSIT vol.5(2011)& (2011) IACSIT Press, Singapore.
- [3] H.G.Rodney Tan, C.H.Lee, “Automatic Power meter reading system using GSM Network” 8th International power engineering conference (IPEC2007).
- [4] Poonam Borle, Ankita Saswadkar, Deepali Hiwarkar, Rupali S. Kad “Automatic meter reading for electricity using power line communication” *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering* Vol. 2, Issue 3, March 2013.PP 982-987.
- [5] M.Balamurugan, N.Magadevi, P.C.Franklin, K.Preethi “An Efficient Energy Monitoring and Load Control Using AMR with Distributed WSN” *International journal of Innovative Research In electrical, Electronics and Control Engineering*. Vol. 2, Issue 3, March 2014, PP 1315-1318.