AUTOMATIC ENERGY METER READING BASED ON ZIGBEE AND ETHERNET TECHNOLOGY

Dr.J.Rajavel[1], Dr.N.Malmurugan[2], S.Yuvaraj[3], M.Parthiban[4]
[1]Associate Professor, [2]Professor, [3,4]Assistant Professor , Department of Electronics and Communication Engineering, Mahendra Engineering College (Autonomous), Namakkal, Tamilnadu, India

Abstract

Every management system is trying to make automatic, moveable, flexible and remote control. This work describes that the novel smart energy meter for an automatic and advanced metering and billing system. An AMR (Automatic Meter Reading) system is a system used to remote reading the consumption of energy. The AMR system based on wireless technology and embedded technology is presented in this paper to solve the problems in existing AMR system. In this paper focused on Embedded domain so that used the low power microcontroller. In this paper develop and measurement of energy, remote monitoring, preparing of bill and billing system is presented. LCD means Liquid Crystal Display. In this LCD used to print the energy meter reading this reading very helpful for user.

Keywords- Zigbee, LCD, AMR, IEEE 802.15.4 and PIC Microcontroller.

I. INTRODUCTION

The Energy Monitoring System is suitable for Industries, manufacturing plants, commercial buildings or any situation where an electrical system is used. The Energy Management System guides to savings in the overall cost [1]. These savings may be come from better consumption of manpower, servicing cost and savings in the energy consumption in the system. In the smart energy meter contains two units [2]. One is web server section and another one is Consumer section or AMER unit. The proposed smart energy meter is able to provide all the metering and billing services. Monitoring purpose only we used LCD and Ethernet [3-4]. Liquid Crystal Display (LCD) provided here displays the no of units of energy consumed and also the billing rates for a month. Microcontroller and Ethernet controller both are using parallel communication between them. Ethernet is used for Web server section. Finally all the energy meter readings displayed by LCD [5].

II. HARDWARE INVOLVED

Web Server Section:
- Microcontroller – PIC18F6722
- Ethernet Controller – RTL8019AS
- ZigBee Module
- Pulse Transformer

- Power Supply
- Level Converter

Consumer Section – AEMR Unit:
- Microcontroller – PIC16F877A
- Energy Meter
- ZigBee Module
- LCD Display
- Relay Unit
- IR Sensor Unit

Software Involved:

- Embedded PIC-C compiler for converting High level language into machine language
- MPLAB IDE for PIC software development and simulation

III. SYSTEM DESIGN

Energy Meter Reading Module

At the energy meter-reading end, a PIC microcontroller is employed to read the energy consumed by the home appliances through the use of a pair of IR transmitter and receiver. A hole available in the disc of the energy meter is used to get the information about the complete revolution of the energy meter disc. As the hole comes in the line of sight between the IR transmitter and receiver, a digital pulse is obtained [6]. This digital pulse is counted by the microcontroller to read the no of units consumed by the electrical appliances. The energy meter readings can be transmitted to the monitoring end via Zigbee [7]. The digital readings are modulated using the Frequency of 2.4GHz signal. PIC16F877A is a general-purpose microcontroller. PIC is a family of RISC microcontrollers [8] made by Microchip. This uses a RISC instruction set, which varies in length from about 35 instructions for the low-end PICs to about 70 instructions for the high-end PICs.
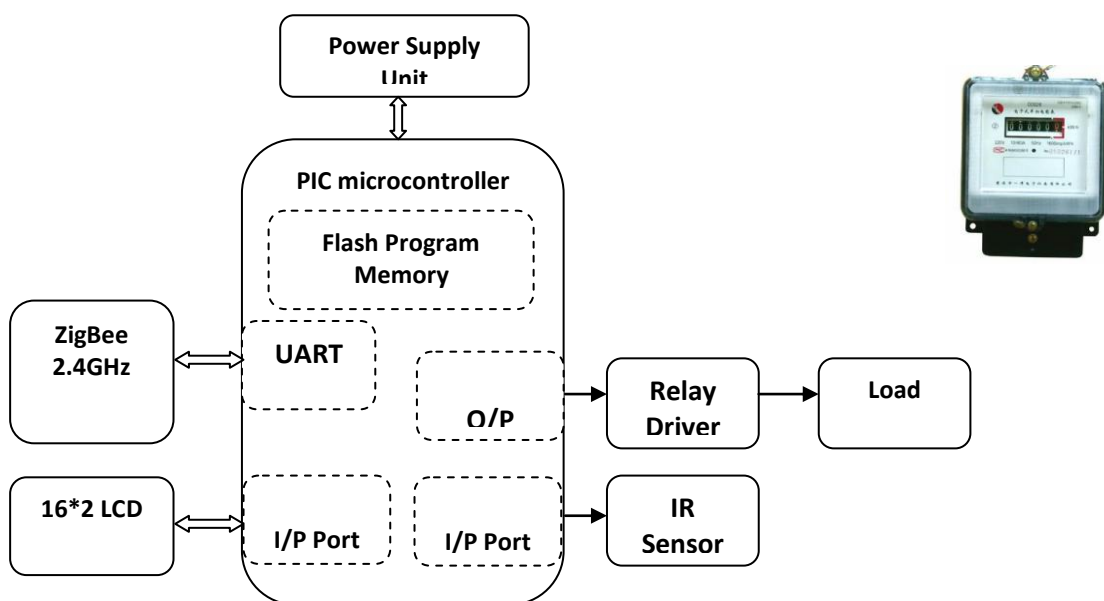
Meter Reading Unit

Figure 1: Energy Meter Reading Unit

Liquid Crystal Display (LCD) provided here displays the no of units of energy consumed and also the billing rates for a month. LCD interfaced with the PIC is used in the 8 bit mode. The 5V relay provided does the function of either supplying or cutting the power to the appliances depending upon the command sent by the PC at the EB end. Figure 1 shows that energy meter reading.

Ethernet Web Server Section

The receiver has a ZigBee modem, which extracts the data and gives to server. Server records the information and shows them to client PC when it needs. Server Consists of PIC18F6722 microcontroller, RTL8019 Ethernet controller, Pulse transformer, RS232 level converter (MAX232) and LEDs for indications. Figure 2 shows that the Ethernet Web server Section.
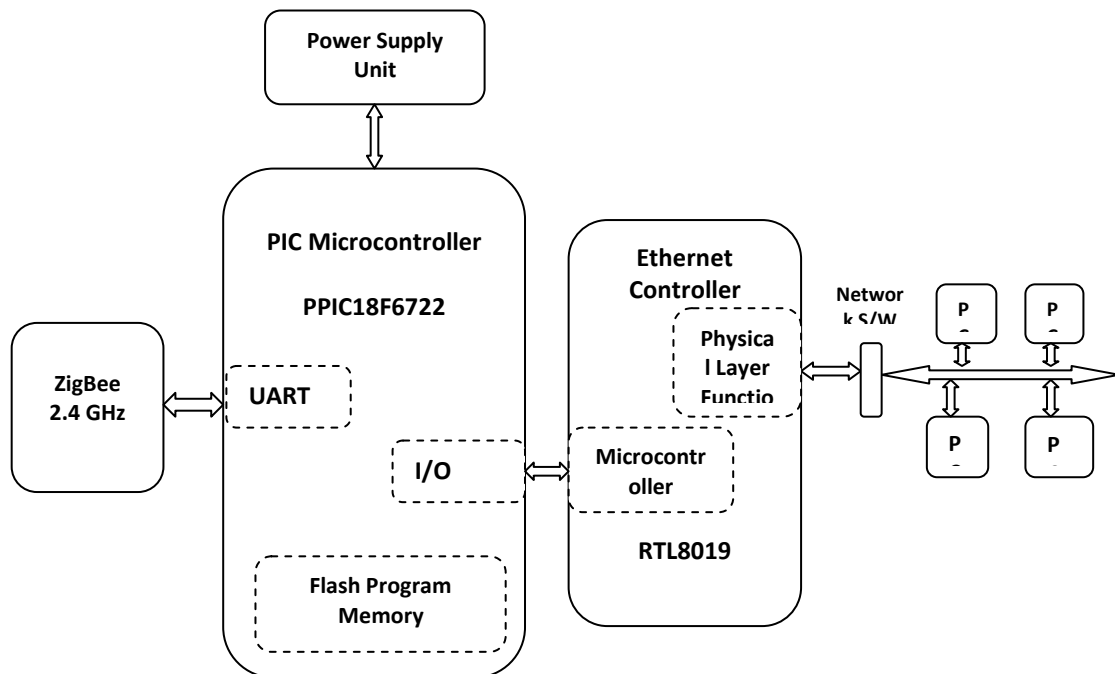
Ethernet Webserver Section

Figure 2: Ethernet Webserver Section

PC network via pulse transformer and it is used for signal level conversion. Similarly microcontroller is using MAX232 level converter for UART communication with ZigBee or PC. MAX232 level converter converts TTL logic signals to CMOS logic signals and vice versa. ZigBee module at server section transferred the information received from meter reading unit to microcontroller unit through UART peripheral. Microcontroller and Ethernet controller both are using parallel communication between them. Ethernet is a family of frame based computer networking technologies for local area network (LANs). This Ethernet frame is developed by the Ethernet controller. Microcontroller receives the information regarding the energy meter reading from remote end. If any client PC requests to view this information then the microcontroller transfers the information through Ethernet controller.
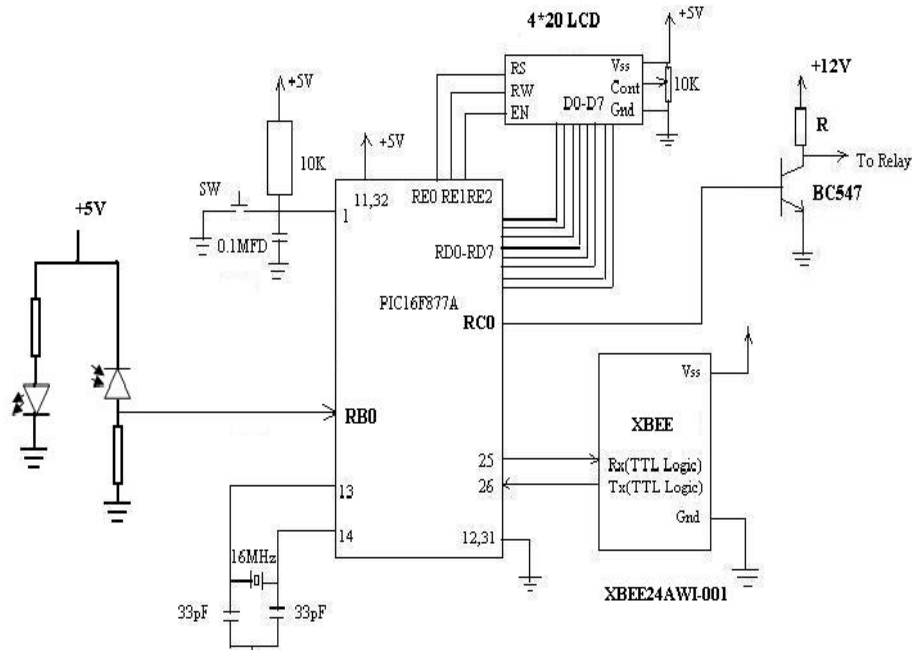
Meter Reading Unit

Figure 3: Meter Reading Unit
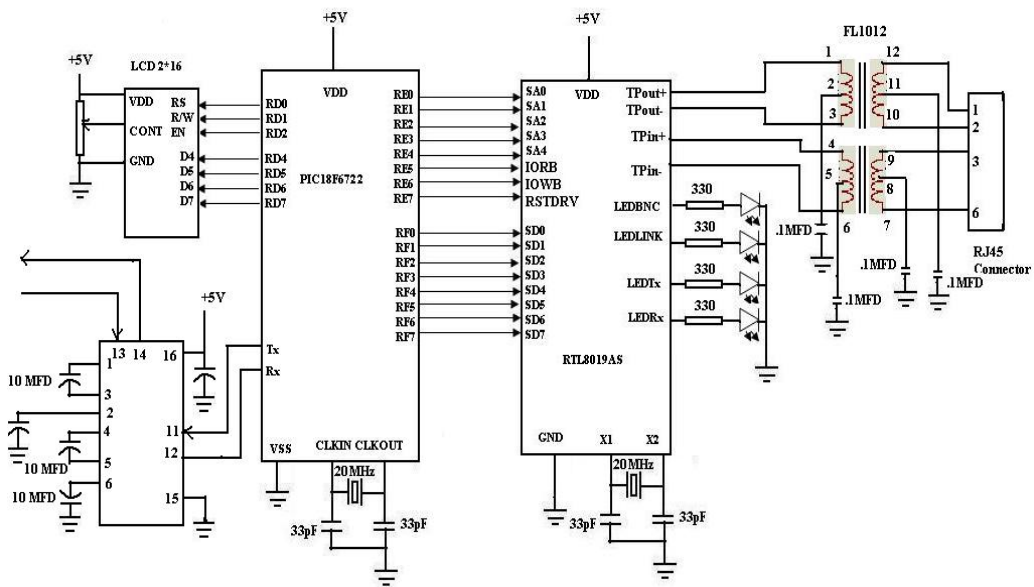
Ethernet Web Server Section

Figure 4: Ethernet Web Server Section

IV.   RESULTS AND DISCUSSION

The energy meter which is developed was tested under a resistive load. A 60W bulb is used as the load and the experimental setup is shown in the figure

Figure 5: Hardware Implementation

Liquid Crystal Display (LCD) provided here displays the no of units of energy consumed and also the billing rates for a month. LCD interfaced with the PIC is used in the 8 bit mode. The 5V relay provided does the function of either supplying or cutting the power to the appliances depending upon the command sent by the PC at the EB end. Figure 5 shows that energy meter reading. Microcontroller and Ethernet controller both are using parallel communication between them. Ethernet is a family of frame based computer networking technologies for local area network (LANs). This Ethernet frame is developed by the Ethernet controller. Microcontroller receives the information regarding the energy meter reading from remote end. If any client PC requests to view this information then the microcontroller transfers the information through Ethernet controller.

V. CONCLUSION

An energy meter is a device used to quantify the measure of power, petroleum gas or water consumed by a residence. Energy meter measure the values to determine consumption during a specific time period and this measured values are recorded by energy meter. In these consumptions are used to generate a bill for the consumption. The existing energy meter systems described that the Energy Meter reading is done through perusing designated authorities, officials, by visiting the residential and commercial places. In proposed system described that the system allows the consumers to monitor and track their energy usages. Now a days if consumers want to know their energy usages to limit their use they should wait until the electricity bill comes. We fixed some threshold value for electricity limit so the consumer usage is exceeds certain limit means some indication alert message receives from the device. So in this energy meter used for reduce the cost, flexible, more efficient and reduce power loss.

Reference

[1] Gutierrez, J. A., Callaway, E. H., & Barrett, R. L. (2004). *Low-rate wireless personal area networks: enabling wireless sensors with IEEE 802.15. 4*. IEEE Standards Association.

[2] Shuey, K. C., Mason Jr, R. T., Bragg, A. W., & Lawrence, D. C. (1999). *U.S. Patent No. 5,923,269*. Washington, DC: U.S. Patent and Trademark Office.

[3] Kulkarni, B. (2012). GSM based automatic meter reading system using ARM controller. *International Journal of Emerging Technology and Advanced Engineering Website*, *2*(5), 446-448.

[4] Shincovich, J. T., Michalek, J. K., Baldwin, N. C., Shahrodi, E., Robinson, D., Pruehs, A. V., & Learmont, R. O. (1996). *U.S. Patent No. 5,590,179*. Washington, DC: U.S. Patent and Trademark Office.

[5] Bharath, P., Ananth, N., Vijetha, S., & Prakash, K. J. (2008, November). Wireless automated digital energy meter. In *Sustainable Energy Technologies, 2008. ICSET 2008. IEEE International Conference on* (pp. 564-567). IEEE.

[6] Hemminger, R. C., & Munday, M. L. (1996). *U.S. Patent No. 5,548,527*. Washington, DC: U.S. Patent and Trademark Office.

[7] Burrowes, D. E., & Holmes, A. W. (1987). *U.S. Patent No. 4,646,084*. Washington, DC: U.S. Patent and Trademark Office.

[8] Haque, M. M., Hossain, M. K., Ali, M. M., & Sheikh, M. R. I. (2011). Microcontroller based single phase digital prepaid energy meter for improved metering and billing system. *International Journal of Power Electronics and Drive systems*, *1*(2), 139.