Single Phase Variable Voltage Generation using Keyboard & Microcontroller

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ABSTRACT

Normally a single phase voltage is varied by analog methods such as dimmer but we cannot get exact voltage by dimmer also. To achieve smart/exact voltage level VFD drives are used. To vary voltage by changing the firing angle of thyristor a variable ac voltage can be obtained. Thyristor conducts in both cycles of ac. If conduction angle is controlled by firing angle of thyristor. For half ac cycle firing angle changes from 0 degree to 180 degree according to that conduction angle changes. As conduction angle and firing angle are inversely proportional to each other. Means that if firing angle less then conduction angle is more and vice versa. A zero crossing detector circuit is used to know the zero point of ac. when zero crossing section gives output of logic 1 then from this point ac voltage starts to rise/fall. This is the reference point from that point to maximum 180 degree point firing angle can be controlled. In this way a variable output voltage is generated.

Keywords: Firing angle, Conduction angle, Thyristor, Zero crossing detector, Microcontroller

1 Introduction

Ac voltage in India has frequency of 50 Hz. It gives time period of 20 millisecond. For half ac cycle time is 10 milliseconds. P89V51RD2 has minimum measurable time of 1 microsecond. So, it has large resolution. So, to control firing angle between 0 degree to 180* then equivalent ally we have to change time from 0 millisecond to 10 millisecond for half ac cycle. Output voltage according to firing angle is given by following equation no.1. Figure 1 shows concept of firing angle, conduction angle & time period.

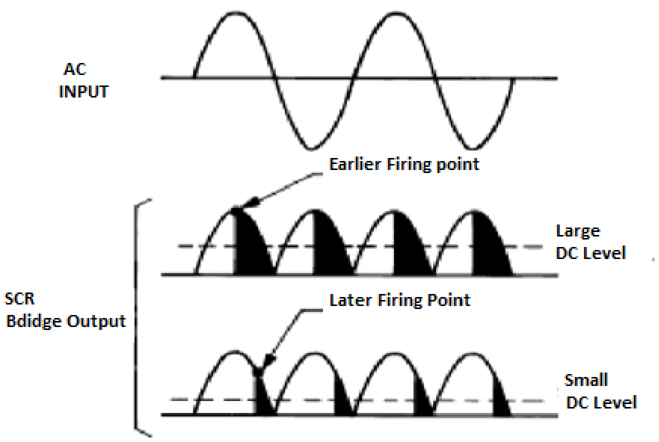

Fig.1: *firing angle of thyristor*.

$$V_{load} = V_{rms} \cos(\alpha) \quad (1)$$

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The P89V51RD2 is an 80C51 microcontroller with 64 kB Flash and 1024 bytes of data RAM. A key feature of the P89V51RD2 is its X2 mode option. The design engineer can choose to run the applicationwith the conventional 80C51 clock rate (12 clocks per machine cycle) or select the X2 mode (6 clocks per machine cycle) to achieve twice the throughput at the same clock frequency. Another way to benefit from this feature is to keep the same performance by reducing the clock frequency by half, thus dramatically reducing the EMI. The Flash program memory supports both parallel programming and in serial In-System Programming (ISP). Parallel programming mode offers gang-programming at high speed, reducing programming costs and time to market. ISP allows a device to be reprogrammed in the end product under software control. The capability to field/update the application firmware makes a wide range of applications possible. The P89V51RD2 is also In-Application Programmable (IAP), allowing the Flash program memory to be reconfigured even while the application is running.

2 Related Work

Rohan s. khodeet.al [1] worked on thyristor firing angle controlled reactive power adjustment using MATLAB Simulink model. They used MATLAB Simulink model. P.A. Kharade et.al [2] worked on Power Factor improvement in single phase high power rectifier by using interleaved boost technology. Mohammad khan et.al [3] worked on compensating techniques to decrease harmonics introduced by thyristor. S.A.Harprasad et.al [4] worked on ac power control using microcontroller and power MOSFET. PWM techniques were implemented. Pallavi R. Burjeet.al [5] worked on PIC microcontroller based CAN system. They observed that PIC IC provides better stability in power sector.

3 Designed System

Figure 2 shows the block diagram of variable output voltage generation by using microcontroller. P89V51RD2 microcontroller is used. It gives stable operations. Total digital circuit works on 5 volt DC power supply. Zero crossing detection is a circuit which runs on bridge network ruined by ac voltage. Zero crossing detector gives output logic 1 whenever ac crosses zero voltage point and this will be the reference point. Input value for voltage to be generated is given from alphanumeric keyboard. According to this value firing angle is controlled. Keyboard input value is displayed on LCD display. To drive thyristor a gate pulse is given from microcontroller. It is coupled through Opto isolator to isolate ac power from dc power. Generated ac power is measured by multi meter

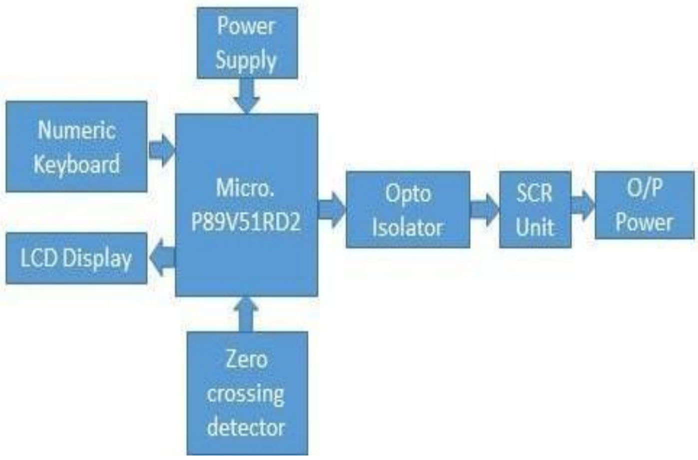

Fig.2 :*Block Diagram.*

4 Experimental set up

Figure 2 shows the actual experimental set up for variable voltage generation. Figure 4 shows PCB layout. Below the figure 4 program is written.

Fig. 3 :*Experimental Set up*

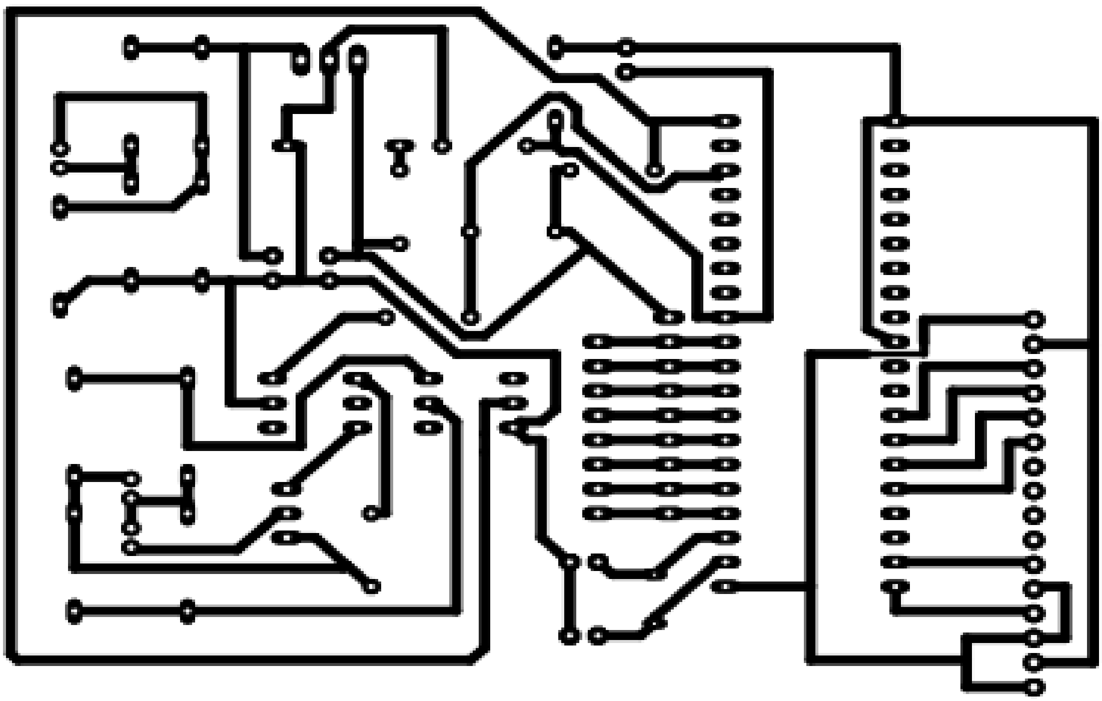

Fig.4 : *PCB layout with track*

Sample Program code:

```
 #include<reg51.h>
//Function declarations void cct_init(void);
void delay(int); void lcdinit(void); void writecmd(int);void writedata(char); void Return(void);
char READ_SWITCHES(void); char get_key(void);
```

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```
voidmsdelay(int);
//*******************
//Pin description
/*
P2 is data bus P3.7 is RS P3.6 is E
P1.0 to P1.3 are keypad row outputs P1.4 to P1.7 are keypad column inputs
*/
//*******************
// Define Pins
//*******************
sbitRowA = P3^0; //RowAsbitRowB = P3^1; //RowBsbitRowC = P3^2; //RowCsbitRowD = P3^3;
//RowD

sbit C1 = P3^4; //Column1 sbit C2 = P3^5; //Column2 sbit C3 = P3^6; //Column3 sbit C4  = P3^7;
//Column4
sbit E      = P1^6;    //E pin for LCD sbit RS   = P1^7;           //RS pin for LCD sbitsw = P1^0;
sbit relay = P1^2;
//*******************************************************
// Main program
//
int main(void)
{
char key; //key char for keping record of presed key unsigned int d1,d2,d3;
relay = 0;
cct_init(); // Make input and output pins as require. lcdinit();               // Initilize LCD sw = 1;
relay = 0;
//lcdinit();                // Initilize LCD
//writecmd(0x01);
key = get_key();           // Get pressed key d1 = key;
writedata(d1);
key = get_key();           // Get pressed key d2 = key;
writedata(d2);
key = get_key(); // Get pressed key
d3 = key;
// Clear screen
//writedata(key);         // Echo the key pressed to LCD writedata(d3);
// while(sw==1); while(1)
{
if((d1=='1'&&d2=='1')&&d3=='0'||d3=='1'||d3=='2'||d3=='3'||d3=='4'||d3=='5'||d3==
'6'||d3=='7'||d3=='8'||d3=='9')
{
while(1)
{
while(sw == 1); msdelay(9); relay = 1;
relay = 1;
relay = 1;
relay = 1;
relay = 1;
relay = 1;
```

```
relay = 1;
relay = 1;
relay = 1;
relay = 1;
relay = 0;
while(sw == 0); msdelay(9); relay = 1;
relay = 1;
relay = 1;
relay = 1;
relay = 1;
relay = 1;
relay = 1;
relay = 1;
relay = 1;
relay = 1;
relay = 1;
relay = 0;
}
}
```

Following are the different figures of firing angle changed. Figure 5 shows firing angle of 110˚. Figure 6 shows firing angle of 130˚. Figure 7 shows firing angle of 150˚. Figure 8 shows firing angle of 170˚.

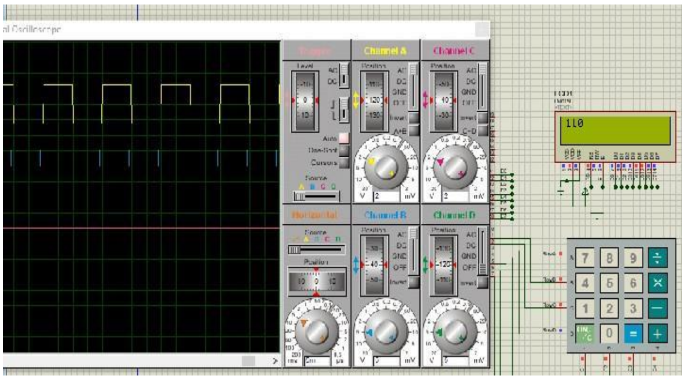

Fig5:Firing angle of 110

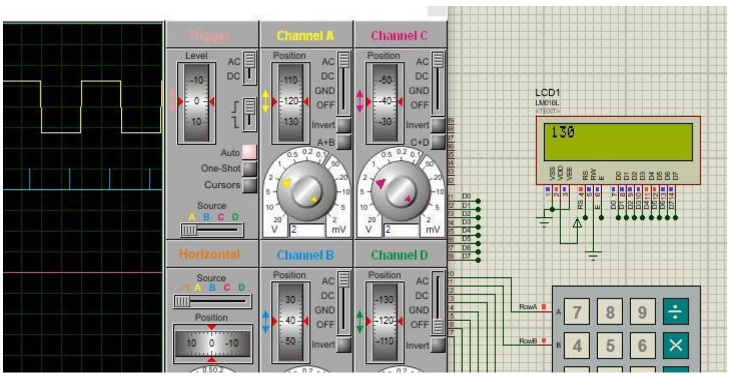

Fig 6: Firing angle of 130

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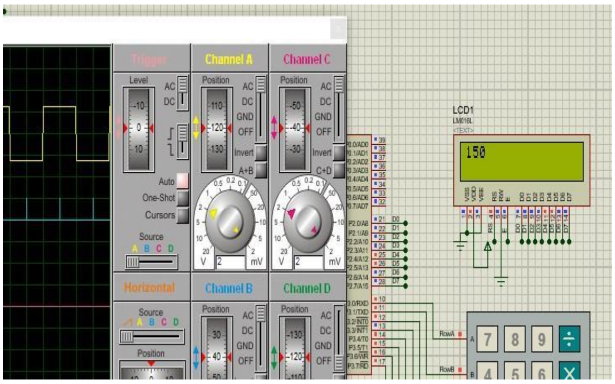

Figure 7: *Firing angle of 150*

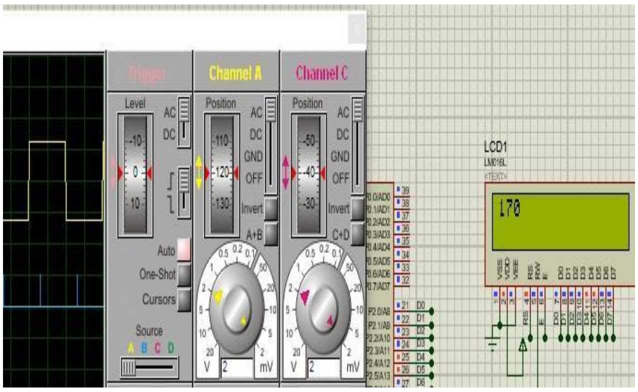

Figure 8: *Firing angle of 170* ˟

5 Conclusion

It is practically observed that a maximum number of resolution made in half cycle is 10 means that a minimum measurable /visible bulb intensity is 110 volt then 120 volt up to 230 volt. The voltage below 110 volt is not visible i.e. bulb doesn't glow to voltage lower than 110 volt. We implemented & practically observed the 10 different firing angles according to this firing angle intensity of bulb were changed. To control/generate fine ac voltage VFD method is best suited. Microcontroller method generates 10 to 12 resolution points of ac voltage, dimmer can generate 5 point resolution but VFD drive can generate around 200 point resolution. But for understanding firing, conduction angle concept we implemented & practically studied the systems.

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