Power Line Carrier Communication for Home and Small Industries based on the Low Cost

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Abstract

The communication infrastructure is an important part of the future power system. Electrical power network is a very large transportation that covers almost all part of the places in the world. With its widely spread network and connectivity, Electrical power network can be utilized as a communication medium. Communicating high frequency control signals over a power line is well known by everyone and getting popular day by day. The aim of this project to propose low cost tool equipment in a home or small business based on the low cost hardware for controlling and monitoring the energy consumption using power line communication technology. The technology improvements achieved from the power line communication to the recently evolved cognitive radio networks. The proposed tool allows them to identify the highest demands of energy consumption in a home or small business with consumption reduction goal. Power line communication is a communication technology that enables sending and receiving data over already existing power cables. During the last year's power line technology have been widely developed due to new modulation technologies. Power line communication is a preferred choice over wireless communication or other home networking technologies due to the ease of installation, inexpensive, high speed communication medium, availability of AC cables, low cost, high reliability and security. PLC system model was analyzed by PROTEUS software and coding is done in KEIL UVISION.

Keywords – *Cables, Energy Consumption, Power line communication, Wireless communication***.**

I. INTRODUCTION

For communication purpose, we have to provide extra cable or some other techniques along with the electrical network. In order to reduce such work, we have to send the communication signals along with the power. To achieve this, power line carrier communication (PLC) has to be used for the electrical line. This technology is emerging from the 19th century and the idea proposed as the telegraph. Nowadays, this technology is used in the substation level, automated meter reading, etc. Research is on going to implement this PLC in various applications for economical purpose. We are proposed to implement the PLC in home and small business level. Implementing the PLC in home level is ongoing research nowadays. We are proposed a method to implement the PLC technology in home or small level business. Normally frequencies between 1-30 MHz are used in the communication signals in the electrical line. But some problems occur in this technology such as attenuation, Dispersion and cross talk [1]. Impedance and attenuation levels are changeable due to the frequent switching of electrical equipments. Interference in the equipments results in bandwidth problem, power restrictions and noise. After 1980's PLC evolved with the classy error control coding techniques [2]. There is no modification occurs in the voltage level, if the cable length is long. PLC can be used in both AC and DC cables [3].

Power line communication is evolved recently as cognitive radio networks and it is used to avoid the spectrum deficiency in communication signals. PLC technology is well suitable for substation and distribution electrical networks than the other technologies like ZIGBEE, WIFI, and WIMAX etc [4]. Transmitter and receiver may be single side band or double side band depending on the purpose but single side band is more economical than the double side band whereas double side band is more secure than the single side band. In recent scenario, PLC communication provides successful transmission in both narrowband and broadband and also PLC can be used for multiple applications [5]. In smart grid PLC technology is used instead of fiber optic and wireless. Now research is going on to access the home appliances by PLC communication. We are simulated the model to control the home appliances in this paper.

II. POWER LINE COMMUNICATION

Power line carrier communication is a technology that is used to send and receive the

communication signal in the already existing electrical wiring. It is also called as power line communication, main communication, power line digital subscriber line and power line networking. PLC technology has been established from many years but it is still not used in the homes and small industries. The communication signals are transmitted by superimposing the 50 Hz electrical signal.

Various modulation techniques used to communication purpose are frequency shift keying, amplitude shift keying, and phase shift keying, orthogonal frequency division multiplexing. Coded orthogonal frequency division frequency multiplexing, spread spectrum and Gaussian minimum shift keying.

III. SYSTEM DESCRIPTION

The proposed system has communicative electrical outlet, which can be controlled by a microcontroller and most important thing use the already existing wiring. This system is proposed to use in the home area and the small industries. It makes the power line not only suitable for electrical power but also be suitable as a communication medium.

To control the home appliances through power line carrier communication this saves energy consumption in home. Power line communication is used for industrial communication. The computer operates as host station for transmitting and receiving the signals and PLCC modem is act as transceiver serially using recommended standard (RS232) and transceiver (MAX232). PLC modem uses the carrier wave of between 20-200 KHz in the household wiring transmitter. The modem can be used in the regular power outlet. The carrier is modulated by amplitude shift keying. In this we proposed the system for ON – OFF the home appliances. In amplitude shift keying, whenever the binary value '1' occur, the equipment is to be in ON condition otherwise the equipment is in OFF condition i.e. 0.

IV. SYSTEM DIAGRAM

A. *Transmitter*

Figure 1 proposed the block diagram of the transmitter system. The computer operates as a host for transmitter and receiver. In this microcontroller is the controller part to send and receive the signals for controlling the home appliances.

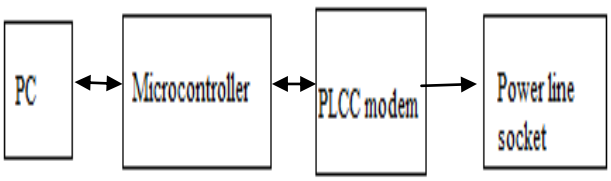


Figure 1: Block diagram of transmitter system.

From the PC, information is send by the characters or numbers for which appliances have to be controlled i.e. ON or OFF. The command is send to the microcontroller where the microcontroller converts the command into the serial digital signals. The serial digital data is converted into amplitude shift keying (ASK) signals by the PLCC modem and merge into the power line by the power line socket. The data is merged at the zero crossing of the AC signal.

B. *Receiver*

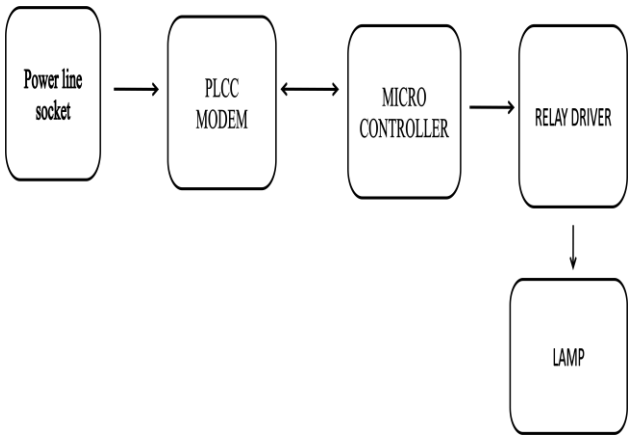


Figure 2: Block diagram of receiver system

The transmitted communication signal received by the PLCC modem. The signal is in the form of ASK signal. It is converted into serial digital signal by the PLCC modem. The serial digital data signals are sending to the microcontroller. The Microcontroller gives the command to the relay driver for which equipment have to be control. And then it sent to the appropriate equipment by the relay.

C. *Microcontroller*

The microcontroller used here is the AT89S52. It has normal cost and it is available in all markets. It is 8 bit microcontroller and 40 pin structure. It has 8 Kb ROM and the 256 bytes RAM. And also it has 4 parallel ports and 1 serial port. In this controller, transmit pin is connected to the receiver pin of the PLCC modem and vice versa. For availability AT89C51 is used in the simulation. The microcontroller output is connected to the PLCC modem. The microcontroller demodulates the carrier wave and send signal to the microcontroller.

D. *PLCC Modem*

The power line communication has TDA5051A modulation/demodulation IC to convert the serial digital data signals into ASK modulated signals. The signal is added on the zero crossing of the

AC signal. The IC will modulate and demodulate the data on the AC signal.

It's the home automation modem used for home lighting and appliance control. It is cost effective and it transmits and receives 1200 baud (maximum) from a 5V supply. It enables easy connection to the microcontrollers.

Full digital carrier generation and shaping modulation/demodulation frequency set by clock adjustments, from a microcontroller. High clock rate of 6-bit D/A (digital to analog) converter is used for rejection of aliasing components.

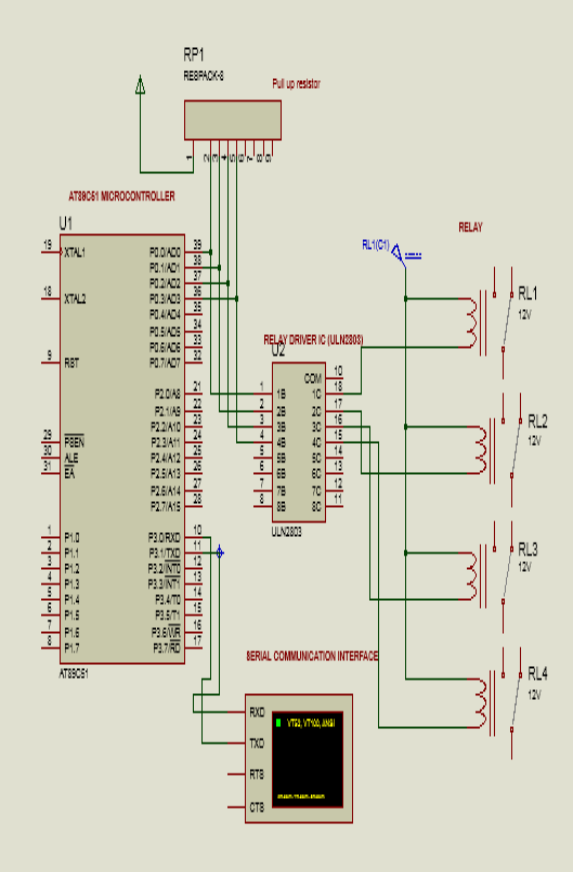
V.CODING

The embedded coding in the microcontroller helps in the controller part. Header files vary according to the microcontroller used. ATMEL controller is used in this part so for this controller "reg 51.h" b is used.

```
#include <reg51.h>
#include "serial.h"

sbit load1=P0^0;
sbit load2=P0^1;
sbit load3=P0^2;
sbit load4=P0^3;
      unsigned char temp=0;
void main()
{


   serial_init();
    load1=0;
      load2=0;
      load3=0;
      load4=0;

   serial_string("Welcome to PLC based home device control");
   serial_char(0x0d);
    while(1)
    {

   temp=serial_rx();

   if(temp=='1')
   {
       load1=1;
       serial_string("load 1 is on");
       serial_char(0x0D);

   }
   else if(temp=='2')
   {
       load1=0;
       serial_string("load 1 is off");
       serial_char(0x0D);


   }
       if(temp=='3')
   {

       load2=1;
       serial_string("load 2 is on");
       serial_char(0x0D);

   }
```

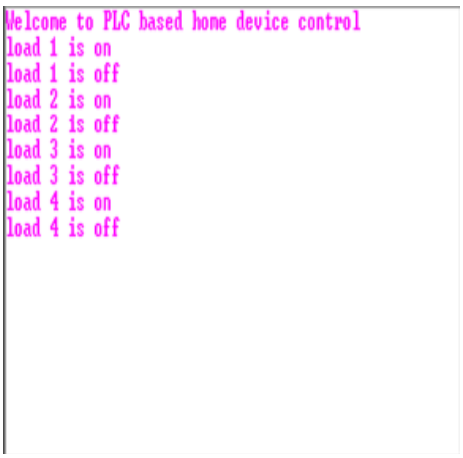
Initially all the loads are in OFF condition so loads are initialized by 0. While (1) is the important part. It defines the body of the loop. The advantage of this is it cannot go out of the loop. If there is any shut down happen in the system, then only it come out of the loop.

VI.SIMULATION

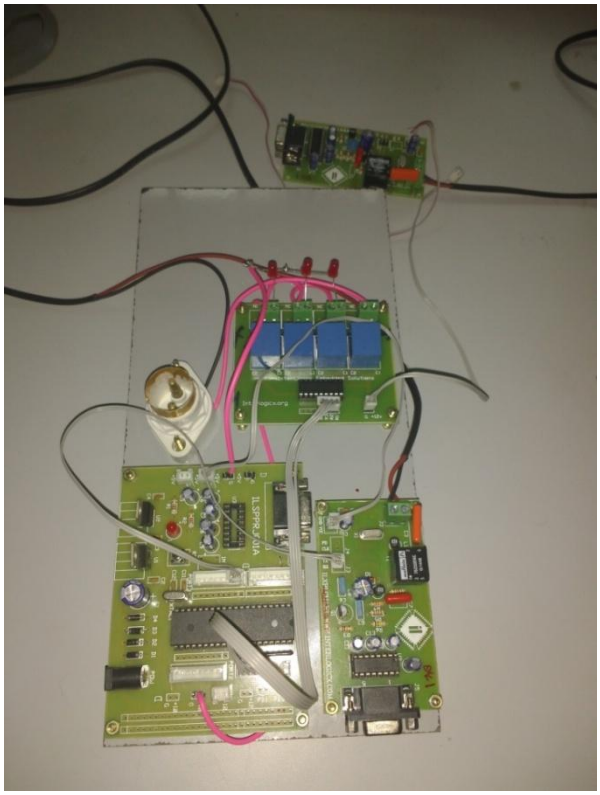


In this simulation, relays are considered as load. Transmit and receive the signals by the virtual terminal. Relay driver IC can be directly connected to the port 2 but on port 1 driver IC have to connect with pull up resistor for the external resistance.

VII.SIMULATION RESULT



VIII.HARDWARE



VIII. CONCLUSION

In this paper, we implement the power line communication in home and small industries for economical purpose. In existing, separate cables are required for transmission of data. Wireless communication is costly and short distance and also it is not strong in the winter season. There is a chance for signal interface between modules.

Power line communication is an advanced way of communication. It is still an ongoing research area for many scholars and it has wide opportunity in research area. When compared to wireless system, it transmits longer distance and also it can receive any data at any power terminal.

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