

Implementation of Power Line Communication for energy measurement

Mohamed Azeem Hafeez *, Vinay Bihman

*Assistant professor ,Department of ECE, SIRMVIT Bengaluru
Department of ECE, SIRMVIT Bengaluru

Abstract

Power line communication (PLC), also known as power line carrier, is a system for transmitting information on an electrical conductor used for carrying electric power from high voltage transmission lines, distribution lines, and to lower voltage lines used inside buildings. All PLC systems operate by applying a modulated carrier signal on the existing electrical wiring system. There are different types of power line communications, depending on frequency bands used. The aim of this work is to receive the monthly energy consumption from a remote location directly to a centralized office. In this way we can reduce human efforts needed to record the meter readings which are till now recorded by visiting every home individually. This can be achieved by the use of Microcontroller unit that continuously monitors and records the Energy Meter readings in its permanent (non-volatile) memory location. This system also makes use of a PLC modem for remote monitoring and control of Energy Meter.

Keywords: PLC, Microcontroller, Automatic reading system

Introduction

Nowdays as urbanization is going at rampant pace the use of electricity is increased by many folds thereby the monitoring work associated with it is also increased. The automatic monitoring system automatically gathers data from energy, gas, and water metering devices and transfers it to the master station in order to analyze it for billing purposes[1]. Data are read remotely, without the need to physically access the meter. The advantages include reducing peak demand for energy, supporting the time-of-use concept for billing, enabling customers to make informed decisions, and reducing the cost of meter reading. Various communication technologies in AMR have been proposed recently, including mobile technologies, based on radio frequency, transmission over the power line, or telephonic platforms (wired or wireless).

The inherent communication infrastructure presented by Power Line Carrier (PLC), which significantly reduces the cost of building a new communication network, makes PLC a favorable solution for AMR systems. However, since the low-voltage power supply networks are not designed for communications and bandwidth is limited, PLC alone can hardly scale to support a large network in addition to other shortcomings. If an automatic meter

reading system via PLC is set in a power delivery system, a detection system for illegal electricity usage may be easily added in the existing PLC network. The AMR Systems can also provide quick and reliable meter reading collection with less error, few technical people's involvement and completely eliminates the need for physically reading the meters.

Block diagram of the model

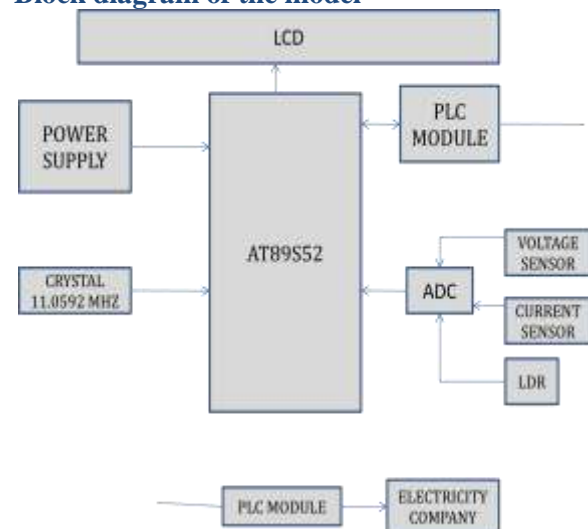


Figure 1: Block diagram of the model

Microcontroller AT89S52 is programmed to send message to electricity board via PLC modem regarding his power consumption. Energy meter display the voltage reading, current reading and total power consumption and these all readings are send to electricity board by using PLC (power line communication) modem which is mounted on both side one at the consumer house and other at the electricity board

The AT89S52 is a 40 pin IC with low power, high performance CMOS 8 bit microcontroller with 8K bytes of in system programmable flash memory. The device is manufactured using Atmel's high-density non-volatile memory technology and is compatible with the industry standard 80C51 instruction set and pin out.

The communication device used for the communication over the power lines is a MODEM, commonly known as Power Line MODEM (PLM). It works as both transmitter and receiver, i.e., it transmits and receives data over the power lines. A power line modem not only modulates the data to transmit it over the power lines and but also demodulates the data it receives from the power lines. By using modulation techniques, binary data stream is keyed on to a carrier signal and then coupled on to the power lines by PLM. At the receiver end another PLM detects the signal and extracts the corresponding bit stream.

Liquid Crystal Display is a device used for display functions. Here we are using 16X2 LCD which display 16 characters in 2 rows. It has the ability to display numbers, characters and graphics. It has an inbuilt refreshing circuit, thereby relieving the CPU from the task of refreshing. 14 pin access is provided having 8 data lines, 3 control lines and 3 power lines.

Here we are using PCF8591 a single-chip, single-supply low power 8-bit CMOS data acquisition device with four analog inputs, one analog output and a serial I2C-bus interface. Three address pins A0, A1 and A2 are used for programming the hardware address, allowing the use of up to eight devices connected to the I2C-bus without additional hardware.

A relay is an electrically (electro-mechanically) operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off, so relay have two switch

positions and they are double throw (changeover) switches. There is no electrical connection inside the relay between the two circuits , the link is magnetic and mechanical

Here we are dealing with 230v main supply but for our electronic devices 5V(12v) is enough which is the threshold so we are using L7805 voltage regulator to which we give 230V as input & will take the 5V(12V) output from it, which is given as an input to all our electronics devices.

PLC Modem



Figure 2 : KQ330 PLC modem

Power-line communication (PLC) carries data on a conductor that is also used simultaneously for AC electric power transmission or electric power distribution to consumers. It is also known as power-line carrier, power-line digital subscriber line (PDSL), mains communication, power-line telecommunications, or power-line networking (PLN). 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. Due to its small size it can be integrated into and become part of the user's power line data communication system. PLC has long been used, with medium-frequency modulation (kHz range), for remote measurement and reporting purposes . The applications are for example for utilities to control and perform telemetry of electrical equipment such as meters , demand side management and power quality monitoring systems. PLC can also be used for home automation, e.g. for remote lighting and appliance control and/or monitoring.

PLC Operating principle

PLC Broadband technology is capable of transmitting data via the electrical supply network, and therefore can extend an existing local area network or share an existing Internet connection through electric plugs with the installation of specific units.

The principle of PLC consists of superimposing a high frequency signal (100 KHz) at low energy levels over the 50 Hz electrical signal. This second signal is transmitted via the power infrastructure and can be received and decoded remotely. Thus the PLC signal is received by any PLC receiver located on the same electrical network. An integrated coupler at the PLC receiver entry points eliminates low frequency components before the signal is treated.

Implementation and results



Figure 3 : Circuit installed at customer site



Figure 4 : Meter readings on LCD

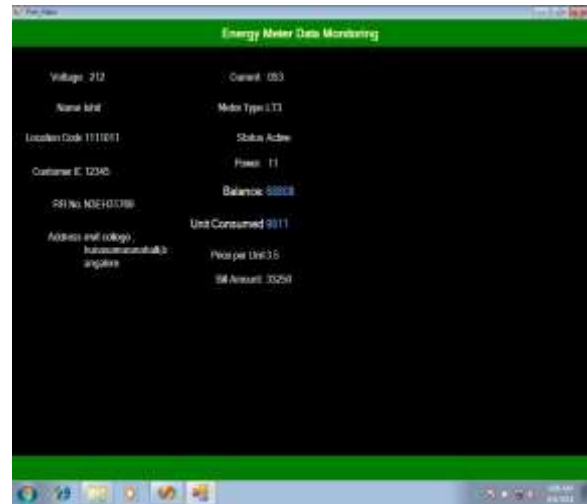


Figure 5 : User interface

The present proposal is a model to modernize the electricity board at optimum expenditure. Using this system, manpower, time etc can be saved. It leads to reliable consumption record and ultimate profit to both electricity board and citizens. If this system is implemented, efficient meter reading can be done. This project is successful with this design. Various features can be added with little change in program. Since cost is very less, it will be widely acceptable. No bill production (eco friendly). No bill distribution. No need to chase payment. Save time and cost. Reduce human error in reading.

References

1. Devidas, A.R., Ramesh, M.V, "Wireless Smart Grid Design for Monitoring and Optimizing Electric Transmission in India" in Fourth International Conference on Sensor Technologies and Applications (SENSORCOMM), pp.637-640, 2010.
2. Md.Shams Arman Rupok, Maruf Ahmed, Mr. A.R.N.M Reaz Ul Haque, "Design and Implementation of A Novel Remote Metering system using USB GPRS/EDGE Modem," IEEE, pp.237-240, 2011.
3. Megalingam, R.K.; Krishnan, A.; Ranjan, "Advanced digital smart meter for dynamic billing, tamper detection and consumer awareness," Electronics Computer Technology (ICECT), 2011 3rd International Conference on, vol.4, no., pp.389-393, 8-10

4. Prof. Dr. K. P. Satheyamoorthy "Smart energy meter load control" international journal of advanced research in electrical,electronics and instrumentation engineering, Vol. 2, Issue 8, August 2013
5. Chunjuan WEI, Junjie YANG "Implementation of Automatic Meter Reading System Using PLC and GPRS" Journal of Information & Computational Science 8: 16 (2011) 4343-4350
6. S.Arun, Dr.Sidappa "Design and Implementation of Automatic Meter Reading System Using GSM, ZIGBEE through GPRS". International Journal of Advanced Research in Computer Science and Software Engineering Research Paper. Volume 2, Issue 5, May 2013.