DESIGN AND CONSTRUCTION OF AN INFRARED REMOTE CONTROLLED LIGHT DIMMER

BY
SADIQ ADEKUNLE
2003/15291EE

DEPARTMENT OF ELECTRICAL AND
COMPUTER ENGINEERING
SCHOOL OF ENGINEERING AND ENGINEERING
TECHNOLOGY
FEDERAL UNIVERSITY OF TECHNOLOGY,
MINNA.

NOVEMBER, 2008.

DESIGN AND CONSTRUCTION OF AN INFRARED REMOTE CONTROLLED LIGHT DIMMER

BY

SADIQ ADEKUNLE
2003/15291EE

A PROJECT WORK SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY

FEDERAL UNIVERSITY OF TECHNOLOGY,MINNA.
IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF ENGINEERING (B.ENG) DEGREE IN ELECTRICAL AND COMPUTER ENGINEERING

NOVEMBER, 2008.

DECLARATION

I, SADIQ ADEKUNLE, with the registration number 2003/15291EE, hereby declare that this project work is originally done by me, and that it is the record of my carefully done research work which barring coincidence, has not been presented else where before.

....

SADIQ ADEKUNLE

2003/15291EE

17/11/08
....

DATE

CERTIFICATION

I hereby certify that this project titled " Design and Construction of Remote Controlled (Infrared activated)lamp Dimmer" was solely carried out by SADIQ ADEKUNLE (2003/15291EE) under the able supervision of Usman N. Galadima and submitted to the department of Electrical and Computer Engineering, Federal University of Technology, Minna.

This is partial fulfillment of the requirements the award of Bachelor of Engineering (B.Eng.) degree in Electrical and Computer Engineering.

....
Project supervisor
Usman N. Galadima

04/11/08
....
Date

....

Prof. Yunusa A. Adediran
Head of Department

....
Date

....
External Examiner

....
Date

DEDICATION

This project is dedicated to the Almighty God, the unchangeable changer that changes every situation who in His endless love and Grace guided and protected me from my Remedial days to this finishing point.

Also to my ever loving and caring brother who God use to stand by me in all areas (financially and morally) throughout the programme.

ACKNOWLEDGEMENT

All glory and honour be unto the Almighty God, the one who changeth not for sparing my life up to this completion stage.

My immense gratitude goes to my able Head of Department, Prof. Yunusa A. Adediran who took his time to explain to us on how to use the Departmental Hand Book to write a successful project.

I appreciate the efforts of my supervisor, Mr. Usman N. Galadima for finding time to go through my work and assessment of it despite his busy schedules. I thank him for all he has done to make my project work a great success. He gave me hope when all hope of graduating was almost lost.

My profound gratitude also goes the power man in the department, Prof. Oria Usifo for his own contribution too. I equally appreciate the following lecturers in the department: Dr. E.N.Nwuka, Engr. M.N.Nwohu, Dr.J. Tsado, Mr.J.G. Kolo, Mr.Paul Attah, Mr A.S. Mohammed, Engr. Mrs. C.O Alenoghena, Engr. M.S. Ahmed, Mr. J.A. Ajiboye, Mr.Michael David Mr.O.D.Ahmed Engr.Emmanuel Eronu, Mr.J.A.Abolarinwa, Mr.M.B.Z Ahmed, Mr.Umar Abubakar, Mr. Audu B. Pada, Mr.Mohammed K.Sagir, Mal. Adamu Mohammed, and Idris` Abubakar. I also appreciate the efforts of those that I could not mention here, thank you all.

This acknowledgment will not be complete without mentioning the wonderful family who God has been using to make my study a great success. No any other family than Mr. and Mrs. Sadiq Ajayi. I am most grateful to you for all-round support and may God bless you all.

I thank the following people for their support too: Mr. Stephen Ashiwel, Alh. Mohammed Bashir, Late Mr Ojo Isah (may his soul rest in peace), Mr Williams Shaibu, Mr and Mrs. A. Isaiah (my landlord), Mrs. J.O. Isah, Miss J. omowumi, thank you all.

This page will be meaningless without saying thank you to friends within and outside F.U.T. Minna for their supports.

Miss Omolewa O. Ruth, thank you a million time for the love and care, my old friend and room mate, Linus I. Imodiboh (BOYZCAMP), Simeon Bright, Richard Akande, Azeez Adebimpe, Bashirat S. Shagaya, Bukky P. Bolaji, Agada O.Emmanuel, A.Abdul,, O. Isaac, U.O. Kingsley, Obafemi O.Daniel, Seun Lotu, Timi A. Lawrence, A. I. Abiodun, James Osei, Oseni Yusuf, Sule Omoba, A. Ebenezer, Vicent Success, Danjuma I.Usman (D.J), Peter Isah and Kandy, thank you all. Other friends not mentioned here be rest assured that my heart appreciate you all.

ABSTRACT

The project is the Design and Construction of Remote Controlled (Infrared activated) Light Dimmer. It is a device which enables users to control light intensity from approximately 10m away. The control of light could be in homes, theater, photo studio etc.

Infrared signal is transmitted by transmitter circuit and received by the receiver. Three relays are connected in parallel and each of them is activated at a time by the received infrared signal. As a result of varying drops across the different resistor values connected to the relays, the brightness of the lamp is varied.

The dimmer was tested and three different light intensities were observed in the lamp at different presses of the remote transmitter.

TABLE OF CONTENTS

TITLE PAGE		i
Dedication		ii
Certification		iii
Dedication		iv
Acknowledgments		v
Abstract		vi
Table of contents		vii

CHAPTER ONE

1.0	Introduction	1
1.1	The Remote Control Light Dimmer	2
1.2	Objectives of the project	3
1.3	Project outline	4

CHAPTER TWO

LITERATURE REVIEW

2.0	Introduction	5
2.1	Review	6

CHAPTER THREE

SYSTEM ANALYSISAND DESIGN CALCULATION

3.0	Introduction	10
3.1	power Supply Unit	10
3.2	Transmitter section	13

3.3 Receiver Unit 15

3.3.1 Clock Pulse Generator 16

3.4 Counter stage 18

3.5 Switching Network/Dimming Stage 20

Complete Circuit Diagram 23

CHAPTER FOUR

4.1 Construction 24

4.2 Testing 25

4.3 Result 26

4.4 Packaging 27

CHAPTER FIVE

5.1 Conclusion 28

5.2 Problems 28

5.3 Recommendations 29

Reference 31

Appendix 33

CHAPTER ONE

1.0 INTRODUCTION

For over some years now, there has been an increasing demand by man for things to be done with the help of automated systems. This is necessary in order to reduce the stress of doing much work manually. Automated systems, when designed save us from the stress of timing based on the fact that they can start and stop automatically or spontaneously. The use of light dimming systems in our homes, theatres and photo studio cannot be over emphasized. This gave rise to the design and construction of Remote Controlled Light Dimmer which is the entire focus of this project work.

In almost all situations, luminaries are not used constantly at full power. They are generally required to fade in and out and to be used at different brightness or intensities at various times. A device is needed to regulate or control the amount of electrical voltage sent to each luminary, thereby allowing the intensity of the light to be varied : This is called a dimmer.

A light dimmer is a circuit designed to control the magnitude of the voltage supplied to a lamp. The magnitude of the voltage at the terminals determines its resulting brightness. As a result of this dimmer, the intensity of light in a room, theatre or in the photo studio can be varied or alternated by merely controlling the voltage at the terminals of the lamp (source of the light).

Each dimmer regulates one lighting circuit or channel, allowing the electrical supply sent to the attached luminary to vary between 0 and the mains voltage (230V). Some times, it may be required that the control point of light in the house or other places being mentioned earlier be easier to locate and operate. This is usually the case with frequently used lights in the house such as ones in the sitting room, bed room etc.

Apart from the ability of the dimmer to control the intensity of light in the house, it also help the physically handicapped people who in one way or the other find it difficult to reach the location of the control point before controlling the brightness of the light. Some people find it extremely hard to sleep when the light in the room is very bright in which case they have to move to the control point of the light; switch it off before retiring to bed finally.

With the Remote Controlled light Dimmer, it is convenient for an individual to be on the bed and decide the intensity of light with which he or she wants to sleep with. The problem of having to work across the room to the controlling point has been taken care of by the use of the dimmer which means that at a distance of about ten meters (10m) from the controlling point, the intensity of light can be determined by the intending individual without much stress which is one of the objectives of this project work.

1.1 THE REMOTE CONTROLLED (INFRARED ACTIVATED) LIGHT DIMMER

This device as designed above is an infrared activated system with the capability of controlling the intensity of a light source in homes, theatres or studios with remote control. The remote designed for this circuit cannot work for more than a distance of ten meter (10m). However, since the project is just a model, it is still okay but can be improved upon subsequently.

The device comprises five (5) units which are listed below and shown in the blocked diagram that followed.

i Power supply unit

ii Infrared transmitter unit

ii Infrared receiver unit

iv Counter stage

v. Transistor Switching Network/ Dimming circuit

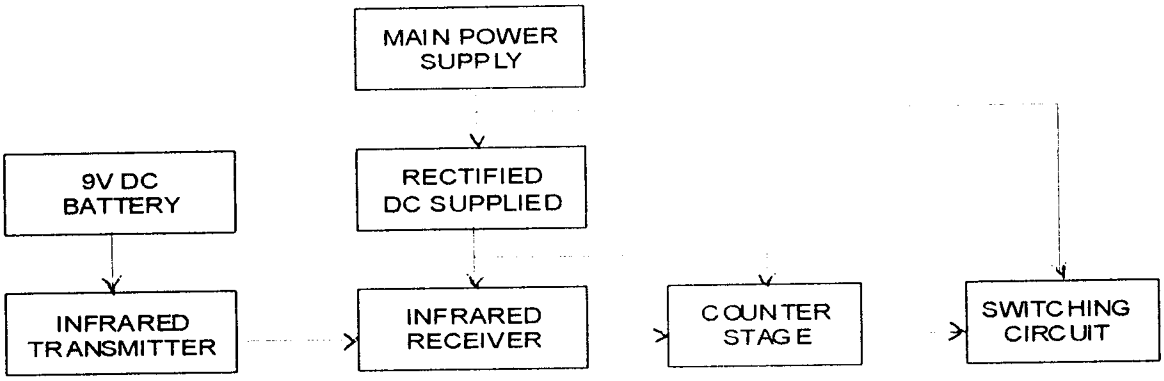


Fig 1.1: Block Diagram of Remote Controlled Light Dimmer

1.2 OBJECTIVES OF THE PROJECT

Some of the objectives as related to this project work include the following:

1. To demonstrate the idea of the use of automated system in our daily life.
2. To aid people with eye problems that is to say people whose eyes cannot withstand high intensity of light.
3. To help the physically handicapped people who find it difficult to move from point to point in order to control light intensity within the house.
4. To develop an affordable and cost effective way of regulating light intensity to our convenience
5. To demonstrate the use of logic in programming devices

1.3 PROJECT OUTLINE

The Infrared Remote Controlled Light Dimmer is a light intensity controlling device designed to be controlled by a remote and it also provides comfort to both people at homes and public places such as theatres, cinemas, photo studio etc. This project outlines the procedure, techniques, design, calculation etc which were involved in the construction and implementation of the system, and the amount of research carried out on the field.

Chapter one gives an introduction of the study and brief description of the device and its objectives.

Chapter two gives a brief history of previous invention (Literature review) that culminate the present day concept of the device under study

Chapter three discusses the principle of operation of each unit, details in the overall design, mathematical deductions and calculations as related to the project.

Chapter four expatiates on the constructions, testing and packaging of the device.

Lastly, chapter five which entails conclusion and recommendation.

CHAPTER TWO

2.0 INTRODUCTION

The first remote control called "Lazy Bones" was developed in 1950 by Zenith Electronics Corporation (then known as Zenith Radio Corporation). Lazy Bones used a cable that ran from the device, then a TV set, to the viewers. A motor in the TV set operated the turner through the remote control. By pushing buttons on the remote control, viewers rotated the turner device clockwise or counter clockwise, depending on whether they wanted to change the channel to a higher or lower number.

Light dimming is based on adjusting the voltage which gets to the lamp. Light dimming has been possible for many decades by using adjustable power resistors and adjustable transformers. Those methods have been used in movie theatres stages and other public places. The problem associated with the controlling pattern have been that they are big expensive, have poor efficiency and they are not easy to control from remote control.

The power electronics have preceded quickly since 1960, between the years 1960 -1971, thyristors and triac came into the market. Using those components, it was lees difficult to make small and less expensive light dimmers which have good efficiency. Electronics controlling also made possible to make it easily controllable from remote location.

Solid –state light dimmers work by varying the "duty cycle" (ON/OFF time) of the full A.C voltage that is supplied to the lights being controlled for only half of each A.C cycle, the light bulb will be much less brighter than when it get full A.C voltages; because it gets less power with which to heat the filament.

Typical light dimmers are built using thyristors and when triggered, it keeps conducting until the current passing through it goes to Zero value (exactly at the next Zero crossing if the load is purely resistive, lights the bulb). By changing the phase at which one triggers the triac, one can change the duty cycle and this therefore result in the brightness of the light.

2.1 REVIEW

For successful design and construction of the project, a lot of information was sourced. Some of these were obtained from the previous project works done by others, from text –books and the Internet. Literature sources available review some methods of constructing different kinds of light intensity control systems.

A simple light dimmer can be constructed using rheostat (adjustable resistor) as the control element to regulate the voltage supplied to the lamp, with the rheostat resistance at maximum, the voltage across the lamp is zero. As the resistance is gradually reduced, the voltage across the lamp rises and the brightness of the lamp begins to increase. At minimum resistance, the full supply voltage is applied to the lamp and it will become very bright. Therefore, varying the resistance of the rheostat results in either increase or decrease in the intensity of the light.

The system is cheap and easy to construct but it has a lot of disadvantages. The main disadvantage is the waste of energy as the full supply voltage is dropped across the rheostat when the lamp is at minimum brightness. The power loss V^2/R is dissipated as heat and this will increase the temperature of the resistance wire which will in turn leads to early damage of the system.

The above disadvantage makes it unsuitable for use in high voltage applications. Further research shows that lamp dimmer can be constructed using a thyristor and other discrete components. When the switch is closed, no current flows to the lamp until a positive voltage (0.8V) is applied to the gate of the thyristor from the potential divider network. Once the current in thyristor exceeds its holding current, it will conduct until such a time when the current across it falls below the holding current, when it is said to have switched off.

The firing angle of the thyristor is varied between 0-180$^{0.}$ If the firing angle is small, the lamp will be very bright as more current flows through the thyristor. If on the other hand, the angle is large, the reverse will be the case. The setting of VR_1 determine the firing angle hence the brightness of the lamp.

Bi-directional power switch like triac can as well be employed in the construction of a light dimmer. The triac, which is a silicon controlled rectifier, can operate on both positive and negative, half cycles of the mains voltage.

The rate of voltage build- up across capacitors C_1 and C_2 is controlled by VR_1. With VR_1 at minimum, at the beginning of each half cycle, the voltage rises almost in step with main voltage and then it reaches about 30 volts, the voltage developed across the triac is sufficient to make it fire. When it does so, its impedance avalanches from a very high level to an extremely low one resulting in the capacitor discharging into the gate of the triac.

This switches on the triac and connects the main supply to the load. The supply remains connected until the end of each half cycle, where upon the current through the triac falls to zero, and switches off. If VR_1 is adjusted for higher resistances, the rate of voltage build- up across C_2 and C_3 is lower and it takes long time to reach avalanch voltage of the triac.

By early 1980, the industry moved to infrared, or IR, remote technology. The IR remote works by using a low frequency light beam, so low that the human eye cannot see it but which can be detected by a receiver in the TV. Zenith's development of cables compatible turning and teletext technologist in the 1980s greatly enhanced the capabilities and uses for infrared remotes.

Today, remote control is a standard feature on other consumer electronics products, including VCRS, cable and satellite boxes, digital video disc players and home audio receivers. The most sophisticated TV sets have remote with as many as 50 buttons. In early 2000, more than 99percnt of all TV sets and 100 percent of all VCRS and DVD players sold in the United States are equipped with remote control. The average individual these days probably picks up a remote control at least once or twice a day.

With most pieces of consumer electronics, from camcorder to stereo equipment, an infrared remote control is usually always included. The remote control functions are to wait for user to press a key, and then translate that into infrared light signals that are received by the receiving appliance.

However, the infrared activated remote controlled light dimmer which forms the bases of this project work has greater advantage over other light dimming systems explained earlier in the sense that, the stress encountered in operating them is completely eliminated by the Remote Controlled Light Dimmer. Using digital integrated circuits and discrete component, the remote controlled light dimmer is able to dim light source with the aid of a remote control at a distance of about 10m. The control of the voltage supplied to the load is very smooth and efficient, and there is less energy loss which can be ignored.

CHAPTER THREE

SYSTEM ANALYSIS AND DESIGN CALCULATIONS

3.0 INTRODUCTION.

The ultimate aim of any project work is that the practical work undertaken should operate in accordance with the design specifications. For the purpose of analysis, this project design is broken down into five stages, namely:

- i Power Supply unit
- ii Infrared Transmitter unit
- iii Infrared Receiver unit
- iv Counter stage
- v Transistor switching Network/Dimming circuits.

3.1 POWER SUPPLY UNIT

The power supply unit for this project was designed to provide 5V (d.c battery) for infrared transmitter unit, 5v for the transmitter, receiver unit and the out put circuit respectively (counter stage) and 12v for the switching network (relay). The transformer used, has an input voltage of 240v a.c at $50H_z$ and an output voltage of 12 v a.c at 300mA. The rectifier unit consists of a bridge rectifier, which rectifies the output of the transformer to a pulsating d.c voltage output.

A filtering capacitor filters the output of the bridge rectifies to a pure d.c voltage. A 5v IC regulator (7805) is used to stabilize the out put voltage at exactly 5v. This d.c voltage is used to power the transmitter, the receiver and the counter circuits. The design illustrating the power supply unit is in figure3.1

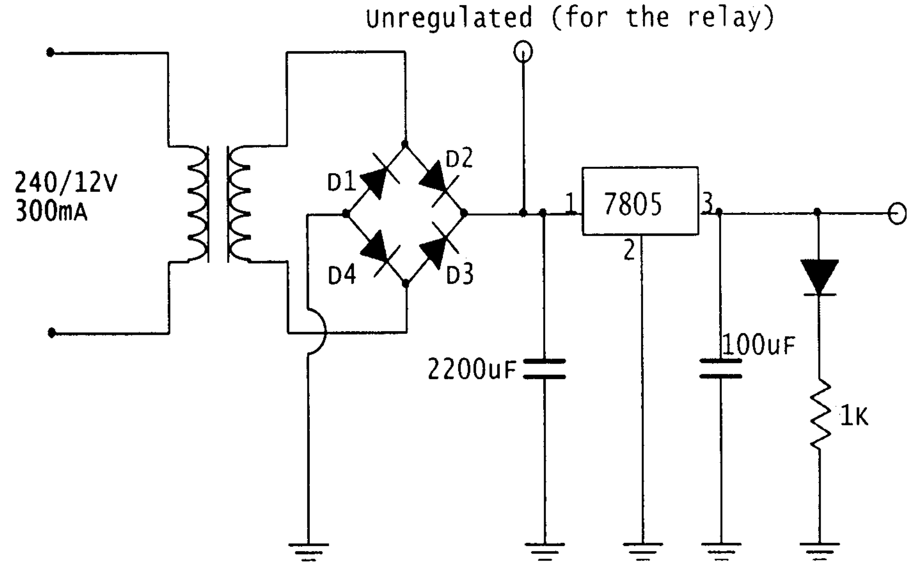


Fig 3.1: Power Supply Unit

The normal a.c mains supply is meant to be of 240V rating. However, in order to give room for minor fluctuations that range from 6% of this, (fluctuation as low as 140V and as high as 340Vthe transformer turns ratio must be such that the minimum amount of supply voltage to the system is maintained. In this case, the unit which contains 555 timer and CMOS 4017IC, required a minimum of 3Vand maximum of 18V.

The step down transformer produces an output of 12V when the supply from the a.c mains is 240V. Therefore, this implies that when the voltage falls as low as 140V,a minimum of 30V should still be obtainable to power the output unit circuits.

For bridge rectification

Since a 240V/12V a.c 50Hz, 300mA step down transformer was used to obtain a stabilize 12Vd.c voltage, the peak –to- peak voltage of the supply.

$$Vp = V_{rms} \times \sqrt{2} \quad ....3.1$$

$$V_p = 12 \times \sqrt{2} = 16.97V$$

4diodes (rectifier) whose end are connected to one another were used to connect the a.c voltage to d.c voltage. A rectifier capacitor, C connected across the out put of the rectifier removes the ripple voltage. The d.c voltage output of the filter capacitor.

$$V_{dc} = \frac{2V_p}{\pi} = 0.636V_p \quad \cdots\cdots\cdots\cdots 3.2$$

$$= 0.636 \times 16.97 = 10.80V$$

Since the d.c voltage is 10.80v, than the filter capacitor working voltage should be $2xv_{dc}$ (volts) i.e $2x10.80v = 21.60V_{dc}$

The filter capacitor used in 1000f, 35v.

The peak -to-peak account of the supply is given as

$$I_p = \frac{I_{rms}}{\sqrt{2}} \quad \cdots\cdots\cdots\cdots 3.3$$

$$= \frac{300 \times 10^{-3}}{\sqrt{2}} = 212.1mA$$

$$I_{dc} = \frac{2I_p}{\pi} = \frac{2 \times 212.1}{\pi} = 135mA$$

Though a voltage regulator IC (type 7805) was used to stabilize the output d.c voltage of the filter capacitor at exactly 5v, the circuit could still have worked in accordance with specification in the absence of the regulator (since 12v falls between minimum 3v and 18v maximum for CMOS 4017 to operate effectively)

From the calculations above, it is observed that the peak output voltage V_{out} (peak) at 240v mains supply was enough to power the output unit circuit which requires a minimum of 3v. The d.c output voltage at the 240v main was also high enough to power the output unit currents.

When the supply drops to a minimum of 140v at the a.c mains, the peak output voltage V_{out} (peak) is 10v and this proved to be high enough to power the output unit circuit components. The value of the peak output voltage (d.c) obtained at the 140v supply main was 6.36v which is good enough to power the integrated circuits (CMOS) in the output unit which requires a minimum of 3v to operate. All these values obtained were as a result of bridge rectification.

The bridge rectification gave high values than full wave rectification and this made it preferable over the full wave rectification.

Then if the primary voltage of the transformer falls is low as 140v then the secondary voltage would be 7V.

Ie

$$V_{peak} = 7 \times \sqrt{2} = 9.899 \approx 10V$$

Then,

$$V_{dc} = \frac{2V_{peak}}{\pi} = \frac{2 \times 9.899}{\pi} = 6.36V$$

e

3.2 TRANSMITTER SECTION

A transmitter by definition is electronic equipment that generates radio frequency energy for broadcast. The heart of the transmitter is an oscillation which converts DC current into an alternating current of the desired frequency. Infrared rays have an approximate frequency in Hertz between $3x10^{11}KH_z$ and $4x10^{14}KH_z$. The transmitter, for the purpose of this project is built around an n-p-n transistor (BC 337), which is designed amplify the voltage coming to the infrared LED from the voltage source (Battery) the purpose of this project is built around an n-p-n transistor (BC 337), which is designed amplify the voltage coming to the infrared LED from the voltage source (Battery)

The methodology behind this project is the ability of the receiving diode to respond to the light intensity that is falling on it (ie light intensity is being generated by the light emitting diode, LED). In which case the conductivity of photo receiving diode increase in proportion to the light intensity that falls on it.

The circuit diagram of the remote control is shown in figure below.

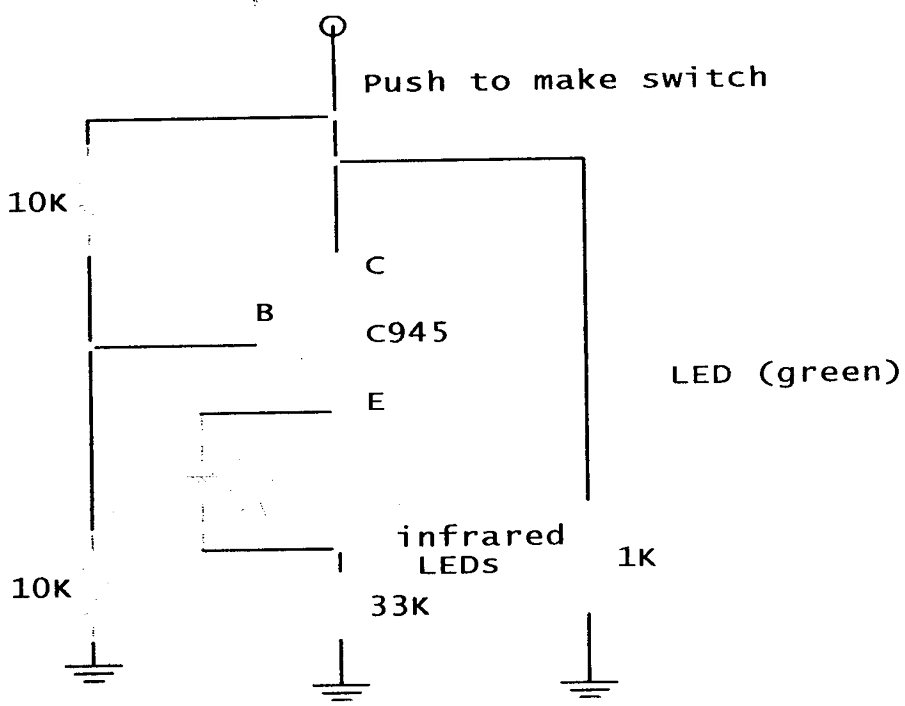


Fig 3.2: Infrared Remote Control Circuit

As shown in the diagram above, the circuit is just switch on the infrared LED, the transistor is there to amplify voltage, so as to increase the infrared emission. The 10KΩ resistors are to bias the n-p-n transistor. When the switch is pressed, the transistor is powered and infrared emits beams of light. In order to customize it and avoid false triggering. This project makes use of an infrared light working at a distance of about

It is also designed to operate at certain frequency which would easily be detected by the receiver circuit so as to customize the remote control system. From fig 3.2 illustration diagram of C945 transistor, the transistor (C945) varies from 100 to 600.

Choosing a gain (h_{fe}) =150 (for switching operation

V_{cc}=5v, V_{BE}= 0.7v

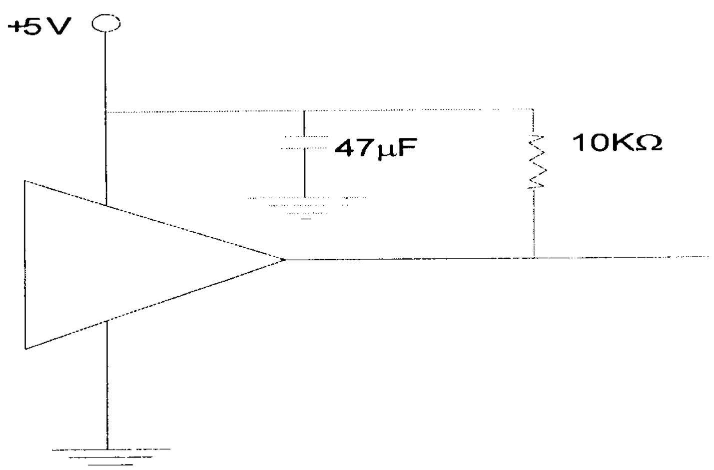
At saturation, V_{BE} =V_{CE}

$$V_{CE}(sat) = \frac{I_c}{h_{fe}} \cdots\cdots\cdots\cdots 3.4$$

$$= \frac{50\times10^{-3}}{150} = 3.3\times10^{-4}A$$

3.3 RECEIVER UNIT

For the transmitted infrared beam to be of any use, there must be a means of detecting the transmitted beam. The receiver unit performs this function using an infrared receiver and a 555IC Timer for the clock generation.



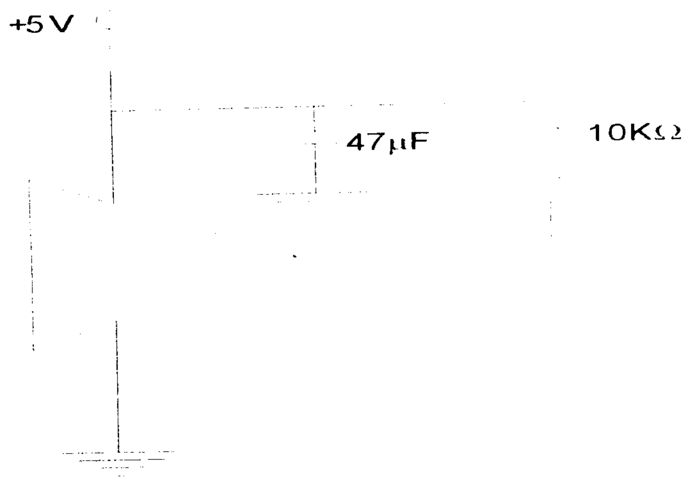


Fig 3.3: Infrared Receiver

3.3.1 CLOCK PULSE GENERATOR

The clock pulse generator is designed to operate on 5v d.c and use 555IC Timer connected in monostable mode. The 555IC timer has a wide range of operation of +5v to +15v on any d.c supply. It can sink current up to 200mA into its load. This type of logic circuit switches back and forth between two states in which one is stable at a time. The 555 timer connected in monostable state (set at 1s), is used to light the LED (green) to show that the infrared receive is sensing; if the LED does not come on, the infrared receiver is not sensing. When the high comes on pin 2 of the 555timer, the pin3 produces a low which lights the green LED, showing that the receiver is sensing.

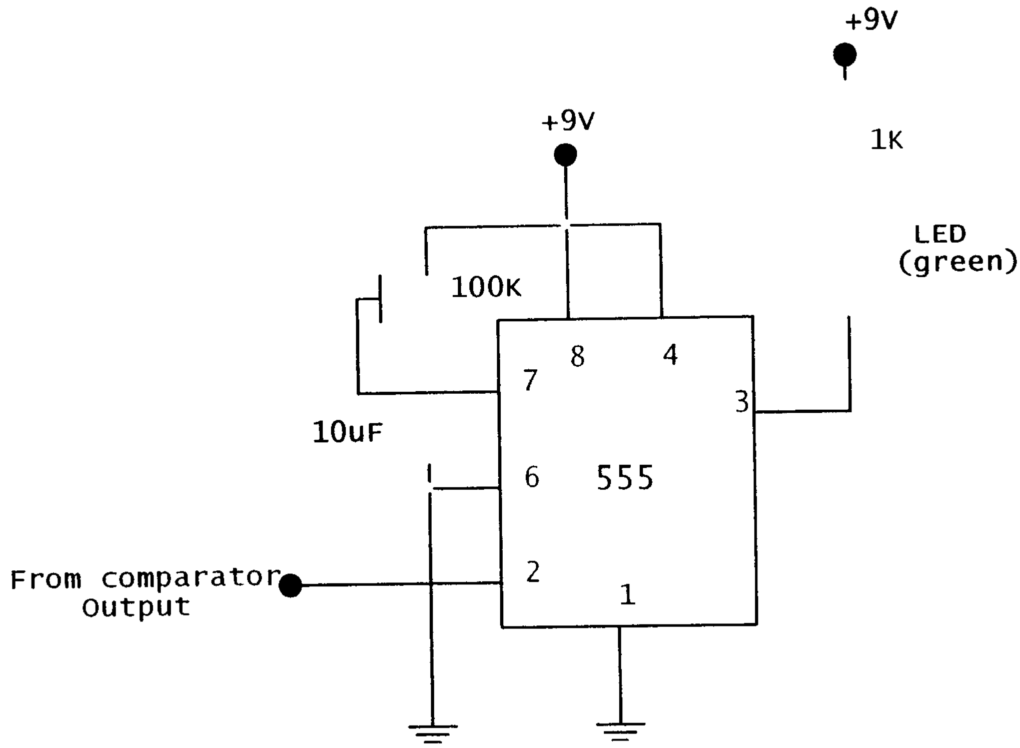


Fig 3.3.2: Clock Pulse Generator

The 1sec. timing of the 555 timer is to allow the green LED to light just when the receiver is sensing. The 1sec.timing is achieved by 100kΩ preset resistor and the 10µf capacitor, connected between pin7 and pin6, and it is calculated as follows:

$$T = 1.1RC$$

$$1 = 1.1 \text{ x} R \text{x} 10 \text{ x} 10^{-6} \text{ (for 1sec.)}$$

$$R = 1$$

$$\Rightarrow R = \frac{1}{1.1 \times 10 \times 10^{-6}} = \frac{1}{11 \times 10}$$

$$\therefore R = 90.9K\Omega$$

R = 90.9KΩ.which is why the look preset was chosen to set it to the required 90.9KΩ, for accuracy.

3.4 COUNTER STAGE

The 4017 is a 5- stage divide – by –Johnson counter with 10 decoded outputs and a carry-out bit. This counter is cleared to its zero count by a logic 1 on its reset line. The counter is advanced on the positive edge of the clock signal when the clock enable signal in the logic 0 state. The configuration of the 4017 permits medium – speed operation and assures a hazard free counting sequence. The 10/8 decoded outputs are normally in the logic 0 state and go to the logic 1 state only at their respective time slot. The carry –out signal completes full cycle for every 10/8 clock input cycles and is used as a ripple carry signal to any succeeding stages.

The CD4017BE is a decade counter belonging to the family of logic and analog switching circuits, fabricated according to the complimentary metal oxide semi conductor (CMOS)) technique. It is composed of standard logic circuits.

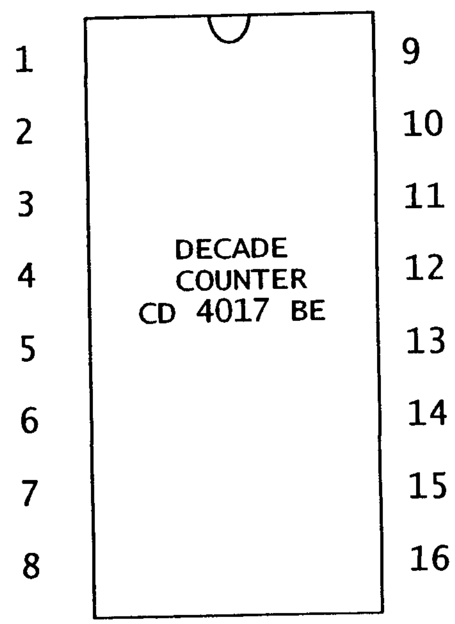


Fig 3.4.1: C.D 4017 Decade Counter Pin Layout

The circuit diagram of how the CMOS IC is connected is shown below in figure 3.4.2. The circuit out put is fed into the clock input of the 4017IC. The 4017 counter counts if there is a high at the clock input (pin 14), so when the receiver senses the infrared, the pin 1 which is connected to the clock input (pin 14) goes high, and the counter counts by sending high to pin2 which puts on the relay and the light dims. So for each high on the clock input, the equivalent relay is chosen which dims the light.

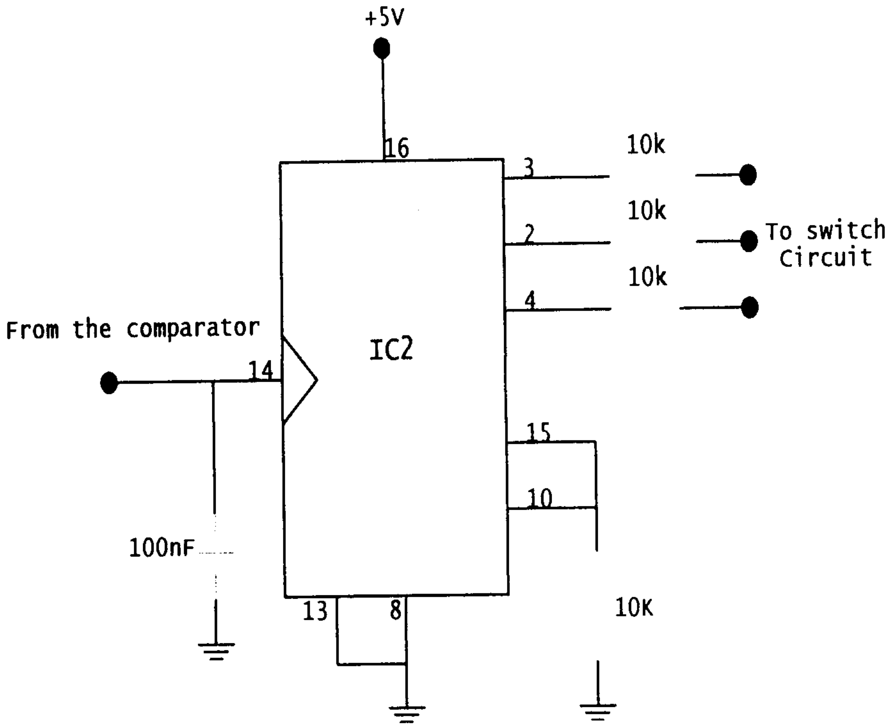


Fig 3.4.2: Counter Circuit Diagram

The 100nf capacitor connected to the clock input (pin 14) of the 4017 counter is to eliminate all other noise (unwanted signals) coming in from the 555timer pin15 (reset) is connected to pin 10, because we only want to count from 0 – 3, so since pin10 is 4, when the high comes to pin 10 which is 4, ie after pin 7 (3), it is sent to pin 15 which is reset and the counter reset to pin3 which is 0. So the dimming is achieved 3 times only. Pin3 (clock enable) is connected to the grand, because it is the requirement of the 4017

IC, to count successfully, while pin16 and pin8 are the power and the grand pin respectively.

3.5 SWITCHING NETWORK /DIMMING CIRCUIT

The lamp dimmer /switching circuit is the actual circuit responsible for the control of the light intensity. With several fixed resistors connected to the dimmer circuit, via relays, the control of light intensity can be achieved through the sequential network described in the subsequent sections.

Since we want to dim the load 3 times, we just need from 0-3, which is pin3, pin2 and pin4, connected to the relays. The diagrams illustrating switching network /dimming circuit is shown in figure 3.5.

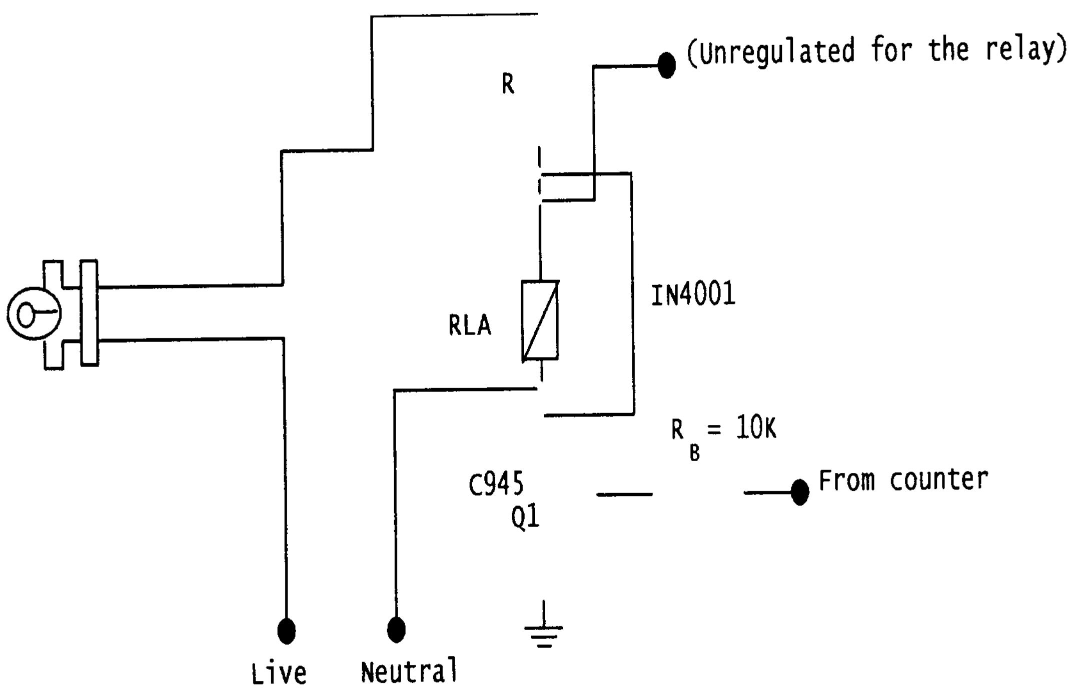


Fig 3.5: Transistor Switching Network/Dimming Circuit

R= Fixed resistors (0Ω, 200Ω, 330Ω). The dimming is achieved by connecting resistors (clock resistors, SW) to the normally open (NO) point of relays, which connect the bulb to the neutral of the A.C power, so higher values of resistors is used on the relays so that it help reduce voltage across the bulb, i.e relays 1 (0),relay 2 (200), and relay 3 (330). The first relay has no resistor, which is the highest point of the of the bulb; the subsequent relays are connected to resistors which dim the bulb.

When voltage passes across the coils of the relays, magnetic fields are set up and contact made. The relays connect the neutral terminal of the a.c mains to the fixed resistors, and reduced output voltage goes into load. The supply mains connected until another pulse is triggered by pressing the button in the infrared remote.

With another triggering pulse, the counter select relays -2 (RL_2), via transistor 2, and it again connect a.c main to resistor of higher value and so on. The IN4007 connected across the coils of the relay is to stop backward conduction from the coils. The transistor connected to the coil of the relay is to boost the voltage, so that the coil will work properly while the 10kΩ resistor is a biasing resistor. The C945 used was because the BC337 was not obtainable as at the time of this design and conclusion of the construction.

THE SWITCHING ACTION OF THE TRANSISTOR

The transistor used is C945 as switch. It has a resistor R_B at the base of the transistor and a relay coil which controls the illumination of the lamp as shown in fig 3.5 previously. By forward biasing the base emitter junction such that I_B is large enough to drive the transistor into saturation, the collector current attains maximum possible value and the relay is energized. The output of the counter are used to forward- bias the base emitter junction by connecting them to the base RB through to RB_4 (Refer to the complete circuit diagram)

THE OFF STATE

The collector current is zero, output voltage is equal to the voltage gain.

$I_c = 0, V_o\ V_A$

The ON state.

The output voltage is equal supply voltage,

$V_o = V_{cc}$ and $I_c = (V_A - V_{cc})/R_L$.(saturation)

To maintain this collector current, $I_B < I_C$. The relay resistance=400

gain of transistor, β(C945) =150

$V_{cc} = I_c R_c + V_{CE}$

$V_{cc} = I_c R_c + 0$ since V_{CE} is grounded.

$I_c = V_{cc}/R_c = 9/400 = 22.5mA$

$I_B = I_c/\beta = 0.15mA$

V_B is the out put voltage of the 4017IC, and is 1.48V (measured with multimeter)

$R_B = V_B/I_B = 1.48/0.15 \times 10^{-3}$

$R_B = 9.866K\Omega \approx 10K\Omega$.

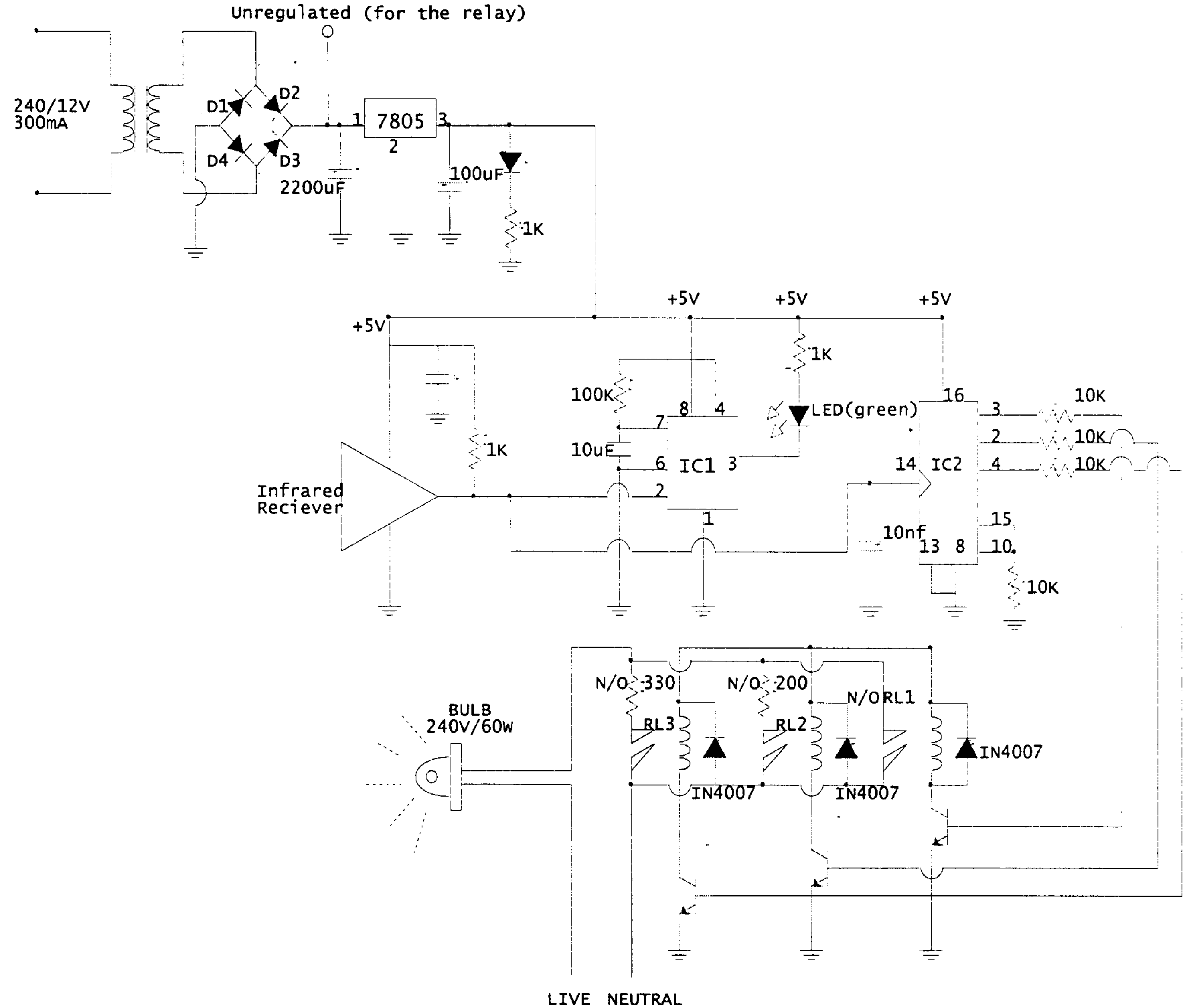


Fig 3.6: Transformer/Infrared Receiver/Counter Circuit/Dimming Circuit

CHAPTER FOUR

CONSTRUCTION, TESTING AND PACKAGING

4.1 CONSTRUCTION

Construction is the process of assembling the various components of a circuit together on a vero-board. In constructing the system all the various unit which made up the entire system wave followed in an orderly manner. This implies that the logical sequence which the system uses to operate was not broken. The point of commencement was the power supply unit followed by the transmitter unit, receive unit and eventually to the output unit which controls the intensity of the lamp.

The electrical circuit design was first assembled on a bread board. After it has been found to be functioning well to a vero-board. Care was also taken to ensure that the vero-board was free from corrosion by using a razor blade to clean the surface of the copper strips.

The resistors and capacitors as well as the connecting terminals were carefully connected on the vero-board. A 25w soldering iron was used in the soldering of the leads of the components on the vero-board. Care was also taken to prevent over heating of the component as this may cause damage to them.

To avoid damage to CMOSIC and 555IC timer, 16-pin and 8-pin sockets were used for the CMOS IC and the timer respectively. It was also ensured that shunt-circuit was taken of between adjacent copper strips on the vero-board during soldering.

In order to avoid possible shut-circuit, the continuous copper strips were cut where necessary at point where there is no electrical connection.

4.2 TESTING

On the connection of the construction, a thorough test was carried on the circuit to ensure that all the connection was done correctly and there was continuity in wires used for the connections. This means that the circuit was made free from wrong and bad connections as these may lead to the bridging of components before being powered. Tests were also carried out after the circuit was powers in order to ensure that the system is in proper working condition. Visual and equipment tests constitute the test-ran in order to ascertain a proper working condition of the circuit. The former relates to the test done before power was connected to the circuit while the later relates to the test done when the power was connected to the circuit.

4.2.1 VISUAL CHECK

There was a visual inspiration carried out on every connection and components before the power was introduced into the circuit and power attention was given to the following areas:

1. Checking that all resistors were connected in the right way.
2. Particular attention was paid to polarity of the diode during connection as well as making since they were connected in the right order.
3. Checking to ensure that there were no soldering bridge
4. Checking to if is any dry joint.
5. Checking to make sure that the power supply was properly positioned on the vero – board with particular attention paid to the polarity.
6. Checking to ensure that all wire links wave correctly located in their right places.

4.2.2 EQUIPMENT CHECK

The equipment check takes care of the following and other related areas:

i It ensure that the required voltage is supplied to the vero-board putting into consideration the current polarity

ii It ensure that the required voltages get to the board at the appropriate Points as required.

iii It checks to see and notice the voltage drop across each component irrespective of whether they are active or passive.

Iv It also check for continuity copper trace to components pin that look aright to the usual check but not functional because soldering point was not firmly bounded together or because of dry joint.

4.3 RESULTS

The following results were observed on the completion of the testing of the system.

The transmitter was tested and was found working properly with the receiver. The transistors which are common-emitter configuration were also observed to be in good order. The 555 Timer IC while contains an oscillator that generates frequency performed is function as delay circuit optimally. The relay which is normally open (NO) is activated or triggered into action by the driver (NPN transistors) through the 4017 CMOS, and in turn closed the a.c. supply powering the lamp connected to several fixed resistance. The relay however, required a minimum of 12V as stipulated by the circuit diagram.

4.4 PACKING

The transmitter unit was enclosed in a small circular plastic box with an opening through which the infrared beam can transmit. The receiver was enclosed in another plastic box bigger than that of the transmitter and provision was made for the infrared sensor to be able to receive the infrared beam from the transmitter. The receiving configuration circuits and output unit circuits are equally enclosed in this bigger casing. The infrared sensor which adversely affected by surrounding light rays is shielded from the rays in order to maintain its efficiency of the design

4.5 COMPONENTS USED

The following comprises wave used in the construction of this project work.

240/12V, 300mA Transformer, IN40007, 2200µf, 100µf, 1 K (2), 5v voltage regulator (7805), Infrared LED, 10kΩ (2No), 33Ω, 5v battery, LED indicator,1MΩ, 1K Ω, 4.7KΩ (variable), 100KΩ (variable), 1KΩ resistor, NESSSIC Timer, LED, Decade counter (CD4017BE), 100nf (3NO) resistor, bulb (60W/240V), 12relay (3NO) NPN transistor (C945 3 NO).

4.6 TOOLS USED

The following tools were used in the construction of this work.

1. BREAD BOARD
2. SOLDERING IRON
3. MULTISIM
4. MULTIMETER.
5. VERO-BOARD

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

The aim and objective of this project write has greatly been achieved, that is to say, the design and construction of a low cost, explicit and functional infrared activated remote controlled light dimmer.

As earlier stated in the preceding chapter, this effort in the field of infrared activated device provide adequate response and gives room rooms for future action of the others who are willing to explore topics related to it.

A well planned applications of this design will aid as the provision of comport in the public. Apart from the provision of comfort illumination provides, its inconvenience such as eye irritation due to expose of the eyes to bright light, can be eliminated. This shows the wide range of the application of the infrared in our daily lives apart from the conventional remote control and security alarm systems.

5.2 PROBLEMS

Before the completion of this project, some problems were encountered and those include:

i. Fluctuation in voltage supply: when the voltage falls below 12v, the integrated circuits (ICs) involved being CMOS in nature can still function because they operate between the range of 3-18v. However, the relay required a minimum of 12v to function and therefore, this design required a steady voltage source to function efficiently

ii. Setting a desired delay time. As earlier stated, the delay time depends on the value of the external capacitors and resistors, since the frequency generated is usually given by the relation $f = 1/T$. For this reason, raising the values of the frequency and this increase the delay time according to another relation which is $T = 1.1\ RC$

Where T is the period (time)

C is the external capacitor

R is the external resistor

5.3 RECOMMENDATIONS

In this design and construction, the aim of designing a remote controlled lamp dimmer i.e control the intensity of a light source to a desired voltage, is to avoid damage to eyes which cannot withstand high light intensity and wastage of electric energy because some times the full brightness of the light is not required especially when a person is sleeping.

So, having it at the back of our mind that the fact that the use of automated system in our everyday lives has come to stay, the importance of this infrared cultivated light intensity controlling system cannot be over emphasized.

Using the success achieved in this project and the limitations recorded as a yardstick, the following recommendations should be taken into consideration.

i. The system could be modified to control the speed of an a.c motors such as ceiling fan stand fan, kitchen exhaust fan e.t.c.

ii. Students should be encouraged to under take research in the numerous ways of application of infrared to activate different systems.

iii. The system should not be dumped in the store but be modified through further research to higher application in our daily lives.

iv. It is also recommended for use in our homes and school dormitories where it is required that all lights should be switched off reduced to a minimum intensity before going to bed.

v. Finally, it is required to be used in the theaters and the photo studio when different light intensities are needed to carry out some specific jobs.

REFERENCES

1. M.Nelkon and Parker: Advanced Level Physics, Heinemann Educational press, Ibadan, Nig 2nd Edition Pp 217-218.
2. www.Elevtronic-circuit diagram.com
3. B.L Theraja and A.K Theraja: " Electrical technology", S. Chand and Company Ltd, 1999, ISBN 81-219-0289, Pp 1743-1761.
4. D.C Green: Electronic II", Pitman publishing Ltd 11978, ISBN 0-582 – 23915 x, Pp 27-50
5. J.H and Fredric and F.P Gerald: Pitman publishing introduction to Switching theory and logical Design: Minerva Publishing, London, 1991, 3rd edition Pp73-80
6. N. Power : Electronic, Technology Handbook, Mc Graw, Hill Compar Ltd, New york,1999.
7. I. E Sunday : Light Dimmer with Automatic Sequential Light intensity control system ; Dept. of Electrical Engineering, Kaduna Polytechnic, Kaduna Nig. (Unpublished
8. R.M Marton : Today Electronics, An ETI supplement on 555timers applications, Epirus England pp41-45
9. L.I. Williams: " Introduction to modern Electronics' John Wiley and Sons Inc, 1991, ISBN 0-471 -6224-7 Pp N3 -263
10. A.M. Kefas : Simple Light Dimmer; Dept of ElectricalEngineering Kaduna Polytechnic, Kaduna, Nig (unpublished)
11. A.E Fitzgarald : 'Basic Electric Engineering" M_c graw – Hill Inc. ISBN 0-07-021154 0-07-021154- X 1981 Pp 443 -465
12. www.soft copy. Co. UK /index.

11. A.E Fitzgarald : 'Basic Electric Engineering" M_c graw – Hill Inc. ISBN 0-07-021154 0-07-021154- X 1981 Pp 443 -465

12. www.soft copy. Co. UK /index.

APPENDIX

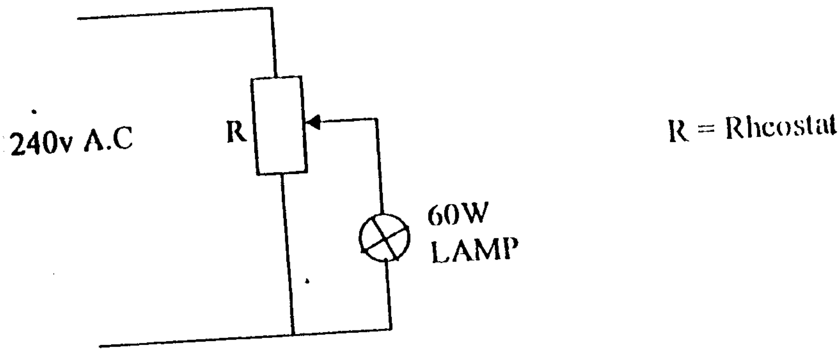


Fig. I(a): Lamp Dimmer Circuit Using a Rheostat

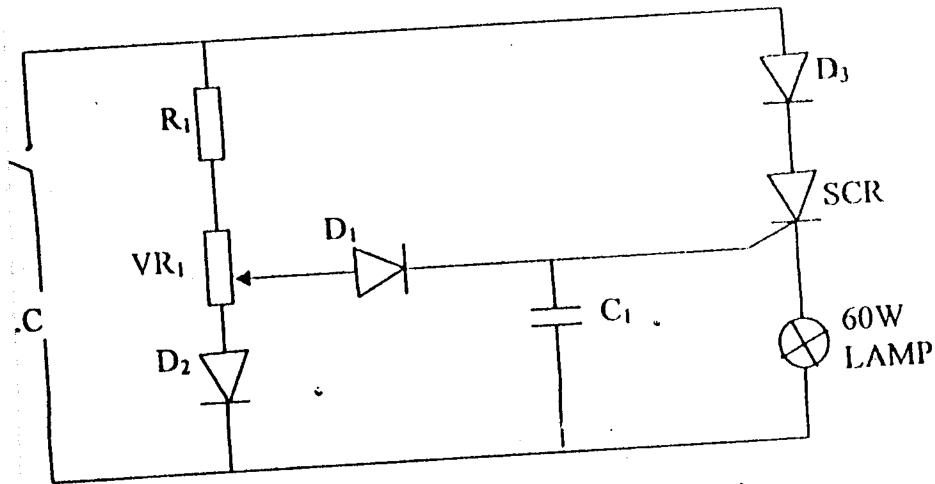


Fig. I(b): Lamp Dimmer Circuit Using a Thyristor

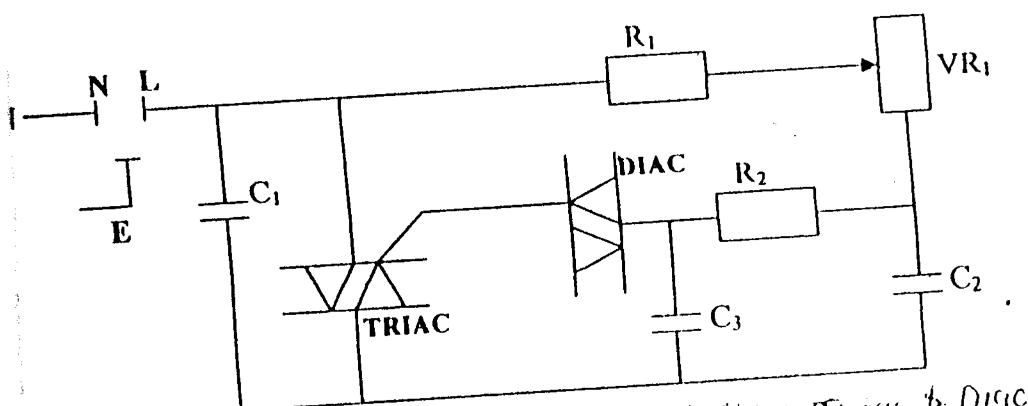


Fig. 1(c): Lamp Dimmer Circuit Using Triac & Diac