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THYRISTOR BASED IR REMOTE CONTROL FOR HOME APPLICATION

UMADEVI.KS.D.SUNDARSINGHJEBASELAN
DEPT OF EEE
Sathyabama universitysathyabama
Chennai
umashri4490@gmail.com sundarjeba@yahoo.co.in

ABSTRACT

The present paper describes a design and implementation of an infrared (IR) remote controlled by using thyristor firing angle which can be used for various home control applications. The microcontroller is used to control the entire system that makes the control system smarter and easy to modify for other applications. It enables the user to control and operate the Load from about 10 meters away. The control setting and output voltage of the system has been observed.

1.INTRODUCTION

A home appliance control system (HACS) is a system is used to provide the control of remotely operated home appliances. This project is designed to control the home application such as lights, mixer and grinder etc using the InfraRed TV remote which is efficient and low cost.

Nowadays Infra-Red (IR) is widely used in communication and control circuits. Infrared light is an electromagnetic radiation with a wavelength of 0.74 micrometers,and extending conventionally to 300 micrometers. IR is longer than that of visible light, when its measured from the nominal edge of visible red light. These radiation are invisible to the human eye, but can only be felt by our skin temperature sensors[6].

The LED in the standard remote control is an infrared transmitter, The led light used to carry the commands from the user to the appliance is the near-infrared range frequency of approximately 980 nanometers.[6] The receiver passes the code to a microprocessor, which decodes it and carries out the command TV remote that follows RC5 Protocol is used here. Receiver in the circuit receives pulsed IR rays from the remote and sends them to a microcontroller that plays the role of a decoder. Decoded signal is thus received by optoisolator connected to the anti parallel of the thyristor. The firing angle is varied by using the optoisolator connected the thyristor. Thus the load voltage and power to the load will varies accordingly

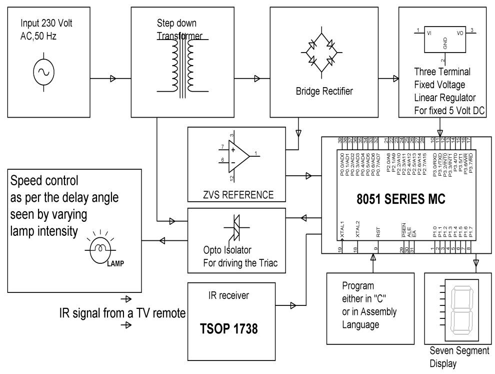

Figure1.Block Diagram of thyristor controlled system

Figure1 shows the block diagram of thyristor controlled device by using the firing angle it consists of power supply unit with bridge rectifier used to convert 230v input supply to 12v output. And it is connected to the voltage regulator to regulate 5v dc. zero voltage reference is used to compare the output voltage. optoisolator is coupled with the antiparallel thyristor to vary the firing angle[1]. Tsop is used as Irreceiver.seven segment display is used to display the firing angle.

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2. DESIGN OF HARDWARE

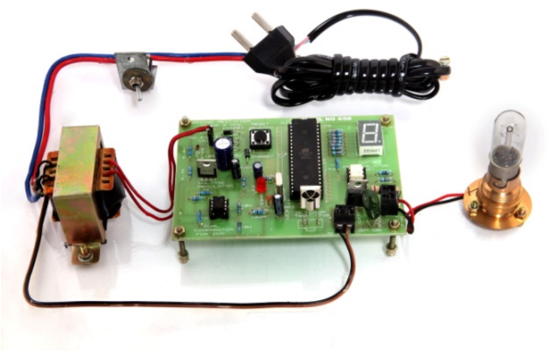

Figure2.Pictorial View OfDeveloped System

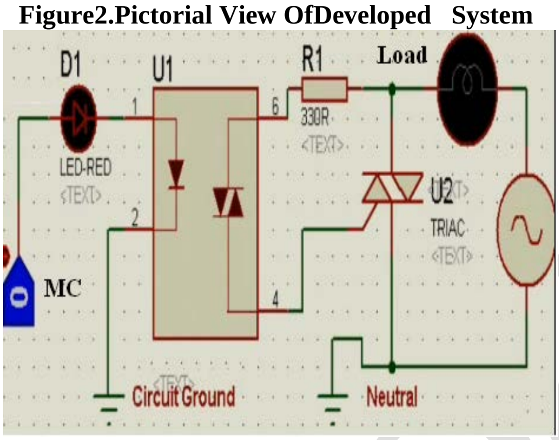

Figure 3.Circuit Diagram Of The Developed System

3.WORKING

In the figure 3 the circuit diagram consists of (triac) antiparallel of thyristor. It consists of two modes of operation.

mode 1:(0 ≤α ≤π radians)
When supply is ON the thyristor T 1 is forward biased during the positive half cycle of the input supply voltage. The thyristor *T* is triggered at a delay angle of 'α ' The current flows through lamp (provided a triggering pulses through optoisolator) and then only lamp glows for that half cycle directly through the M2 & M1 terminal of the triac. [1] [2]The conduction time of T1 from ω*t*=α to π radians. ω*t*= (π +α) to 2π. At ω*t*=π , when the input voltage falls to zero the thyristor current (which is flowing through the load resistor *L R*) falls to zero and hence 1 *T* naturally turns off . No current flows in the circuit during ωt=π to (π +α) .

mode 2:ω*t*= (π +α) to 2π
The thyristor 2 *T* is forward biased during the negative cycle of input supply and when thyristor 2 *T* is triggered at a delay angle (π +α) , the output voltage follows the negative halfcycle of input from ω*t*= (π +α) to 2π.When 2 *T* is ON, the load current flows in the reverse direction the same thing repeats. Thus the lamp glows in both the cycles in controlled manner depending upon the triggering pulses at the opto isolator.In –ve half cycle as seen on the graph below. If this is given to a motor instead of lamp the power is controlled resulting in speed control. At ω*t*= 2*π* the input supply voltage falls to zero and hence the load current also falls to zero and thyristor 2 *T* turn off naturally.

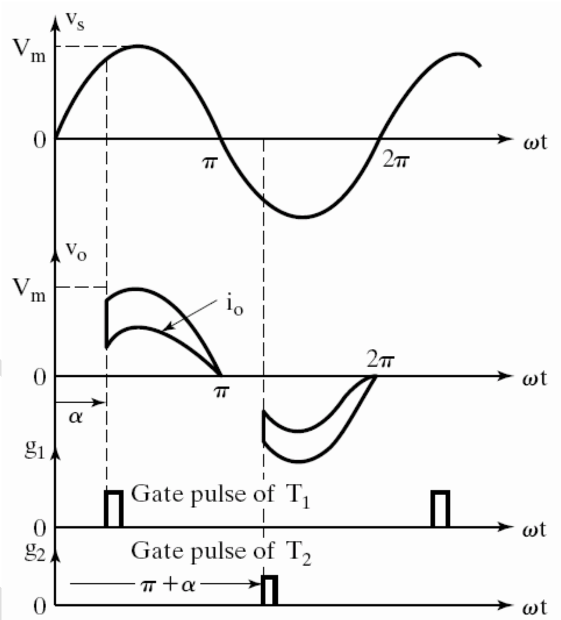

Figure 4.Output Waveform Of Antiparallel Thyristor

4.DESIGN CALCULATION

The Input supply voltage of the thyristor based system is given below

$VS = Vm\sin\omega t = \sqrt{2}VS \sin\omega t;$

The Output voltage across the load and Output load current is obtained using
forω*t*=α to π and ω*t*= (π +α) to 2π

$V_o = V L = V m \sin\omega t;$

$I_o = \frac{V O}{R} = \frac{I m \sin \omega t}{R}$;

The rms output voltage can be found using the equations of the antiparallel thyristor[8].

$$Vo(rms)^2 = V L^2 = \int_0^{2\pi} V L^2 \, d(\omega t)$$

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$$\mathrm{Vo(rms)} = VS\sqrt{\frac{1}{\pi}(\pi-\alpha)+\left(\sin\frac{2\alpha}{2}\right)}$$

Lighting System Efficiency = System Lumen Output ÷ Input Wattage

When α=30°

$$\mathrm{Vo(rms)} = VS\sqrt{\frac{1}{\pi}(\pi-30)+\left(\sin\frac{2*30}{2}\right)}$$

Vo(rms) = 228.34V;

I_o *(AMPS)*=228.34 = *2.28A* ;
100

P = VI = 521.39

Figure 5. Table of summary

Trigger Angle In Radians	Output Voltage V_o (Volts)	Output Current I_o (Amps)	Output Power W (Watts)	Lighting Efficiency η %
$\frac{\pi}{6}$	228.34	2.2834	521.39	98.75
$\frac{\pi}{3}$	218.47	2.1847	477.29	98.5
$\frac{\pi}{2}$	199.19	1.9919	396.73	95.68
$\frac{2\pi}{3}$	177.83	1.7783	316.19	88.56
$\frac{5\pi}{6}$	164.97	1.6497	272.118	84.23
π	162.63	1.6263	264.49	84.16

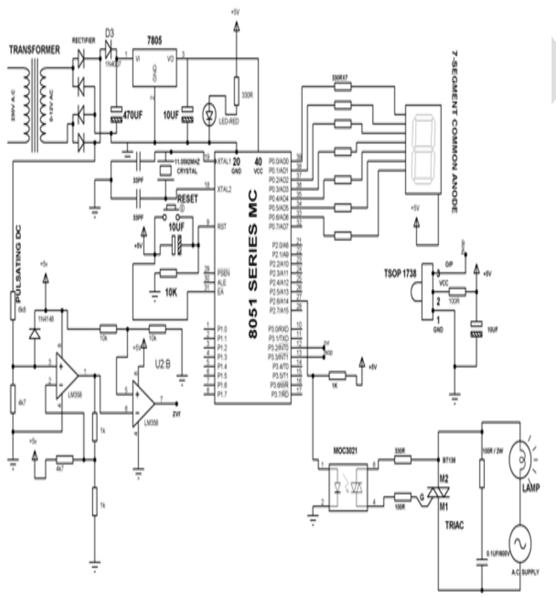

Figure 4.Schematic Diagram of the thyristor based ir remote control system

5. SIMULATION CIRCUIT AND WAVEFORM

5.1 POWER SUPPLY UNIT

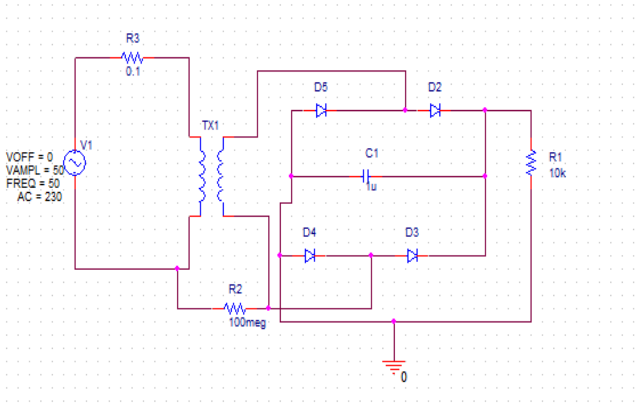

Figure5 Input Supply Circuit

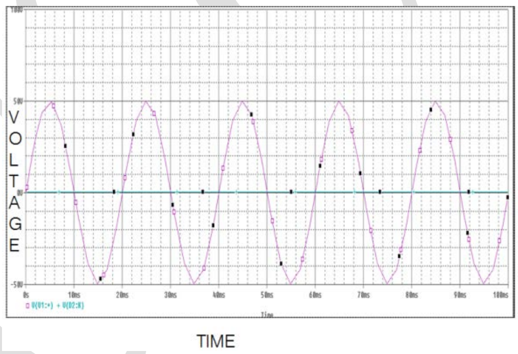

Figure 6 Output Of The step down Transformer

The figure5 shows the power supply unit and the corresponding output waveform of the transformer in the figure6.

5.2 555 TIMER CIRCUIT

The simulation of the 555 timer circuit which is used to convert the 12v dc to 5vdc to the microcontroller is given in the figure 7 and the corresponding output is shown in the figure 8.

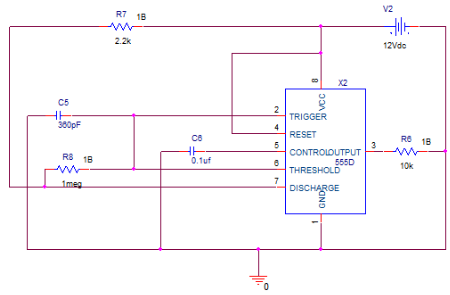

Figure 7. 555 TIMER Simulation Circuit

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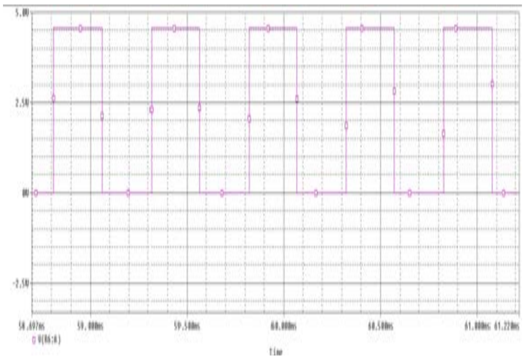

Figure 8. Output Waveform Of 555 Timer

5.3 CIRCUIT OF ANTI PARALLEL THYRISTOR

The figure 8 shows the circuit of two antiparallel thyristor conned to the filter and R load. the corresponding output waveforms of different parameters are shown below in the figure 9-12

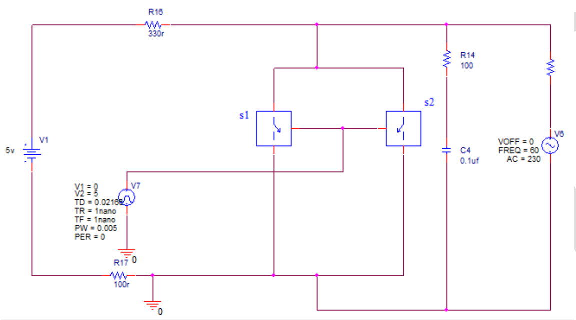

Figure 9.Simulation Circuit Of The Antiparallel Thyristor

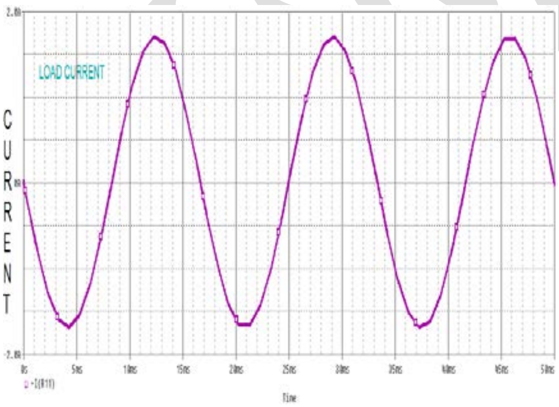

Figure 10.Output Current Of The Antiparallel Thyristor

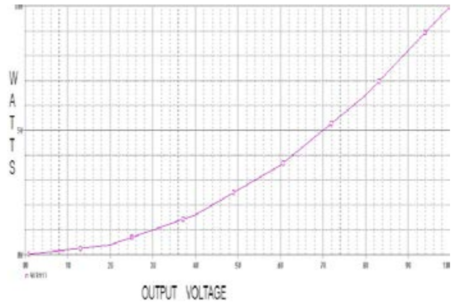

Figure 11. Output Watts and voltage of the Load

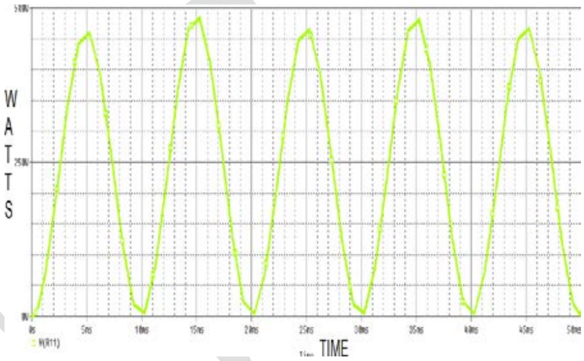

Figure 12 Output Watts In The Of The load

5.4 ANIMATED OUTPUT FOR THYRISTOR CONTROLLED SYSTEM USING PROTEUS

The led which indicates the power flow and light load is animated using proteus. The delayed angle of the thyristor is also shown in the seven segment display. the figure 12 shows the output of the proteus.

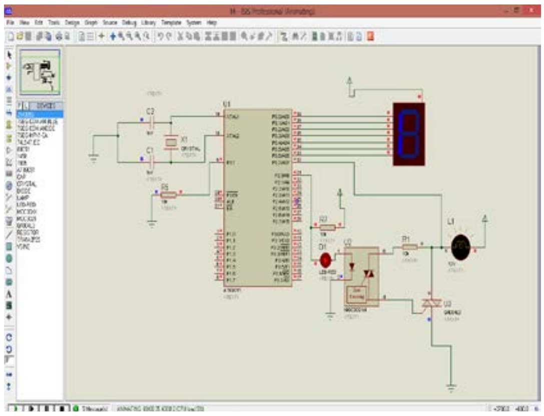

Figure 13.Led And Lamp Display using proteus

6. CONCLUSION

This paper is to develop an automatic control system for home appliances.IR remote control signal using thyristor is implemented using microcontroller and its application is successfully demonstrated for home applications.The system is quite cheap, reliable and easy to operate. And reduces human efforts and makes life a bit easy

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without compromising on the efficiency of appliances. This system can also savetime and can also be used in industries for controlling purposes

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