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Energy Efficient RF Remote Control for Dimming the Household Applainces

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Abstract

During recent years there is a strong trend towards radio frequency (RF) remote controls as it is delivering even more comfort to the users and increased usability with high robustness of the RF links. Lower power consumption with new features and security make RF remote control systems more competitive with widely used IR remote control systems. In this paper we propose, a RF module based real time system, which is an integrated system designed to control the dimming or speed of the appliances. Zigbee module is used as RF module to establish wireless link between Remote and appliance section having 9600kbs baud rate and range of 100m. Dimming control circuits is part of appliances section which is used to control the appliances corresponding to signals generated by the remote section. This system provides energy efficient solution for household uses.

Keywords: *applaince section, dimming control circuit, energy efficient, RF remote*

1. Introduction

In present market there are number of IR remote controlled appliances are available. The data transmission using IR modules are having limitation of line of sight, which is required by transmitter and receiver. In this paper, an energy efficient systems under dimming condition is considered, paper focus on system cost, real energy saving, reliability and environmental friendliness. The system proposed for large-scale lighting applications where the dimming function can be used to provide energy savings such as car parking, residential public parks etc [1]. The system provides solution to existing wired lightning system having complex construction [2]. The energy consumption is rapidly increasing due to development of the urbanization process and population. It also affects the cost and supply of electricity [3]. Due to drawback of its short range and speed RS-232-based digitally dimming lighting system and also each lighting area needs its own driver and dimmer circuit, which results in large numbers of circuit components and non-cost-effectiveness. It needs to improve [4]. USB-based protocol instead of the RS-232-based, provide better interface and increase dimming controlled nodes (devices) with the use of Zigbee transmission [5]. Zigbee transreceiver module is based on IEEE 802.15.4 protocol to make the wireless sensor network [6]. The system provides the characteristics of low power, low cost, flexible structure [7]. ADPCM (adaptive differential pulse code modulation) dimming control system can be used to control the LED current with high resolution. It also helps to reduce RFI (radio frequency intensity) because of spreading out the harmonic current of pulses [8]. By simulation results it can be concluded that pulse width modulation (PWM)-based pulse position modulation (PPM) signal format is better for visible light communication systems. It is also useful for operation of data transmission and dimming control simultaneously [9]. A new scheme is proposed to avoid problems of the pulse width modulation (PWM) control of the lamp current. A PWM-controlled half-bridge inverter is used for this purpose [10]. A dynamic dimming control system is discussed for highway tunnel LED lighting, based on controllability of LED [11].

2. Hardware Development

In the proposed system the communication range between remote and appaliance node is of 100 meters. At the remote section control switches (two for UP/DOWN dimming bulb, two for UP/DOWN dimming Fan and One for OK the set level) are to generate control signals

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corresponding to both appliances. The bulb is dimmed in eight levels and fan is dimmed in four levels. Processing unit is Atmega16, which is programmed by Embedded C language and generated Hex code is then dumped to it through ISP connector. Display unit is to display and check input to controller. The block diagram of remote Section for the proposed system is shown in Figure 1 and Figure 2 represents the block diagram of applliances section for the proposed system. AVR studio4 is used and programming is done in embedded C language. Zigbee is used as RF module. In this system dimming control circuits are used to control dimming of appliances with the help of different ports of single controller.

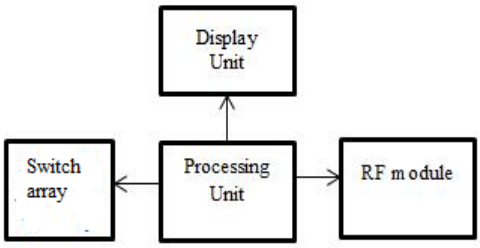

Figure 1. Block diagram of Remote Section for the proposed system

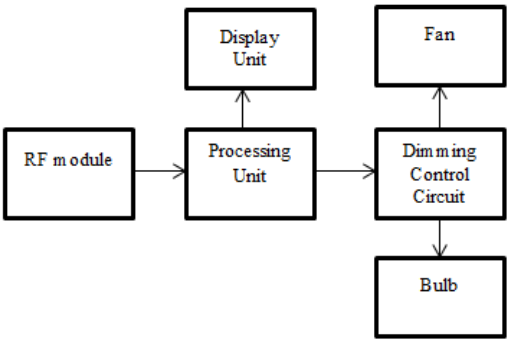

Figure 2. Block diagram of appliance section for the proposed system

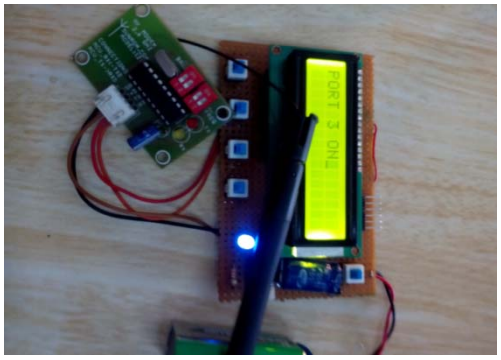

Figure 3. Developed receiver section

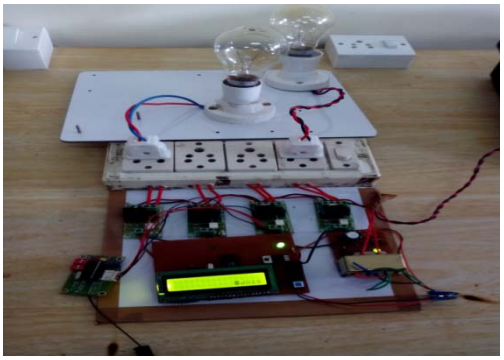

Figure 4. Snap Shot of developed system

3. System Software Design

The controller is programmed with the help of AVR studio. The language used for this is Embedded C and complied with open source compiler avr.gcc. The software design of the system is divided in two sections.

3.1. Remote Section

Program for remote section:

```
#include <avr/io.h> // avr main header file
#include <util/delay_basic.h> //avr delay header file
#include "lcd.h" //avr lcd header file
DDRB&=~(1<<0); //Assigning register B as input
DDRB&=~(1<<1);
DDRB&=~(1<<2);
DDRB&=~(1<<3);
PORTB|=(1<<0);
PORTB|=(1<<1);
PORTB|=(1<<2);
```

```
PORTB|= (1<<3);
InitUSART (71);// initilise USART
LCDInit (0);// initilise LCD
LCDClear();// clear LCD
if(!(PINB&1)) // reading pin 0 of B register
{
_delay_ms(200);
LCDClear();
LCDWriteSXY(0,0,"FAN Speed in %");
LCDWriteSXY(7,1,"10%");
USARTWChar('a');// write data
}
else if(!(PINB&4))// reading pin 2 of B register
{
_delay_ms(200);
LCDClear();
LCDWriteStringXY(0,0,"FAN Speed in %"); // print on LCD
LCDWriteStringXY(7,1,"50%"); // print on LCD
USARTWChar('c'); // write data
}
```

The Programming window of AVR studio4 for remote Section is shown in Figure 5.

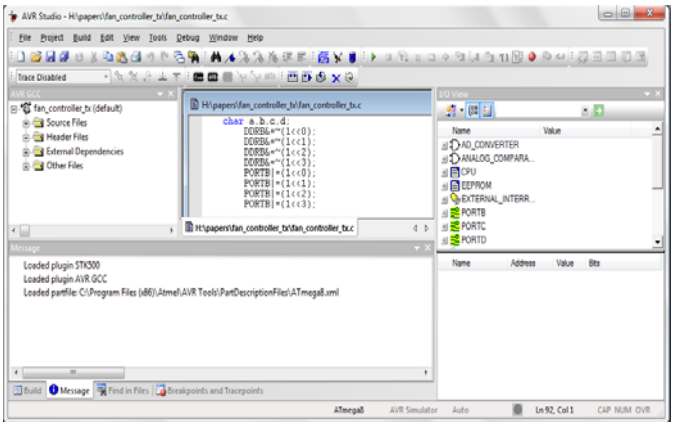

Figure 5. Programming window of AVR studio4 for remote Section

3.2. Applaince Section

Program for receiver section

```
InitUSART (71);// initilise USART
LCDInit (0);// initilise LCD
LCDClear();// clear LCD
DDRB=0b00001111;//assign register as output
PORTB=0b00001111;
while(1)
{
data=UReadChar();// read data as char
if(data=='a')// received data
{
PORTB=0b00001101;// dimmer signal from PORT B
LCDClear();//clear LCD
LCDWriteSXY(0,0,"FAN Speed in %");// print on LCD
LCDWriteSXY(7,1,"10%");// print on LCD
}
else if(data=='d')// received data as char
{
```

```
PORTB=0b00000011; // dimmer signal from PORT B
LCDClear();//clear LCD
LCDWriteSXY(0,0,"FAN Speed in %");// print on LCD
LCDWriteSXY(7,1,"75%");// print on LCD

}
```

The Programming window of AVR studio4 for receiver section is shown in Figure 6.

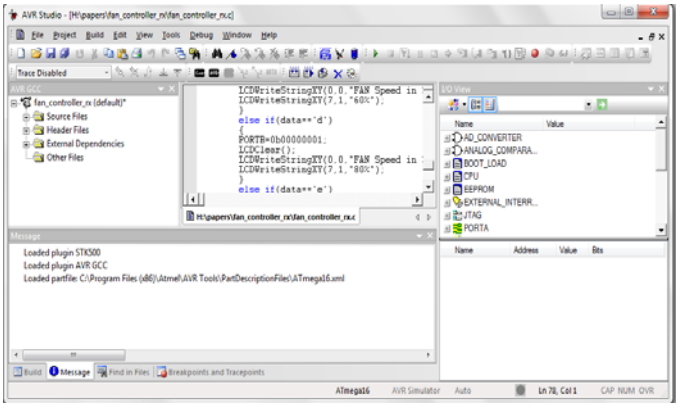

Figure 6. Programming window of AVR studio4 for receiver section

Flow Chart:

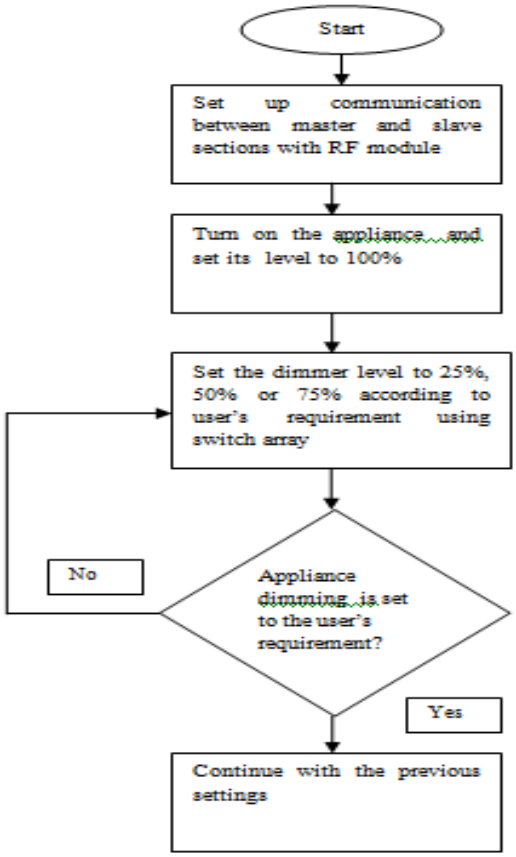

Figure 7. Flow chart of Programming window of AVR studio4

The Table 1 shows the load power consumption w.r.t dimming level of the device with the help of dimmer circuit, if divided into eight levels.

Table 1. The load power of dimmable port (up to 1kW)

Input to dimmer from controller	% input provided by remote	Load current (A)	Voltage across port (V)	Load Power (W) At 50 ohm
111	15	1.1	55	60.5
110	25	1.88	94	176.74
101	40	2.4	120	288
100	50	2.8	140	392
011	60	3.2	160	512
010	75	4.04	202	816.08
001	85	4.36	218	950.48
000	100	4.6	230	1058

Figure 8 shows the graphical relation of power consumption w.r.t dimmer level. It clearly shows at low dimmer level power consumption is low.

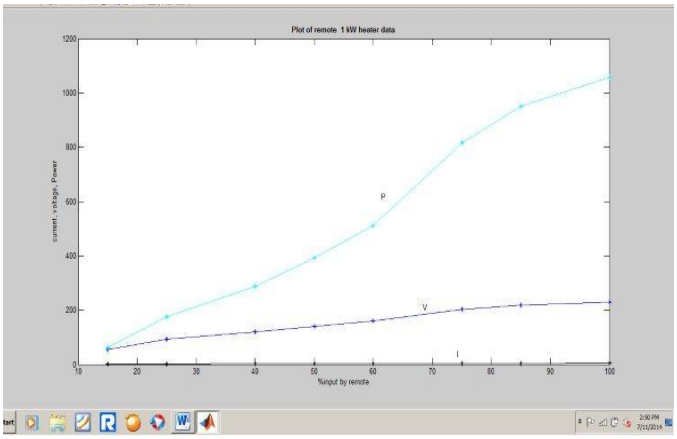

Figure 8. Graph shows relation between power consumption w.r.t dimmer levels

Black color graph line shows current consumption by system w.r.t dimmer level. Blue graph line shows voltage required by the system w.r.t dimmer level. Sky blue graph line shows power consumption by the system w.r.t dimmer level.

4. Conclusion

Zigbee module based developed system has no limitation of line of sight like IR remotes and establish wireless link at 9600kbps. The number of appliances can be controlled by using single module of the proposed system. Dimmer control system is able to reduce the amount of energy. The system offers energy saving through their dimming capabilities and to reduce electrical demand.

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