Power Line Communication Using Embedded System

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Abstract- *The PLC refers to transferring the information using power line as communication system. Plc turned to approach to implements low cost & reliable network in domestic & industry purpose. The PLC network transfers the data through an A.C main line. The A.C line act as communication channel or medium.*

Keywords- Dual mode Power supply, Relay card, Transmission & Receiving section using PIC16f877a, FSK power line modem, power consumption (energy) meter.

Review of the relevant literature:

This technique basically refers to providing intelligence to the device. In the current scenario, automation is widely used to control various devices in industries and home. Current systems used wired technologies like LAN thro' twisted pair cable or wireless technologies like Bluetooth, zig-Bee, RFID & Infrared.

In the wireless communication case, all the technologies are susceptible to interference due to the presence of other devices nearby.

I. INTRODUCTION

A power line carrier (PLC) communication system operating on a conventional three wire (Hot (H), Neutral (N) and Ground (G) wires) power line uses more than one of the several RF transmission lines that are defined by the three wire power line to improve communication between units of the PLC system. According to a first embodiment a PLC system transmitter sends out of phase RF signals across the H and G wires and across the N and G power wires to the PLC system receiver, which receives and combines both of the out of phase transmissions, and so even if one of these paths is severely attenuated, the other path can deliver a sufficiently strong RF signal to the receiver for effective communications. According to another embodiment three different pairs of the H, N and G wires of the power line are selected in Sequence for transmission of the PLC system RF and the pair that results in the best communication between a system transmitter and Receiver is used for continuing communication. Also included is a PLC telephone extension system for which there is full duplex communication between each of the extension telephones of the system at different locations in the premises and the premises telephone line.

Power Line Carrier Communication (PLCC) is mainly used for telecommunication, tele-protection and tele-monitoring between Electrical substations through power lines at high voltages, such as 110kV, 220kV, 400kV.In a PLCC system the communication is established through the power line. The audio frequency is carried by a carrier frequency and the range of carrier frequency is from 50 kHz to 500 kHz. The modulation generally used in this system is amplitude modulation. The Audio frequency is in the range of 300 to 4000Hz. This Audio frequency is allocated in such a way that, it will include the audio signal, protection and the pilot frequency.

Connecting the PBX to the PLCC can make a network among this. Basically the Electricity board in India has a network among themselves using the PLCC and PBX.

The human audio signal is converted/ compressed into the range of 300 to 4000Hz AF and this audio frequency is mixed with the carrier frequency. This carrier Frequency is again filtered and amplified and transmitted. Around the clock a Pilot Frequency (within AF range) will be transmitted and received by the PLCC; this is done.

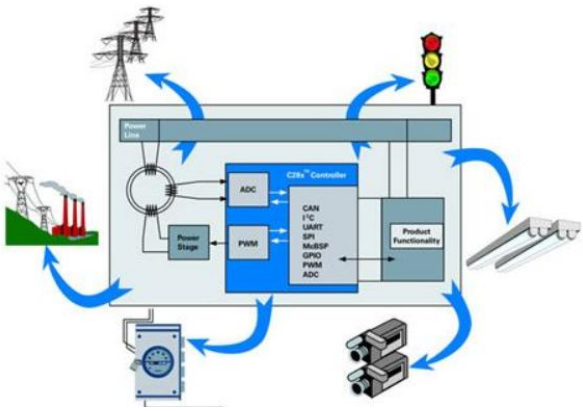

Fig A: General Power Line Communication Network.

Power-Line Communications

The power-line network is a large infrastructure covering most parts of the inhabited areas. In Sweden the

power is typically generated by, e.g., a power plant and then transported on high-voltage (e.g., 400kV) cables to a medium-voltage substation,

Which transforms the voltage into, e.g., 10kV and distributes the power to a large number of low voltage grids Each low voltage grid has one substation, which transforms the voltage into 400 V and delivers it to the connected households, via low voltage lines. Typically several low voltage lines are connected to the substation. Each low voltage line consists of four wires, three phases and neutral. Coupled to the lines are Cable boxes, which are used to attach households to the grid.

This thesis is about communication on the low voltage grid, communication between the substation and the households. Related issues are how to communicate inside a household and how to communicate on the medium voltage grid.

Many systems today use a topology with a central node (the substation) communicating with clients (the households). All communication is between the substation and the households and there is no communication between households. Because there is a physical connection between every two households it would also be possible to support this kind of communication. As an alternative, this communication could be routed through the substation.

The configuration with a central node and a set of clients May be compared with systems for mobile telephony, e.g., GSM . In GSM a base station (central node) is connected to all mobile phones (clients) within a restricted area. Thus the network topology is not unusual, but used in practice .Power line communication is based on electrical signals, carrying information, propagating over the power line. A communication channel is defined as the physical path between two communication nodes, on which the communication signal is propagated. In a low voltage grid there is a lot of different channels, in fact the links between the substation and each household are all different channels with different characteristics and qualities. If the communication system supports communication between households all these links are also different channels.

II. SYSTEM MODEL

Figure shows a simplified model of a digital communication system. The objective of the communication system is to communicate digital information (a sequence of binary information digits) over a noisy channel at as high bit rates as possible. The data to be transmitted could origin from any source of information. In case the information is an analog signal, such as speech, then an A/D converter must precede the transmitter.

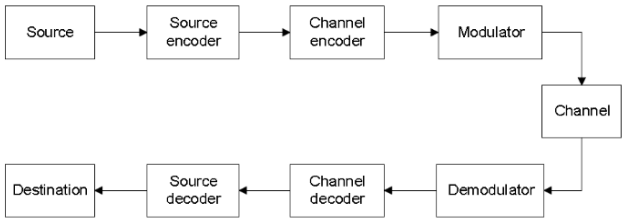

Fig C: A model of digital communication system.

The source encoder outputs data that are to be transmitted over the channel at a certain information bit rate, Rb. As a measure of performance we define the bit error probability,Pb, as the probability that a bit is incorrectly received at the destination. As we will see later, the channel may interfere with the communication, thus increasing the bit error probability.

Figure below shows a digital communication system using the power-line as a communication channel. The transmitter is shown to the left and the receiver to the right. Important Parameters of the communication system are the output impedance, Zt, of the transmitter and the input impedance, Zl, of the receiver.

A coupling circuit is used to connect the communication system to the power line. The purpose of the coupling circuits is twofold. Firstly, it prevents the damaging 50 Hz signal, used for power distribution, to enter the equipment. Secondly, it certifies that themajor part of the received/transmitted signal is within the frequency band used for communication.This increases the dynamic range of the receiver and makes sure the transmitter introduces no interfering signals on the channel.

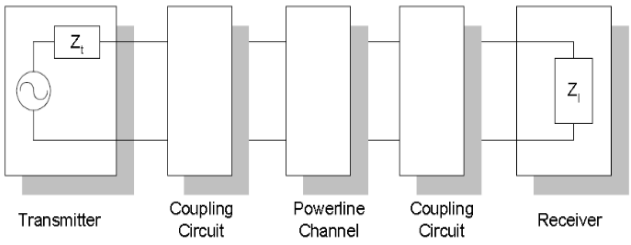

Fig B: A Digital Communication system for Power line Channel.

III. METHODOLOGY & WORKING

Power Line Modeling:

The modeling of the power line channel is of fundamental Importance, since the quality of transmission is highly influenced by characteristics of the channel. Several techniques to model transfer characteristics of indoor power line channel have been presented in literature.

MULTIPLE ACCESS SCHEMES WITH PLCC

Today with the advent of technology , use of high speed applications like internet, voice and data has been increased that's why many researches has been done in last few years to expose the properties of power line channel at the frequencies up to 20 or 30 MHz for fixing power line channel as a communication system. There have some researches been done for evaluating the performance of OFDM and CDMA systems in power lines. In [4] the comparison of OFDM and CDMA for broadband power line communication has been made by simulation. Performance analysis model of OFDM under the effect of impulsive noise and multipath effects has been developed by close formulas and verified by simulation. The first direct sequence multiple access (DSCDMA) [3] is being used with low frequencies of power line channel. In high frequency bands (1-40MHz) minimum output energy receivers (such as RAKE receiver) and multiuser detection techniques have been used. The receiver in the CDMA system is based on coherent receiver structure. Electricity producer and distributor cannot ignore standardization of power line channel, that about to be used worldwide in the field of telecommunication. Depending on the geographical areas, standardization work may be directly associated with an international level or first be developed at a regional level. The deployment of electrical networks, their interconnections and ever increasing number of electrical appliances have resulted in the emergence of the first network standardization bodies such as IEC (International Electro technical commission).

PIC

The microcontroller that has been used for this project is from PIC series. PIC microcontroller is the first RISC based microcontroller fabricated in CMOS (complementary metal oxide semiconductor) that uses separate bus for instruction and data allowing simultaneous access of program and data memory.The main advantage of CMOS and RISC combination is low power consumption resulting in a very small chip size with a small pin count. The main advantage of CMOS is that it has immunity to noise than other fabrication techniques.

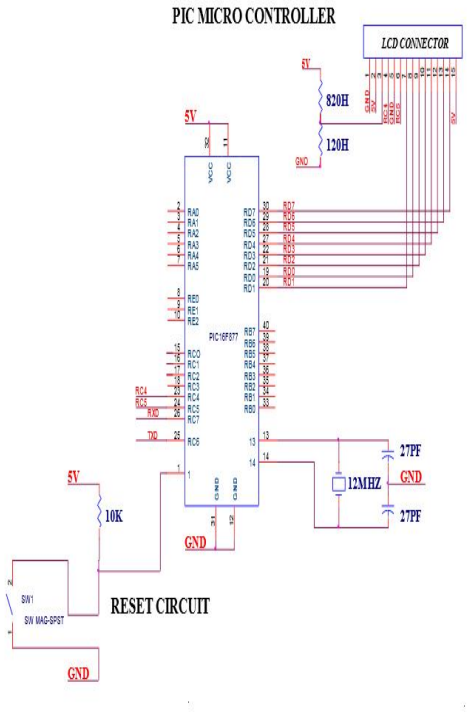

Fig1: PIC 16F877A CPU DIAGRAM

PIC CODING FOR RELAY

```
#include<pic.h>
#include"pic_lcd8.h"
//SGI 2018
#include"pic_serial.h"
#define RELAY RB1

bit ms,t;
unsigned int c[4],d[10],aa;
unsigned int a,b,x,i,j,k;
unsigned int u,sec,y,amt;
unsigned char xx1[10],xx2[10],j1,j2;
void gsm_init();
void keypad();
void msg_receive();
void send();
void del()
{
    Delay(65000);Delay(65000);
    Delay(65000);Delay(65000);
}
void main()
{
    TRISC=0xc0;
    TRISD=0x00;
    TRISB=0x01;
      TRISA=0xFF;
        RELAY=0;
    Lcd8_Init();
    Lcd8_Display(0x80," PIC BASED PLCC ",16);
```

```
Delay(65000);Delay(65000);
Serial_Init(9600);
Delay(65000);Delay(65000);
INTE=1;
INTEDG=0;
Lcd8_Display(0x80,"                ",16);
Lcd8_Display(0xc0,"                ",16);
Receive(1);
while(1)
{


     Lcd8_Display(0x80,"PUL:",4);
     Lcd8_Decimal3(0x84,b);
     if(b>=10){u++;b=0;t=1;}
     if(u&&t){t=0;
     //Lcd8_Write(0xca,'s');
     Serial_Out('*');}
     Lcd8_Display(0x88,"UNIT:",5);
     Lcd8_Decimal3(0x8d,u);
     if(i>0)
     {
          Receive(0);
          Lcd8_Display(0xc0,"     RELAY   ON
          RELAY=0;     i=0;
          Receive(1);
     }
     if(j2>0)


     {
          Receive(0);
          Lcd8_Display(0xc0,"    RELAY  OFF  ",16);
          RELAY=1;j2=0;
          Receive(1);
     }
     if(j1>3)
     {
     Receive(0);
     amt=(xx1[1]-0x30)*100+(xx1[2]-0x30)*10+(xx1[3]-0x30);
     Lcd8_Display(0xc0,"UR AMT IS:",10);
     Lcd8_Decimal3(0xca,amt);
     j1=0;
     Receive(1);
     }

}
}
```

PIC CODING FOR KEYBOARD

```
#include<pic.h>
#include"pic_lcd.h"
#include"pic_serial.h"
#include"rtc.h"
//unsigned char i,x[]={0xc0,0x8d,0x87,0,0x80,0xcd,0xc7},b;
unsigned char i,x[]={0xc6,0xc3,0xc0,0,0x80,0x83,0x86},b;
unsigned char a[10],c[10],d[10],j,u,k,l,amt,sec,min,msec,chk,ms,se;
#define set RB0// RELAY ON
#define mov RB1// RELAY OFF
#define inc RB2// NC
main()
{
    ADCON1=0x0E;   //
      TRISA=0X01;      //
    TRISE=0X00;
    TRISD=0x00;
    TRISC=0xc0;
    TRISB=0xFF;
    PORTB=0Xff;
    set=mov=inc=1;
    Lcd_Init();set_delay(1,10);Serial_Init(9600);set_delay(1,10);
    Lcd_Display(0x80," PIC BASED PLCC ");
    Lcd_Display(0xC0,"                ");
    i2c_init();set_delay(1,10);

    T2CKPS0=1;
      T2CKPS1=1;
      TMR2IE=1;
    TMR2ON=1;
    Receive(1);
    Lcd_data(0x01,0);
    while(1)
    {
        for(i=0;i<7;i++)
        {
            if(i==3)continue;
            b=get_time(i);
            Lcd_Decimal(x[i],b,2);
            set_delay(1,25);
        }

        if(j>0)
        {
            Receive(0);
            u++;
            amt=u*3;
            Lcd_Display(0x89,"U:");
            Lcd_Decimal(0x8b,u,3);
            Lcd_Display(0xc9,"A:");
            Lcd_Decimal(0xcb,amt,3);
            j=0;
            Receive(1);
        }

        if(min==5)
        {

            Lcd_Display(0x8e,"SN");
       Serial_Out('&');
       Serial_Out(amt%1000/100+0x30);
       Serial_Out(amt%100/10+0x30);
       Serial_Out(amt%10+0x30);
       min=sec=msec=0;
       set_delay(1,1000);
       Lcd_Display(0x8e,"   ");

   }
   if(set==0)
   {
        while(set==0);
        set_delay(1,100);

        Lcd_Display(0xce,"RN");
        Serial_Out('@');
   }


   if(mov==0)
   {
        while(mov==0);
        set_delay(1,100);
            Lcd_Display(0xce,"RF");
        Serial_Out('#');
   }



     }
}
void interrupt serial(void)
{

     if(RCIF)
     {
     RCIF=0;
     a[j]=RCREG;
     c[k]=RCREG;
     d[l]=RCREG;
     if(a[0]=='*')j++;
     }
     if(TMR2IF==1)
     {
          msec++; TMR2IF=0;

          if(msec>250){msec=0;sec++;}
          if(sec>59){sec=0;min++;}

     }

}
```

RESULT:

FIG2: OVERALL PLCC CIRCUIT WITH LOAD CONNECTED OFF

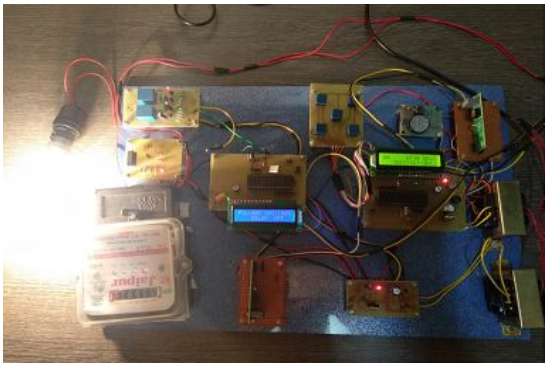

FIG3: OVERALL PLCC CIRCUIT WITH LOAD CONNECTED ON

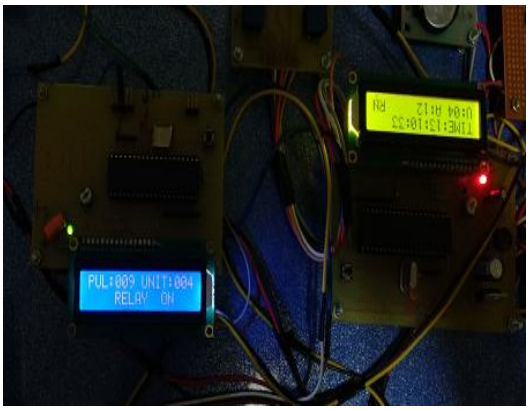

FIG4: RESULT DISPLAY ON LCD:

1. BLUE DISPLAY SHOWS PULSE COUNT DUE TO LOAD IS 9, UNIT CONSUMED WITH LOAD IS 4 & RELAY IS ON.
2. YELLOW DISPLAY SHOWS TIME WITH RESPECT TO REAL TIME CLOCK, UNIT CONSUMED WITH LOAD IS 4, AMOUNT OR BILL WITH RESPECT TO UNIT4 IS 12(4*3) & RELAY IS ON.

ADVANTAGES:

- Most economical automation type.
- No change in infrastructure required.
- Can be used in any environment.

DISADVANTAGES:

- Noise of electrical appliances like grinders lead to be corruption of data.
- Loss of Power hence range is decrease.

APLICATIONS:

- Home, industrialappliance automation
- No need ofphysically to came for cameraman for
- capturing at energy meter.

IV. CONCLUSION

Automation has become a part of daily life.But the current systems available are costly, cumbersome & need extra arrangement with to change in infrastructure. Thus byproposing this system we are making a low cost &easily operatabl esystem.

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