DESIGN AND CONSTRUCTION OF A UNIVERSAL INFRARED REMOTE CONTROLLED SWITCH

BY

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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.

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DEDICATION:

I dedicate this work to my parents without the support of whom it wouldn't have been Possible. May Allah grant them eternal joy and happiness amen.

DECLARATION

I hereby certify that this project, titled "Design and construction of a universal infrared remote controlled switch" was solely carried out by NAZIFI IDRIS KHALID under the supervision of Mrs. Caroline Alenoghena and submitted to the department of electrical and computer engineering, Federal University of Technology, Minna.

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ACKNOWLEDGEMENT:

What could have been accomplished without the will of the Omnipotent Allah? Virtually nothing. Thus my profound gratitude in no measurable terms to him for making this work possible.

My sincere appreciation goes especially to my noble parents who through thick and thin have always stood to see me through to the end of this course and this work.

I also express my thanks to all the staff and student of the department of electrical and computer engineering, FUT minna, some of whom are: my HOD Engr. Musa .D. Abdullahi, Mallam M.S. Ahmed, my level adviser Mr. J.G Kolo, Malam Suleiman zubairu and many others too numerous to mention.

I would also acknowledge the great contributions of my school based project supervisor: Mrs. Caroline Alenoghena for her critical and constructive criticisms and contributions during this work and for taking the pains to read through over and over and for making valuable suggestions in making the work possible. Thank you once again.

Finally I wish to put to record the support of all my friends, my brothers at home and abroad and well wishers, my fellow course mates: Abubakar D. Abubakar, Ahmad Mungadi, Abdulbasit Saeed, and many of whom the whole of these pages cannot contain me to mention for their spiritual and moral support and assistance during the course of my stay and especially during this thesis. I thank you all.

ABSTRACT:

This project work is based on the design and construction of a universal infrared remote controlled switch, it is universal in the sense that any button of any remote control will trigger it provided it is pressed and held for the required time delay (approximately 2 seconds). The prototype can be used to switch on or switch off electrical/electronics equipment such as TV sets, CD players electric fan. The project has three sub circuits, the power supply, the switching circuit and the external circuit. Ideally, the external circuit supposes to be any of the above mentioned loads like electric fan. But as a model here, a disco light indicator was chosen as the load circuit.

As all remote controls generate infrared pulses of the range of 850-950nm, this is detected by the infrared module on the receivers circuit and generates a modulated signal which is buffered by the hexagonal buffer(4069) and further buffered by the IN4148 diode before been fed onto the trigger of a 555 timer connected in a monostable state, this triggers the 555 timer which then generates a one shot pulse that clocks a D- type flip-flop and gives a high which puts the relay on normally closed (NC) and the external circuit is the powered on via the relay contacts. If the remote is pressed again for the same time delay, the monostable 555 timer gives another one shot pulse which resets the flip flop and thus put the relay on normally open state which cuts off the power supply to the external circuit. The whole system functions as a single channel in that it can only control one external load at a time.

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CHAPTER ONE

INTRODUCTION

1.1 Introduction:

Infrared remote controlled appliances are so common nowadays that they are found in virtually every home and are used in switching and controlling mostly electronic gadgets like TV, video sets, CD players etc.[15] All at the users convenience.

As a result of the convenience and comfort derived from having a control of most of the electronic house appliances by mere pressing of a button from a distance, it becomes a matter of interest to expand this convenience to both electrical and non electrical devices such as lightening of a bedroom bulb or even opening and closing of house entrance gates, doors and windows using infra red remote control.

As such, this project features a single channel (on / off) universal switch that may be used with any Infra Red remote control that operates with the wavelengths of 850-950nm. It can be used to turn on or turn off any circuit that is attached to it via the relay. For example night lamp, electric door, electric gate or air conditioner; virtually any house hold appliance.

Universal as its name suggests means; any "button" of any remote control may be used to work this universal switch. The button must be pressed for two seconds delay before the relay will operate. Once operated, the circuit will remain in this state (latched) until reset. To reset it therefore; any button is pressed and held for the same time delay. For example, if the user is watching TV, and the TV set was tuned to Channel 3, mere pressing and holding the TV remote control's channel 3 button for two seconds; That way the TV viewing would not be affected and the relay would activate. The relay can be connected to anything provided the relay contacts can handle the rated voltage and current of the load. [1]

1.2 Objectives:

The main objective of carrying out the Design and construction of an infrared remote controlled switch is to develop a circuit that can be used to switch on or off any appliance connected to it (via relay) by means of any infrared remote control that operates between wavelengths of 850-950nm. This will bring so much convenience and ease in the household by saving the time and energy of the user especially the physically challenged.

1.3 Methodology:

To achieve the stated objective, the following steps were adopted:

1. Consultation was made to relevant texts, journals, magazines, websites and individuals to have a good understanding of the theory behind the principles to be employed.
2. Identifying the components that will make up the units of the entire project.
3. The data and specifications of the required components were obtained from a data sheet (book). And from data sheets websites.
4. Carrying out circuit design analysis based on operation requirements.
5. Finally, the designed circuit is built, packaged and tested.

1.4 Scope of work:

The scope of this project (project thesis) is as follows:

1- Building an infrared receiver that can be operated using any button of any remote control.

2-Building a model load which the infrared switch circuit is desired to control (A green, red disco light indicator).

3-Incorporating the two circuits (i.e. the switch circuit and the load circuit) together so that they can work.

1.5 Limitations:

Limitation in carrying out project works is something which can never be avoided. The only limitations of this project are:

1- Since the circuit can be triggered by any remote control provided it reached the delay time, it is bound to activation by picking undesired signal by any infrared transmitter even if it was not desired to be activated. As such, it should be properly placed in a location in the room so that the remote control should "see" it only when it is desired to be operated.

2- The circuit is only a single channel on/off switch so it can only control a single appliance at a time.

CHAPTER TWO

LITERATURE REVIEW/THEORETICAL BACKGROUND

2.1 Literature review:

The first remote control called "lazybones" was developed by Zenith Electronics in 1950. [16] It uses a cable that ran from the device, which then was a TV set to the viewer. It drives a motor in the TV set by pushing buttons on the remote control. Viewers rotate the tuner clockwise or counter clockwise depending on whether they want to change the channel higher or lower number. The remote control includes a button that turned the TV on and off.

Although customers like having remote control for their television, they complain that people accidentally tripped on the unsighted cable that smeared across the room floor. It was then that the zenith company's engineer Eugene Polley invented the "flashmatic". Which represents the industries first wireless remote control; Introduced in 1955, it operates by means of four photocells, one in each corner of the TV screen. The viewer used a highly directional flashlight to activate the four control functions, which turned the picture and sound on and off and changed channels by turning the turner dial clockwise or counterclockwise.

While it pioneered the concept of wireless remote control, the "flashmatic" had some limitations. It was simple device that had no protection circuits and if the TV was placed in an area in which the sun shone directly on it, the turner might start rotating. This limits the concept of the "Flashmatic". Commander McDonald, the company's director, loved the concept of the polleys "flashmatic" and directed his engineers to develop a better remote control. First thoughts pointed to radio waves. But because radio waves travel through walls, radio waves could inadvertently control TV set in an adjacent room. So, using sound signals was discussed, but zenith engineers believed people might not like hearing sound that may become characteristics of operating the TV set through a remote control. As such therefore, Dr Robert Adler suggested using "ultrasonic" (that is high frequency sound beyond the range of human hearing) [17]. He was assigned to lead a team of engineers to work on the first use of ultrasonic technology in home as a new approach for a remote control.

By the 1980s the company moved to infrared or IR remote technology. Infrared Radiation is the emission of energy as electromagnetic waves in the portion of the spectrum just beyond the limit of the red portion of visible radiation. [18]

The wavelengths of infrared radiation are shorter than those of radio waves and longer than those of light waves. They range between approximately 10^{-3} and 10^{-6}nM. Infrared radiation may be detected as heat, and instruments such as bolometer are used to detect it. [3]

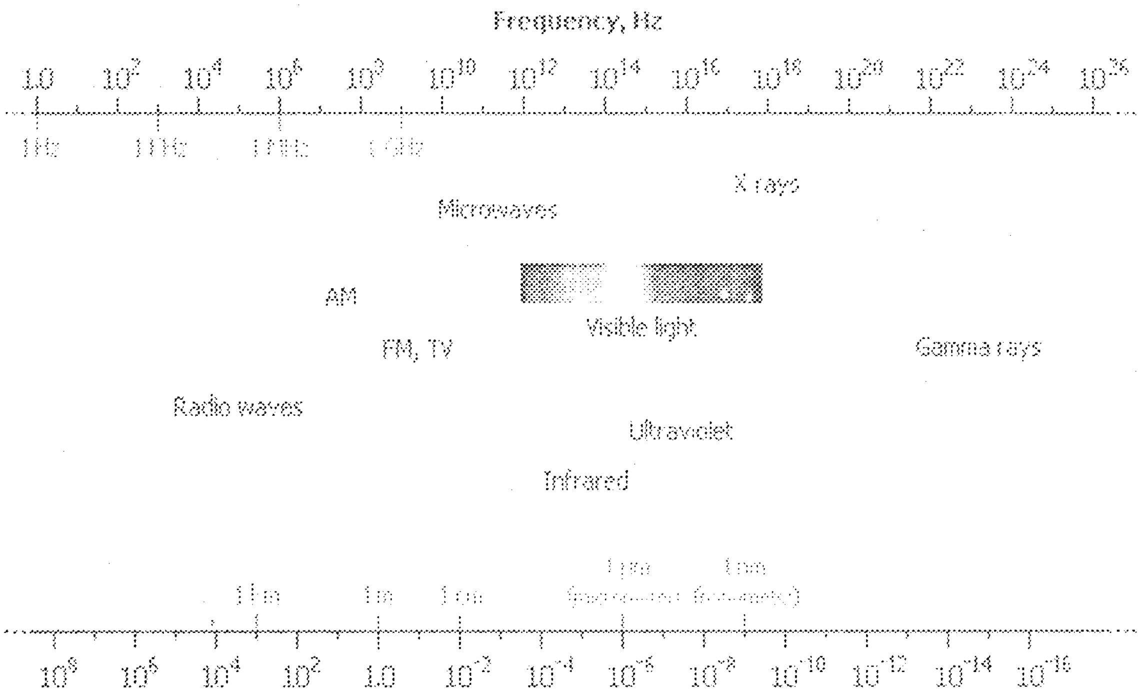


Fig 2.1: Electromagnetic spectrum showing the range of infrared radiation.[4]

2.2 Theoretical Background:

This project features a single channel (on / off) universal switch that may be used with any Infra Red remote control that operates with the wavelengths of 870-950nm. It can be used to turn on or turn off any circuit that is attached to it through the relay. For example night lamp, electric door, electric gate or air conditioner; virtually any house hold appliance.

Universal as its name suggests means; any "button" of any remote control may be used to work this universal switch. The button must be pressed for two seconds delay before the relay will operate. Once operated, the circuit will remain in this state (latched) until reset. To reset it therefore; any button is pressed and held for the same time delay. For example, if the user is watching TV, and the TV set was tuned to Channel 3, mere pressing and holding the TV remote control's channel 3 button for two seconds; That way the TV viewing would not be affected and the relay would activate. The relay can be connected to anything provided the relay contacts can handle the rated voltage and current of the load. [5]

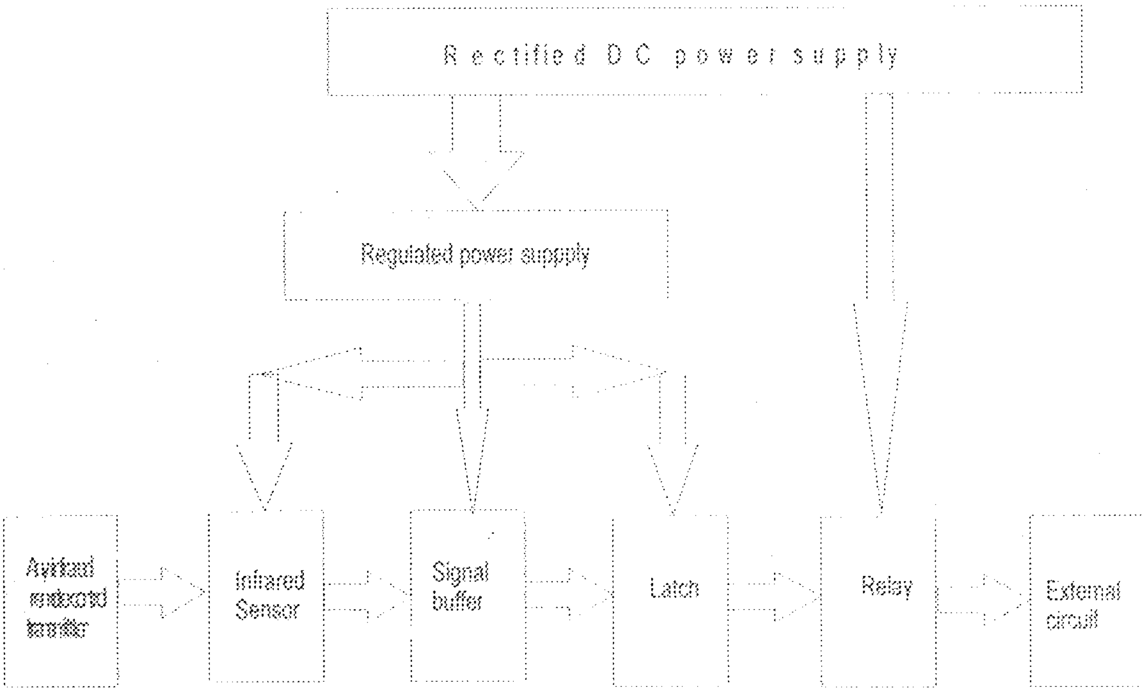


Fig2.2 Functional Block Diagram of the Infrared Remote controlled Switch

2.2.1 The power supply unit:

This is a 12V power supply from a transformer of 220V AC power supply source. It is the main power supply to the circuit. It supplies the 12V rated relay circuit directly and also serves as the supply source for the 5V regulator IC in the regulated power supply for powering of the TTL/CMOS IC components that make up the rest of the circuit.

2.2.2 The infrared sensor unit:

This consists of the infra red module which is the transducer that receives the infrared signal from the transmitter and modulates into a wave train of modulated electrical signal. PIN diode and preamplifier are assembled on lead frame, the epoxy package is designed as IR filter. The demodulated output signal can directly be decoded by a microprocessor. TSOP12. Is the standard IR remote control receiver series, supporting all major transmission codes. [6]

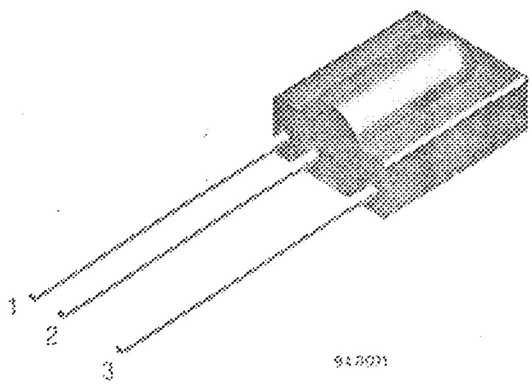
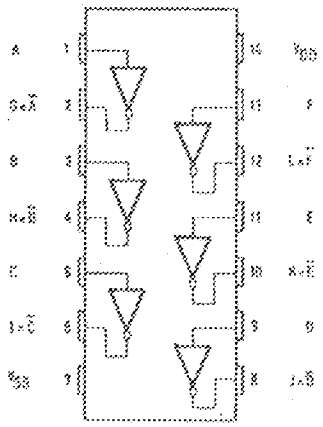


Fig 2.3 a TSOP12. Infrared module sample. [6]

2.2.3 The signal buffer circuit:

This consists of NOT gate hexagonal inverter, a time delay circuit and a 555 timer connected in a mono-stable state which processes the modulated signal and sends a one shot output that is needed to trigger the latch (which is a D-type flip-flop).



Inputs	Output
A	Y
L	H
H	L

Fig 2.4 a 4069. Hexagonal inverter IC and its truth table. [7]

2.2.4. 555 Timer general description:

The 555 timer IC was first introduced around 1971 by the Signetics Corporation as the SE555/NE555 and was called "The IC Time Machine" and was also the very first and only commercial timer IC available. [8]

The LM555 is a highly stable device for generating accurate time delays or oscillation. Additional terminals are provided for triggering or resetting if desired. In the time delay mode of operation, the time is precisely controlled by one external resistor and capacitor. For astable operation as an oscillator, the free running frequency and duty cycle are accurately controlled with two external resistors and one capacitor. The circuit may be triggered and reset on falling waveforms, and the output circuit can source or sink up to 200mA or drive.

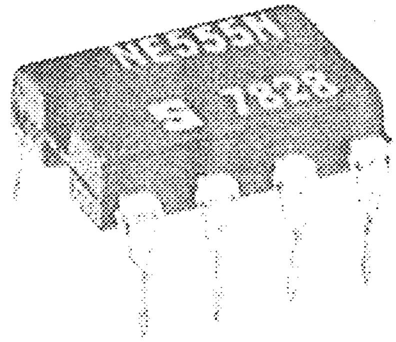
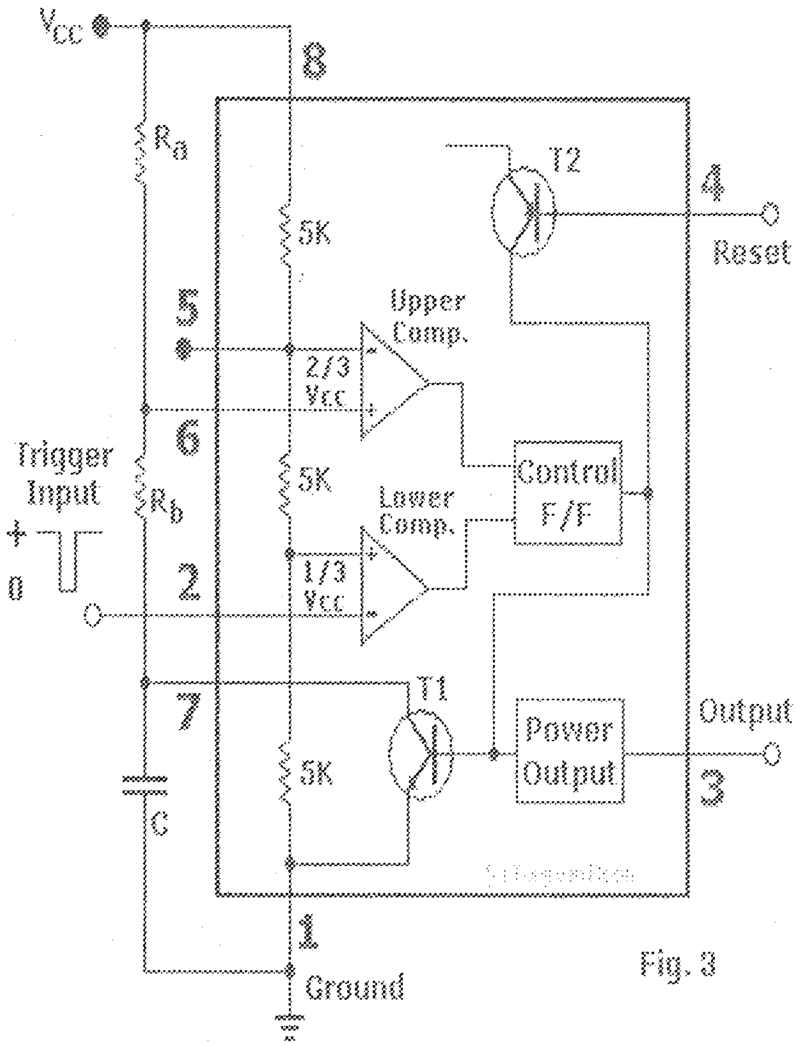


Fig 2.5 A typical 555 timer IC [14]



1.

Fig 2.6 Pin Connection diagram of a 555 timer (Plan view) [9]

Monostable operation:

In this mode of operation, the timer functions as a one-shot. The external capacitor is initially held discharged by a transistor inside the timer. Upon application of a negative trigger pulse of less than (1/3)Vcc to pin 2, the flip-flop is set which both releases the short circuit across the capacitor and drives the output high.[10]

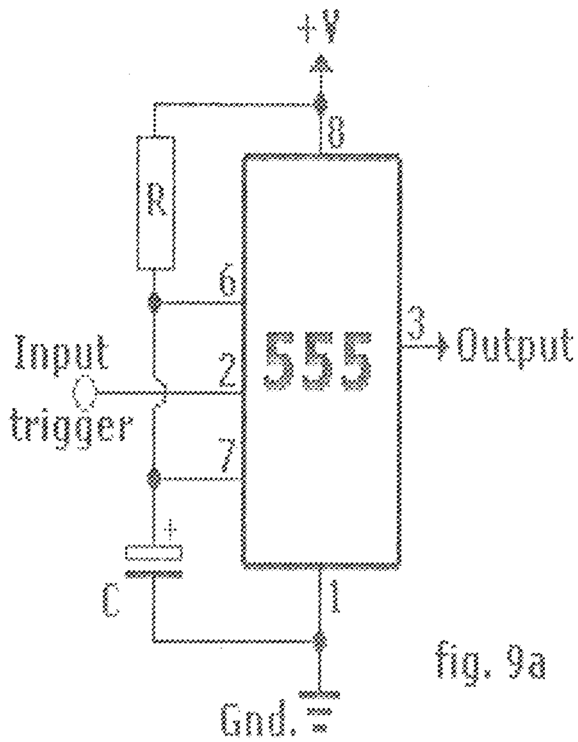


Fig 2.7. A 555 Timer connected in a monostable state [9]

During the timing cycle when the output is high, the further application of a trigger pulse will not affect the circuit so long as the trigger input is returned high at least 10μs before the end of the timing interval. However the circuit can be reset during this time by the application of a negative pulse to the reset terminal (pin 4). The output will then remain in the low state until a trigger pulse is again applied. When the reset function is not in use, it is recommended that it be connected to Vcc to avoid any possibility of false triggering.

Whenever a trigger pulse is applied to the input, the 555 will generate its single-duration output pulse. Depending upon the values of external resistance and capacitance used, the output timing pulse may be adjusted from approximately one millisecond to as high as on hundred seconds. For time intervals less than approximately 1-millisecond, it is recommended that standard logic one-shots designed for narrow pulses to be used instead of a 555 timer. IC timers are normally used where long output pulses are required. In this application, the duration of the output pulse in seconds is approximately equal to: [8]

$$T = 1.1 \times R \times C \text{ (in seconds)}$$

2.2.5 The latch unit:

This according to Microsoft e-dictionary: is a device for keeping doors shut: a device for holding a door, gate, or other opening closed consisting of a movable bar that drops into a hole or notch. [4]

Latches are registers used to hold a set of bits. That is, their output follows the input when enabled and holds the last value when disabled. Example of latches is the D Type flip-flops [11]

The latch is introduced in this circuit in order to serve as a one way switch Which holds the relay on/ active permanently when triggered and would no off It until when it received another cycle of clock signal.

The SN74LS74A dual edge-triggered flip-flop utilizes Schottky TTL circuitry to produce high speed D-type flip-flops. Each flip-flop has individual clear and set inputs, and also complementary Q and Q outputs. Information at input D is transferred to the Q output on the positive-going edge of the clock pulse. Clock triggering occurs at a voltage level of the clock pulse and is not directly related to the transition time of the positive-going pulse. When the clock input is at either the HIGH or the LOW level, the D input signal has no effect. [12]

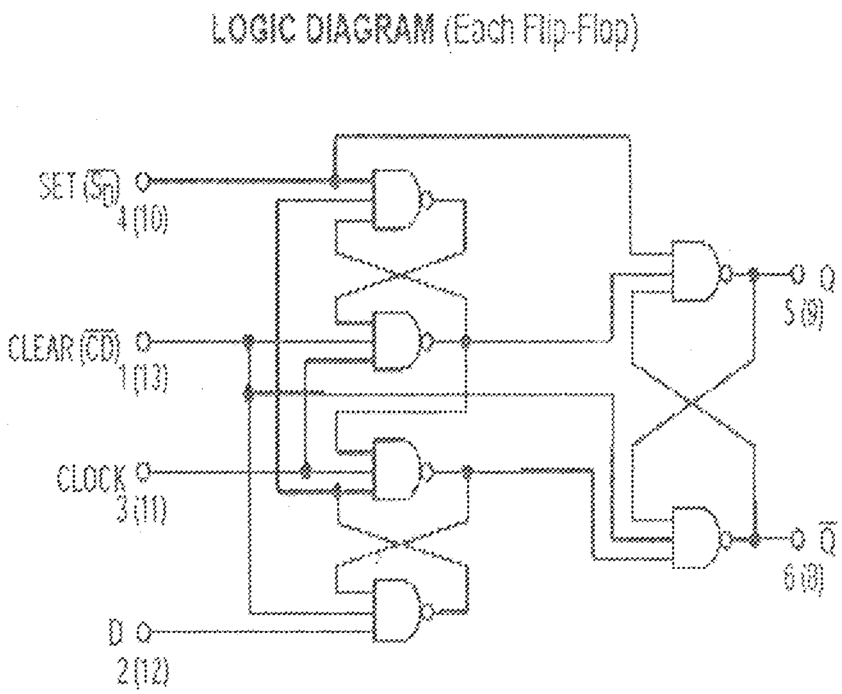


Fig 2.8logic diagram of the D type flip flop.

MODE SELECT - TRUTH TABLE

OPERATING MODE	INPUTS			OUTPUTS	
	$\overline{S}_D$	$\overline{S}_D$	D	Q	$\overline{Q}$
Set	L	H	X	H	L
Reset (Clear)	H	L	X	L	H
*Undetermined	L	L	X	H	H
Load "1" (Set)	H	H	h	H	L
Load "0" (Reset)	H	H	l	L	H

Table 2.1 truthtable of a DTYPE flip-flop [12]

*Both outputs will be HIGH while both SD and CD are LOW, but the output states are unpredictable if SD and CD go HIGH simultaneously. If the levels at the set and clear are near VIL maximum then we cannot guarantee to meet the minimum level for VOH.

H, h = HIGH Voltage Level

L, l = LOW Voltage Level

X = Don't Care

l, h (q) = Lower case letters indicate the state of the referenced input

i, h (q) = (or output) one set-up time prior to the HIGH to LOW clock transition.[10]

2.2.6 The relay unit:

Relays are components which allow low power circuit to switch a relatively high current ON and OFF, or to control signals that must be electrically isolated from the controlling circuit to the controlling unit. [19]

To make a relay operate, you have to pass a suitable 'Pull in' and 'Holding' Current (DC) through its energizing coil. Relay coils are designed to operate from a particular supply voltage often 12V. In each case the coil has a resistance which will draw the right pull – in and holding current when connected to that supply voltage. [13]

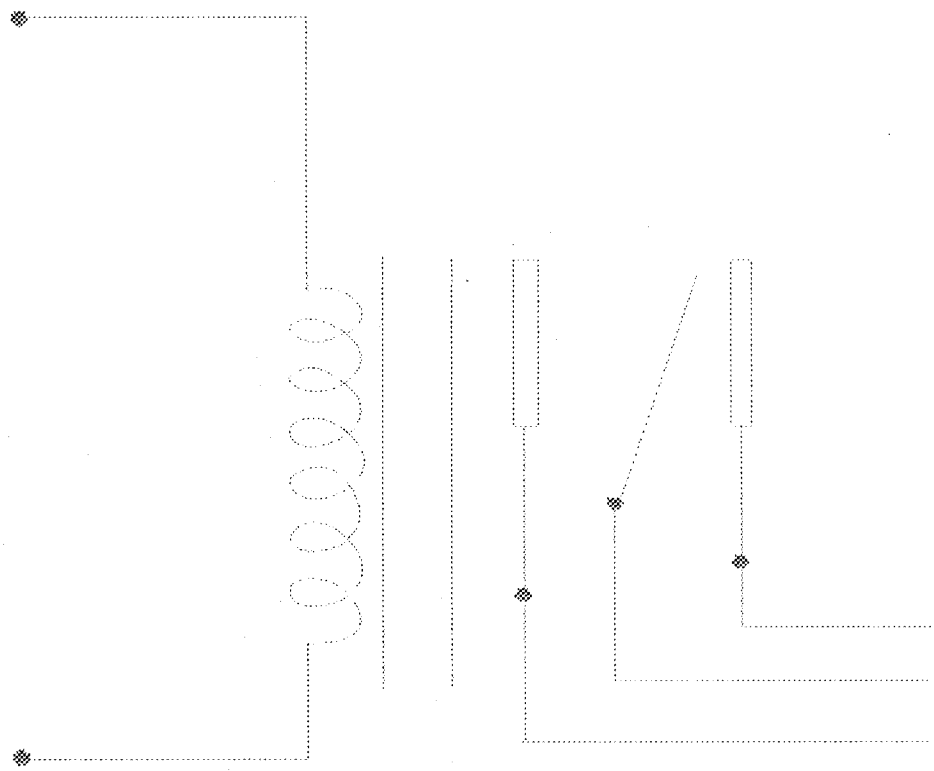


Figure 2.9: relay diagram

CHAPTER THREE

DESIGN AND IMPLEMENTATION

3.1 Functional block diagram of the design work:

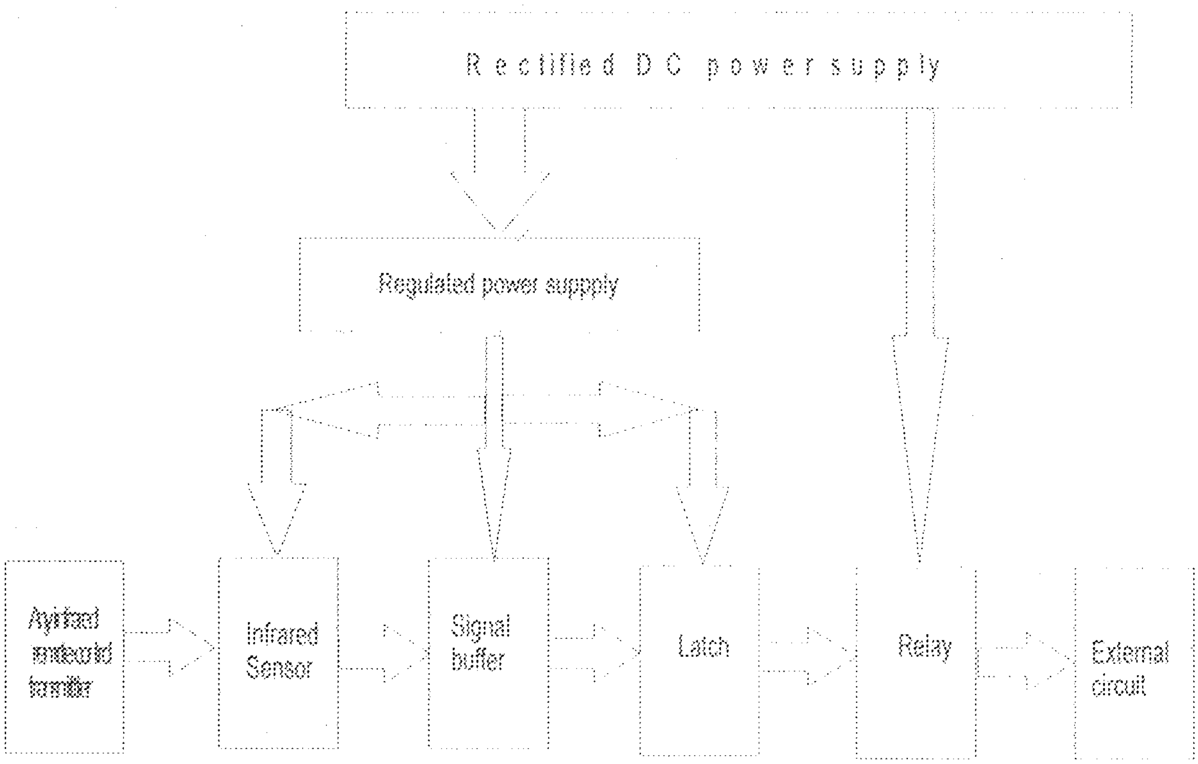


Fig 3.1The functional block diagram

3.2 Design of the power supply unit:

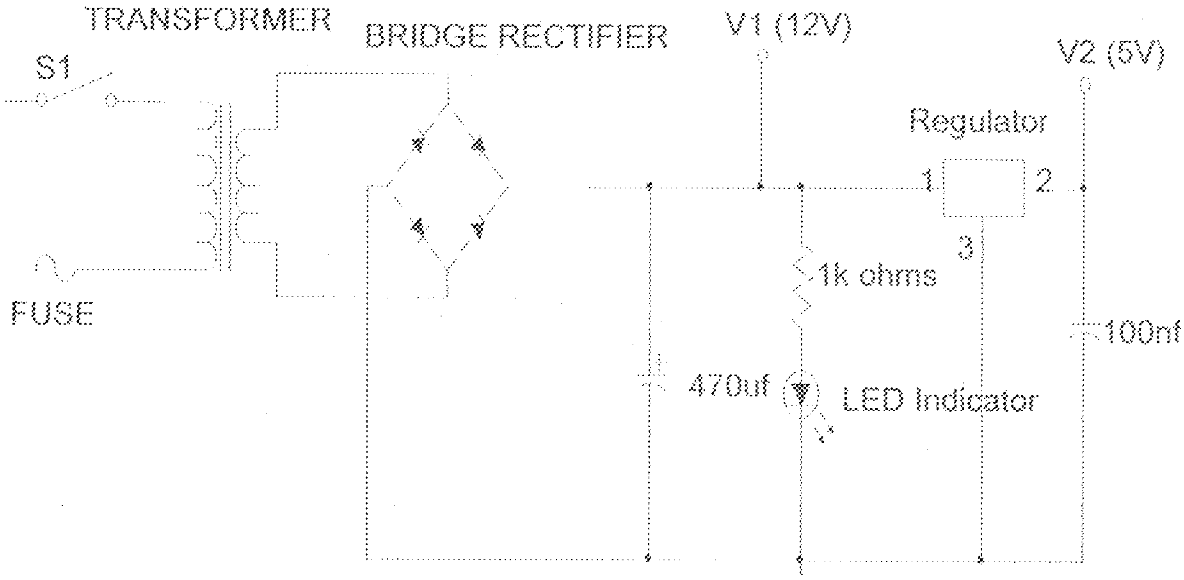


Fig 3.2: the complete two way power supply unit:

3.2.1 Design of the Transformer:

A standard transformer of 220V to 12Vwas chosen for convenience.

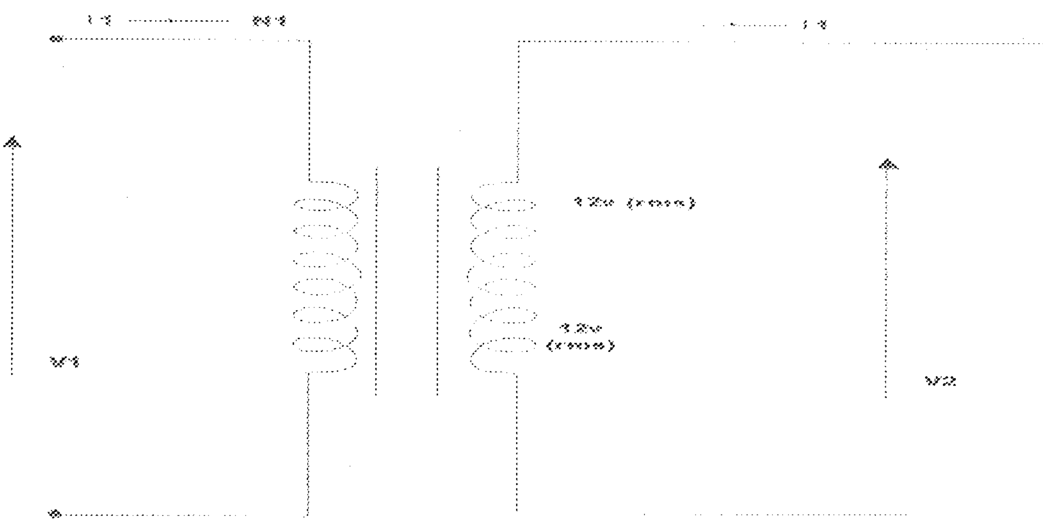


Fig 3.3: a transformer diagram

3.2.2 Design of the Rectifier:

A bridge rectifier was chosen to provide a full wave rectification. IN 4002 rectifiers were chosen.

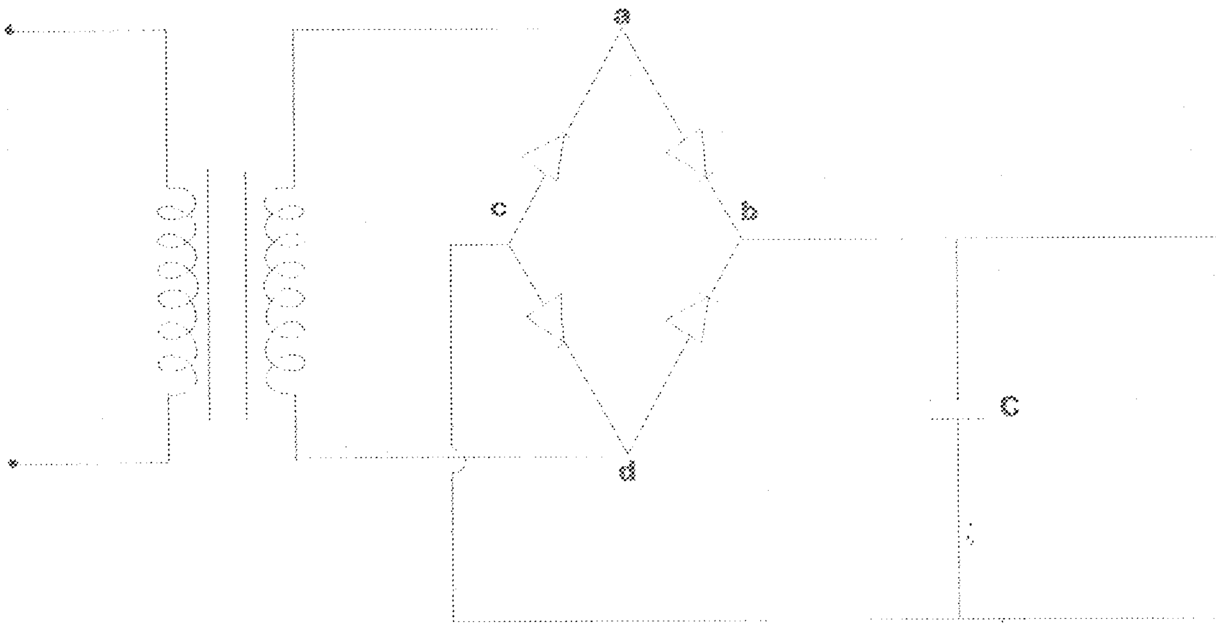


Fig 3.4: transformer and rectification circuit.

3.2.3 Filter:

$$C = \frac{1}{4\sqrt{3}F\,Rrf} \quad \text{------------------------------------ Equation 3.1}$$

Where	C	=	The capacitance of the capacitor
	F	=	The frequency of the supply voltage
	R	=	Resistance of the overall circuit
	Rf	=	Ripple Factor $= V_{rms}/V_{dc} = .00001\%$

F = 50Hz, Rf = 0.0001% R = 170kΩ

Substitute for the values to calculate C:

Thus: $C = \frac{1}{4} \times \sqrt{3} \times 50 \times 170000 \times 0.0001$

$C = 470\mu f$ (approx.)

3.2.4 The Voltage Regulator:

The regulator of 7805 series having a 1 – 5 voltage output was used.

3.3 The infrared sensor and indicator unit:

3.3.1 The infrared module:

The first component is the Infra Red module. IR modulated pulses are received and buffered by this IC. It has a standard TTL output, the output with no signal is held high by R1. One gate of a CMOS inverter drives the LED D1 as a visible (blinking) switching aid. The 1k ohm resistor is introduced in order to limit the current passing to the LED so as not to destroy it. Capacitor C1 is introduced so that it gives the LED a blinking effect by alternately charging and discharging through the 1k ohm resistance.

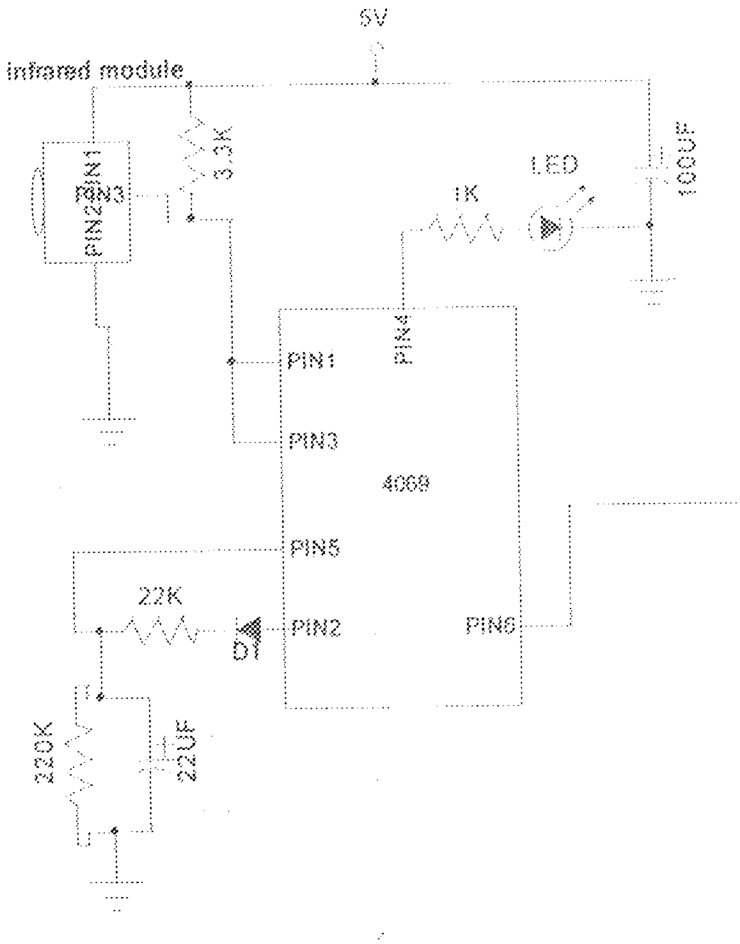


Fig 3.5: the transducer circuit

Another gate buffers the signal and further buffered by the diode D1 (IN4148) and then applies it to the time constant circuit shown below:

3.3.2 Delay Circuit:

The delay comprises of R3, C2, R4 and D1. As shown below:

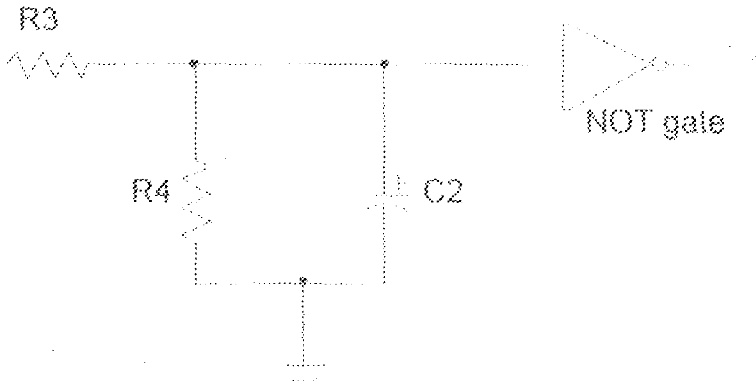


Fig 3.6: the time delay and buffer circuit:

C2 charges via R3, and discharges via R4. D1 prevents quick discharge via the low output impedance of the CMOS buffer. The time taken to charge a capacitor is the product of resistance and capacitance, more commonly known as the RC time constant. At one RC a capacitor will only charge to 63% of the supply voltage. It takes 5 RC"s for a capacitor to reach 99% charge. In this circuit the capacitor charge has to reach the logic threshold of the CMOS inverter.

As the power supply is 5 Volts,

The input threshold is around 3.6V,

Which takes about 3RC'S.

Or about 1.5 seconds to completely charge the capacitor. Once reached the inventor triggers the 555 timer which is connected in a monostable state with a time delay of about two seconds.

3.3.3 The monostable 555 timer:

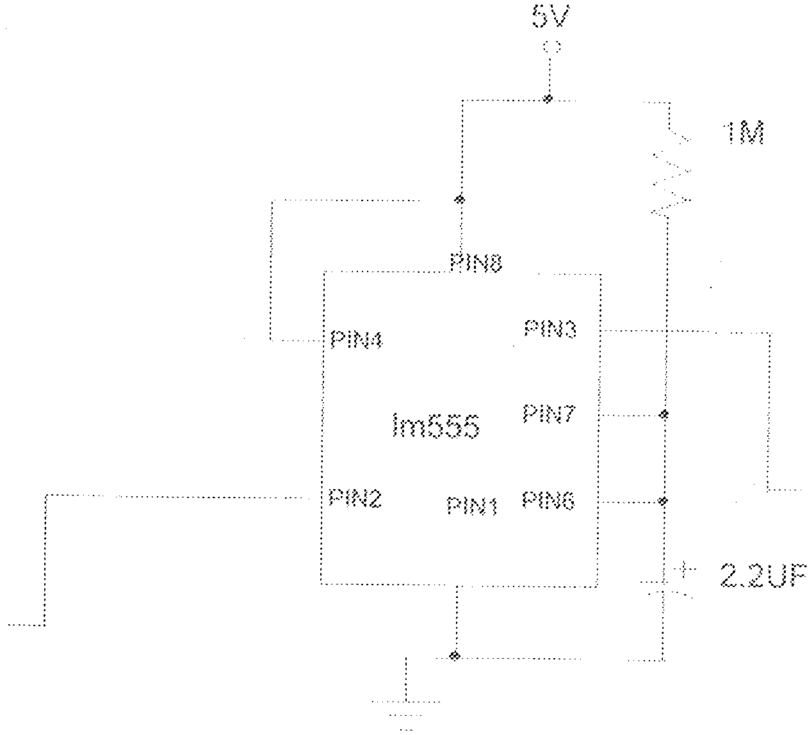


Fig 3.7: the one shot monostable circuit

The time constant of the one shot pulse is desired to be approximately two seconds.

Therefore, choosing a capacitor C1 as 2.2μf:

If	T= 1.1*R*C
i.e.	2.0= 1.1 * R* 2.2μf
Thus:	R=2/1.1/2.2μF
Therefore:	R= 1M (approx.)

The output of which on simulation gives an approximate wave characteristics as shown:

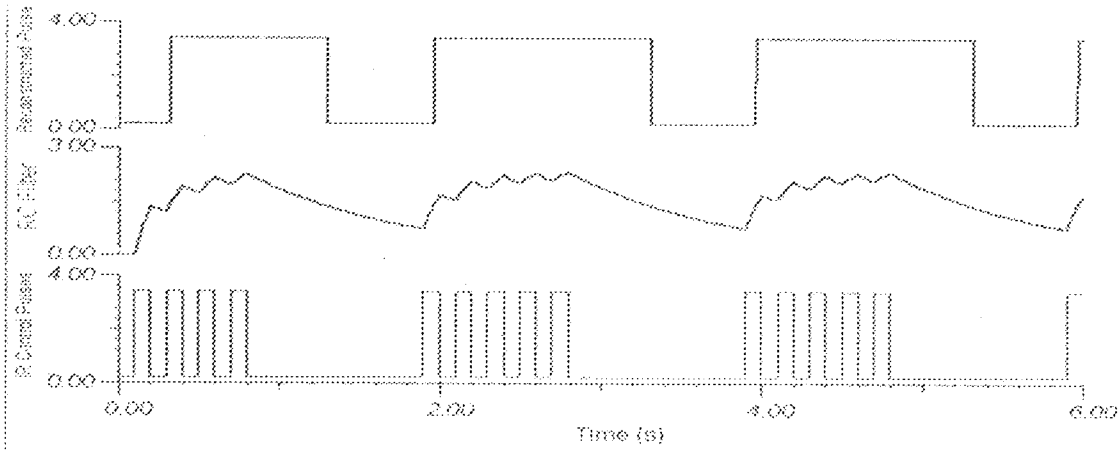


Fig3.8: simulated results of the modulated signal.

From the wave train shown above:

The lower wave is the modulated signal from the infrared module, the middle is its buffer by the RC circuit and the topmost is the reconstructed pulse produced by the 555 timer.

A clean output pulse is produced as in the up most signal wave train above is given out by the 555timer to activate the bitable latch.

3.4 The latch unit:

This is a D type flip flop, built with a TTL 7474 series IC and configured as a bitable. Any version of the 7474 may be used, i.e. Schottky 74LS74, high speed 74HCT74 etc. The input is applied to the clock pin, the inverted output fed back to the data input and clear and preset lines are tied to Vcc. For every pulse the relay will operate and latch. the next pulse will turn off the relay and so on.

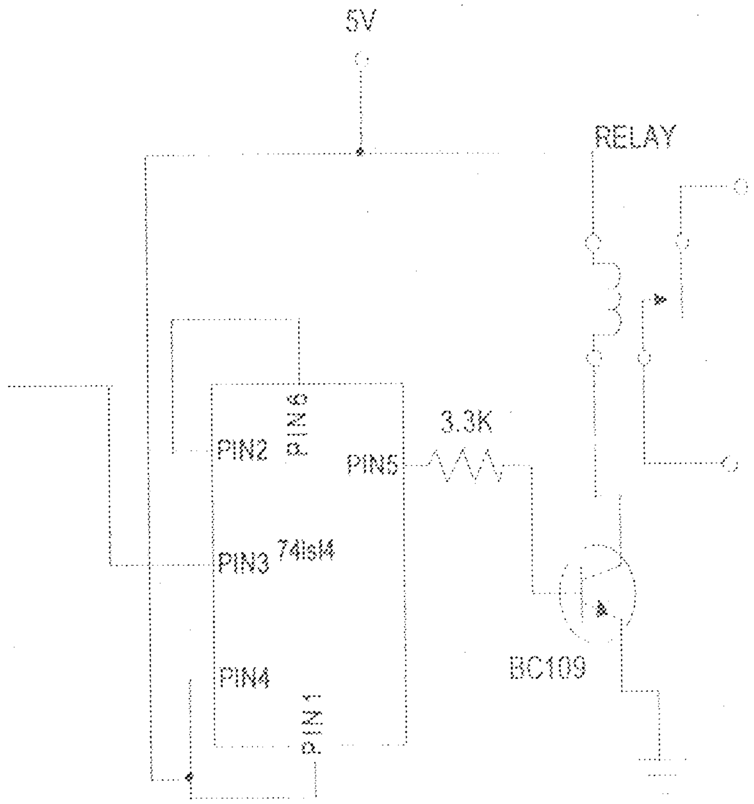


fig3.9. the latch circuit connection

3.5 relay drive unit:

The relay drive circuit is made up of a current limiting resistor, transistor switch and a relay as shown below:

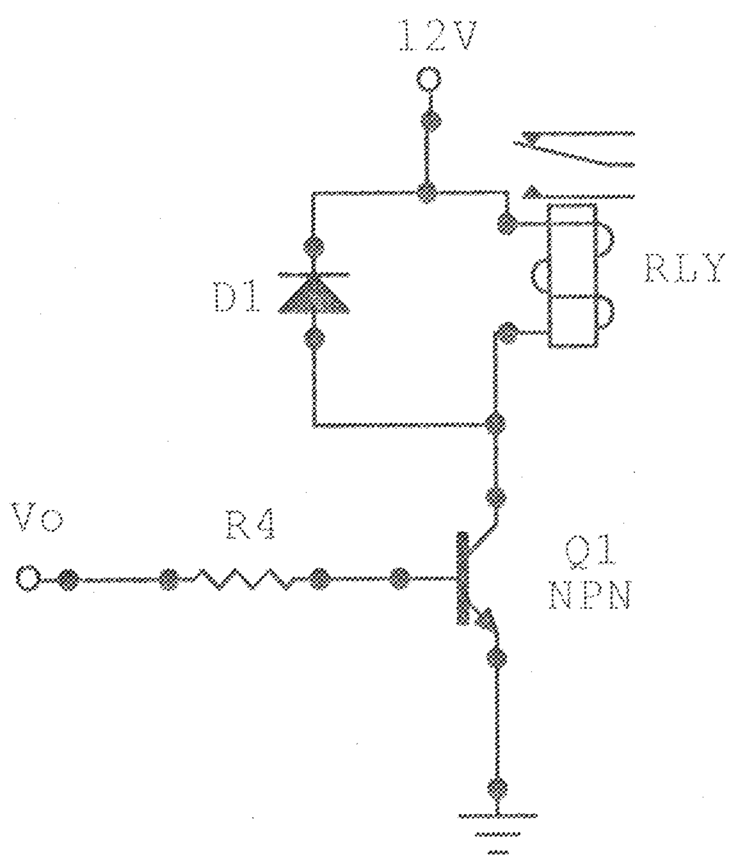


Fig. 3.10 Relay drive circuit.

20mA will be required to switch on the transistor.

Relay data: -

Coil resistance = 400Ω

Vcc = 12V

Coil current of the relay = 12/ 400 = 30mA

I_c = 30mA

I_b = 20mA

$H_{fe} = I_c / I_b = (30\times 10)/(20\times 10) = 1.5$

Almost all the switching transistor can serve the requirement; therefore BC109C was selected as TR.

$$R4 < \frac{(V_{cc} - V_{be})}{I_c / H_{FE} \min}$$

From the data book H_{FE} min = 100

I_b min = I_c/ h_{fe} min = (30 x 10)/ 100 = 0.0003 A

R_b = (12 - 0.7)/ 0.0003 = 37.7KΩ

Therefore 20KΩ is chosen as R4

3.6 The external circuit unit:

Ideally, the switch circuit is meant to be connected to an electrical load circuit via the relay. Such load can be a television power supply, a table lamp or reading lamp. But as a model in this project circuit; I felt using an electric lamp as an indicator might look too common so I decided to feature a disco light (red and green) approach as an indicator. As such therefore, I involved an astable multivibrator connected with a two color disco light as my indicator for the working circuit. As seen below:

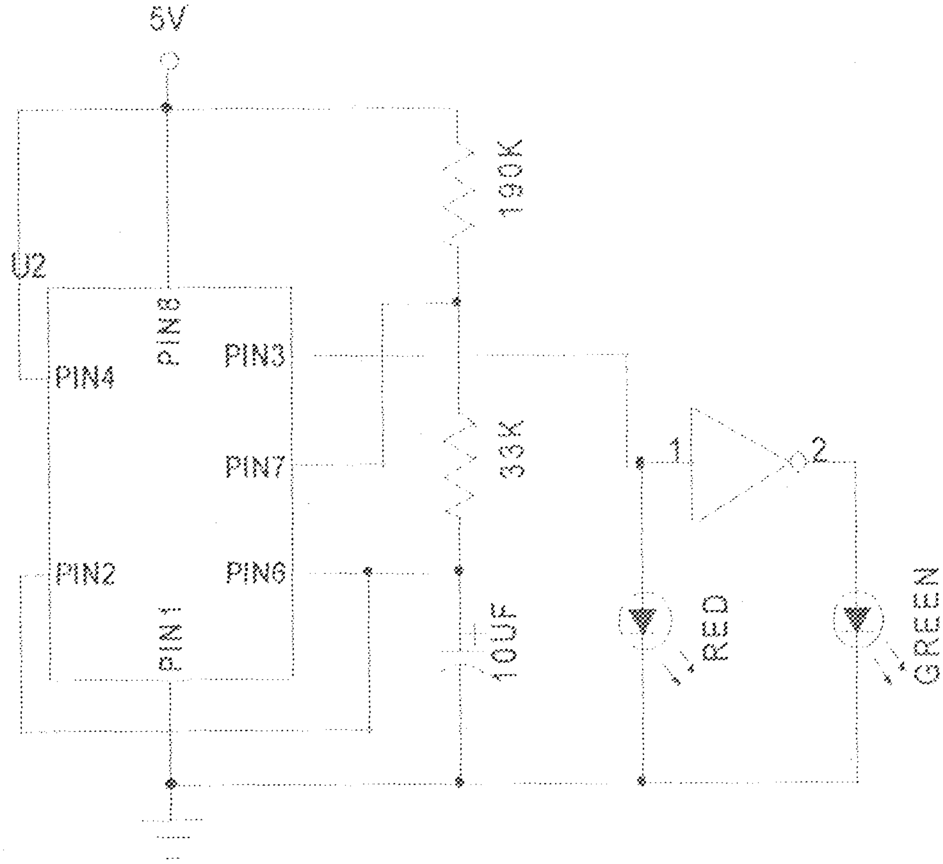


Fig 3.11 the disco light indicator circuit

In fig 3.11 above,

Choosing a capacitor of 10uf as a standard,

I intend to have a frequency of one cycle in two seconds.

I.e. about 0.5 hertz frequency,

Therefore, choosing a resistor R1 of 33kΩ,

Invoking the formula

$$F = 1.44 / [(R1+2R)*C1]$$

$$0.5 = 1.44 / [(R1+2*33k)]$$

Therefore: R1= [(1.44/F-2R2*C1)]/C1

R1= 190KΩ (approx.)

Also, to find the duty cycle of the wave,

Period = T=0.79(R1+2R2)*C1

=0.7*(190K+2*33K)*C1

=2.0 Seconds (approx.)

Thus T is the period or the time it takes to make a complete cycle or the time for all the two LEDS to blink alternately.

Also duty cycle of the wave is given by:

Duty cycle =R1/ (R1+R2)*100%

=190K/ (190=33K)*100%

=85.2%

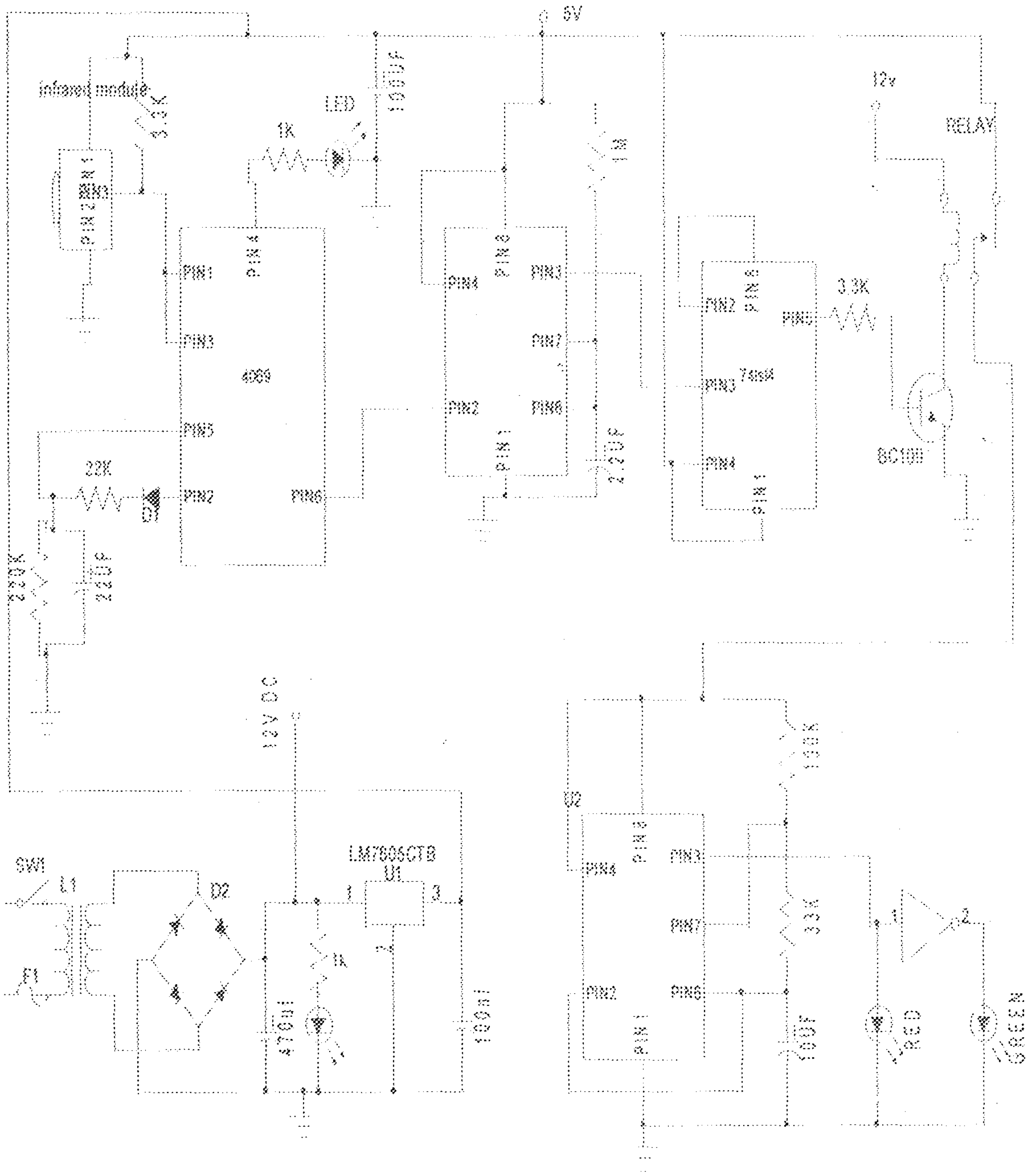


FIG 3.12 the complete circuit

CHAPTER FOUR

TESTS, RESULTS AND DISCUSSION

Series of tests were made during the assembly of this device to ensure that it operates optimally. These include testing all the components before making use of them in order to avoid the use of faulty components, measuring the outputs of the various blocks were made in order to know if their output results conform to expected results.

To ensure that the switch is not triggered by undesired signal, a delay of about two (2) seconds was introduced so that the remote button has to be pressed and held for such a delay before the circuit operates. Also, a filter glass was used with the sensor so that it blocks all unnecessary infrared radiation (probably from sunshine etc.) from unnecessary triggering of the circuit.

Table 4.1 Results obtained from various blocks of the device

Item	Device	Input	Output	Discussion
1	transformer	220/240volts	12 volts	The standard output of the transformer is 12v but a value 11.8V and 12.3V were read due to varying nature of the input voltage.
2	Regulator	12 volts	5volts	Most of the intergraded circuits used have a standard voltage of 5volts. Therefore, the 5v regulator is introduced in order to supply them with their optimal operation voltage. But output of the regulator also varies from 4.7volts

				to 5.2volts as a result of variation on the output of the transformer.
3	Infrared module	...	5.0volts	As a result of the 3.3kohms resistor of the module, the output of the module on no signal reception (i.e. active low) found to be 5.0volts and it goes down to 0voltss as soon as it receives a signal.
4	The not gate inverter(4069)	5volts	0volts	All the six not gate inverters of the 4069 IC were tested with a high voltage of 5.o volts and a low voltage of 0.2 volts was given at the outputs.
5	The one shot 555 timer	3.6volts	5.0 volts	The output of the 555 timer after triggering was found to be 5.0 volts held for duration of 2.0 seconds (i.e. period of 2 seconds) as a one shot and then fall back to zero. The simulated waveform is shown below:
6	The 74ls74 latch	A 5.0volts high clock with a period of 2.0 seconds	High or low	It was discovered that at the falling edge off the clock from the 555 timer monostable, the flip flop latches (i.e. goes high) or resets (i.e. goes low) depending on whether it was formerly reset or set respectively.
7	The relay	12 volts	latching	On receiving a high from the flip-flop, the transistor serves as a switch which continues the ground connection of the relay which energizes the relay coil and the relay contacts are closed.
8	The astable 555 timer	...	...	When the relay is closed, it completes the supply of the astable 555 timer and thus a red, green disco light indicator starts lighting.

CHAPTER FIVE

CONCLUSIONS:

The aim of this design and construction of a universal infrared remote controlled switch is finally achieved with a great deal of patience and good reasoning during the construction of the prototype.

The objective of which is to be able to turn on or turn off an appliance from a considerable distance using infrared radiation as a medium. Though the external circuit employed here was a model i.e. a disco light indicator, any house hold appliance like television, radio, table lamp etc can be controlled using the same circuit, all that is needed is to connect the positive line of the appliance through the secondary part of the relay.

Also, the device was seen to have a high degree of sensitivity with considerable distance (3-4metres away) provided that line of sight is maintained between the transmitter and the receiver.

The device is also portable.

Yet for this achievement to be made, many problems were encountered; such of which are:

1-at the early stage of the construction, the output was very erratic and inconsistent which was later discovered to be due to undesired infrared radiation picked up as a result of the fluorescent lamp of the room.

2-also, after all assembly were made, the circuit still couldn't respond, this was later discovered as a result of wrong pin connections made to some of the integrated circuits and the connections were corrected through the consultation of data sheets. Thanks to www.alldatasheets.com.

3-most of the connections were later discovered to be falsely leaded as a result of an insulating coating of the Vero board from the manufacturer, so, a new vero board was etched all over with a new razor blade to remove the coatings before it is then used.

5.1 Recommendations:

Based on the successes and limitations recorded by this project work, the following recommendations should be considered:

1- The system can be modified so that it can be used with a specific remote control.(unlike universal in this case)

2- As this project involves the switching of only one channel, the project can be modified into driving multichannel i.e. to control many appliances.

3- Also, the power supply can invoke the use of a battery in order to make it more portable.

4- The use of more compact electronic components/ chips can also make it more portable.

5.2 References:

[1] Andy Collin son, Harrison electronics publications (www.harrisonelectronics.com)

[2] Engr. Nasiru Mora, Kano Exchange, Intercellular Nigeria plc

[3] Muhammad S. A, Design and Construction of a Remote Controlled Switch, Electrical/Computer Engineering F.U.T Minna, November 2004.

[4] Encarta World Reference Library 2006, Electromagnetic Spectrum.

[5] www.harrisonelectronics.com/datasheet/relay

[6] www.vishay.com/datasheets

[7] www.sgs-thompson microelectronics.com/datasheets/4069.html

[8] www.howstuffswork.com/555timertutorials.htm

[9] Forrest M. Mims III, 555 Timer IC Circuits, Engineer's Mini Notebook. Radio Shack,

[10] www.alldatasheets.com/LM555

[11] Paul Horowitz, the Art of Electronics, Cambridge University Press, Page,

[12] www.useni.com.

[13] Emmanuel Nandet, Design And Construction Of Sound Activated Switch, Elect/Elect Engineering. ATBU Bauci, nov 1993.

[14] en.wikipedia.org/wiki

[15] John young, discovering electromagnetic, Princeton publications, New Jersey 1997, page 45.

[16] www.remotecontrols.com/history of infrared remote control.

[17] Kraus/ Fleisch, electromagnetic with applications, fifth edition WCB/McGraw-Hill publications page 477.

[18] John young, electronics sensor devices, third edition, Princeton publications, New Jersey 1995. Page 28.

[19] www.Solidrelays.com