DESIGN AND CONSTRUCTION OF AN INFRARED ACTIVATED ELECTRIC BELL SWITCH

BY

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DEDICATION

I dedicate this project work to almighty Allah for his infinite mercy and grace, to my parents for their tremendous support and also to my friends.

DECLERATION

I, Salihu Abdullahi, declare that this work was done by me and has never been presented elsewhere for the award of a degree. I also hereby relinquish the copyright to the Federal University of Technology Minna.

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To friends who stayed close. I love you all and will never forget the good and hard time stayed together and watch our backs even till date. To my lovely pals Isah, Collins, Bemdoo, Adaji, Remi, John, Vera, Nike, peter, and many more to mention I love you all. I won’t forget to say thanks you to all my classmates, our generation will make a change.

ABSTRACT

There are various means in our world today by which signal output can be transmitted. The infrared activated electric bell switch is aimed at transmitting frequency of about 38KHZ from the transmitting unit to the receiving unit (which also receive 38KHZ signal). This is channel toward achieving the objective; controlling an electric bell using remote control and to extend the life span of switches by activating the bell with less manual effort.

All aspect of the design are discussed, these include:

- Introduction
- Theory of operation
- Circuit design
- Result
- Conclusion

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CHAPTER ONE

INTRODUCTION

1.0 RELEVANCE OF STUDY

Remote control have brought about so much ease to most activities we perform especially in the operation of simple electronics in our homes to elementary automation of process that involve security, proximity and other associated obstacles. The principle of infrared technology which the remote control works on has been utilized over the years to facilitate some electronic gadgets with some form of automation to enhance easier use of these gadgets. The advantage associated with the simple automation of the remote control brings to our lives cannot be overlooked even though our perception with the remote control and infrared technology have to be restricted to certain applications like microwave ovens and operation of electric hinders our ability to further explore its non-conspicuous users.

Automation as an aspect of technology advancement deals with the simplification of task we perform for convenient execution and this can be done through the process of interfacing. Interfacing in this case means using an existing remote control or constructing one that is compatible with some form of circuitry connected to the device to be operated to enable control of the device with the remote control. Depending on what aim is to be achieved, the use of circuit to interface with the device is very important because it most fit the operation guidelines of the device to be operated certain conditions or points must be taken into consideration because the ease of use of the device to be operated is given priority. Some may want a special remote control to be design for the circuit while others would make a circuit that will work with any remote control type whether that of the television or that of the CD player thereby brings out the multitasking ability of the remote control. This project is aim at using an ordinary constructed remote to control a bell using infrared ray as a medium.

This kind of interface could be utilized in the electrical structure of buildings to enable wireless operation of alarms and other points that have sound points of such nature. This could be use as a replacement for the mechanical switch or as an alternative switching device by using both in the same device because the infrared activated switch (remote control) prolongs the life span of the mechanical switch. The circuit basically contains an infrared receiver and some supporting circuitry that ensures proper channeling of the signals involved. Infrared receiver modules that are universal in nature, that is, the receive infrared signals form any devices as long as the frequencies of both the sending and receiving devices are the same. Some infrared receivers are in form of phototransistors that are accompanied with their matching transmitters. If this type of infrared receiver is use for the interfacing circuit then the remote control circuit must be designed using its matching transmitter for the proper operation while interface circuit that contain the modules can work with any remote or infrared transmitting device of its frequency range. The circuit works by activating a relay that could perform the function of a switch and the signal received by the module is conveyed all the way to the relay to switch on or off by simply pressing a button on the remote control. The interface circuit could be used as an infrared receiver for a computer once the proper pin connections are made to the serial port.

The relationship between the remote control and some other manually operated devices in our homes and offices is what this project aims at establishing with the aid of interfacing.

Most electronic in our homes are controlled by a remote control which is possible through infrared technology. Even though there are devices that operate based on infrared technology most of them do not perform universal functions that may be utilized in so many ways. This project shows how a constructed infrared receiver would be used for various purposes as it relates to simple automation of switches and products at local scale level for convenient use.

1.1 OBJECTIVES

1. To use an ordinary remote to control an electric bell.

2. To extend the life span of switches by activating the bell with less manual effort.

3. To promote easier use of devices and switches by overcoming proximity obstacles for example switching on a bell without actually being near it.

1.2 SCOPE OF THE STUDY

This project aims at using an ordinary constructed remote control to operate or activate a bell via an infrared receiver circuit that is interfaced to a relay. This project plays an important role of bringing out the diverse and multitasking nature of the remote control as an automation tool because it can be used to operate electronic devices as long as the proper regulations are taken care of and even service design by incorporating the circuit in some specific points in the design like ringing points and switching points provided the power specific are taken into consideration. How all this is intended to be achieved is as follows:

The infrared module receives the signal from the source and this signal is used to trigger the preceding segments of the circuit which consist of a monostable multivibrator. The multivibrator have different properties as far as triggering signals are concerned and a good knowledge of this was utilized in the execution of the project. This creates a switch that is activated with the remote control pressed for a period of two seconds.

1.3 LIMITATIONS.

The aspect of this circuit has to be explored is the ability for the circuit to have the same component values for different applications. In using it for alarm points of a house, the power connection could be critically looked or a battery could be used instead.

CHAPTER TWO

LITERATURE REVIEW

2.0 INFRARED RADIATION AND THE REMOTE CONTROL

2.0.1 INFRARED WAVES.

Infrared (IR) radiation is electromagnetic radiation of a wavelength longer than visible light, but shorter than microwave radiation. The name means "below red" (from the Latin word *infra* "below"), red being the colour of visible light of longest wavelength. Infrared spans three orders of magnitude and has wavelength between 700nm and 1mm. Infrared light lies between the visible light and microwave portion of the electromagnetic spectrum. Infrared light has a range of wavelengths, just like visible light has wavelengths that range from red light to violet. " Near infrared" light is closest in wavelengths to visible light and "far infrared" is closer to the microwave region of the electromagnetic spectrum. The longer, far infrared wavelengths are about the size of a pin head and the shorter, near infrared ones are the size of cells, or are microscopic.

Far infrared waves are thermal. In other words, we experience this type of infrared radiation everyday in the form of heat. The heat that we feel from sunlight, fire, a radiator or a warm side walk is infrared. The temperature sensitive serve endings in our skin can detect the difference between inside body temperature and outside skin temperature. Infrared light is even used to heat food sometimes; special lamps that emit thermal infrared waves are often used in fast food restaurants. They can be used in medical appliances utilized in hospitals such as those used to flex the patients muscles in the psiotherapy unit. Short near infrared waves are not hot at all in fact you cannot even feel them. These shorter wavelengths are the ones used in remote control that can be used to operate devices like televisions, CD players, air condition, satellite receivers and new electric bell. Since the primary source of infrared radiation is heat or thermal radiation, any object which has a temperature radiates in the infrared. Even objects that we think of as being very cold, such as an ice cube, emit infrared. When an object is not quite hot enough to radiate visible light, it will emit most of its energy in the infrared. For example, hot charcoal may not give off light but it does emit infrared radiation which we feel as heat. The warmer the object, the more infrared radiation it emits. Humans at normal body temperature radiate most strongly in the infrared at very short wavelengths.

2.1 THE REMOTE CONTROL AS AN APPLICATION OF INFRARED TECHNOLOGY.

A remote control is an electronic device used for the remote operation of a machine. The term according to the Wikipedia online encyclopedia (www.wikkipedia.com), sometimes abbreviated to "the remote", is most commonly used to refers to a remote control for television or other consumer electronics such as stereo systems and DVD players, and to turn-on and off a main plug as this project has been designed to achieve. Remote control for these devices are usually small handheld objects with an array of buttons for adjusting various settings such as television channel, track number, volume, switching on and off a device etc. In fact, for the majority of modern devices with this kind of control, the remote contains all the function controls while the controlled devices communicate to their respective devices via infrared signals and a few via radio signals and are usually powered by small sized batteries with small direct current ratings.

2.2 EVOLUTION.

One of the earliest according to encyclopedia (www.wikkipedia.com) examples of remote control was developed in 1898 by Nikola Tesla. The first remote controlled model airplane flew 1936. The use of remote control technology for military purposes was worked intensively during the Second World War; one result of this was the German Wasserfall missile. The first remote intended to control a television was developed by Zenith Radio Corporation in the early 1950's. The remote unofficially called "Lazy Bones" used a wire to connect to the television set. To improve the cumbersome setup, a wireless remote control was created in 1955. The remote called "Flashmatic" worked by shining a beam of light onto a photoelectric cell. Unfortunately, the cells did not distinguish between light from the remote and light from other sources. The flashmatic also required that the remote control be pointed accurately at the receiver.

In 1956 Robert Adler developed "Zenith space command", the first modern wireless remote. It was mechanical and used ultrasound to change the channel and volume. When the user pushed a button on the remote control it clicked and struck a bar, hence the term "clicker" was another reference to such a remote. Each bar emitted a different frequency and circuits in the television detected this sound. The invention of the transistor made possible cheaper electronic remotes that contained a piezoelectric crystal that was fed by an oscillating electric current at frequency near or above the upper limit of human hearing, though still audible to dogs. The receiver contained a microphone attached to a circuit that was turned to the same frequency. Some problem with this method were that the receiver can be triggered accidentally by naturally occurring noises, and some people, especially young women, could hear the piercing ultrasonic signals. There was even a noted incident in which a toy xylophone changed the channels on these types of TVs since some of the tones from the xylophone matched the remote's ultrasonic frequency.

In the 1990's, when semiconductors for emitting and receiving infrared radiation were developed, remote control gradually switches to the technology which, as of 2005, is still widely used. Remotes using radio technologies, such as Bose Audio Systems and those based on Bluetooth also exist.

The remote has gone through changes over the years to become the device it is today. By average we pick up our domestic remote at least once or twice a day. Since this is a device we are all used to operating on a daily basis then it is only logical to extend the usage horizon of the devices by addition devices it operates or areas of application.

2.3 HOW THE REMOTE CONTROL WORKS.

The remote control operates by waiting for you to press a key, and then to translate that key-press into infrared light signals that are received by the device to be operated. With a single channel remote control the presence of a carrier signal can be used to trigger a function. For multi-channel remote controls more sophisticated procedures are necessary: one consists of modulating the carrier with signals of different frequency. After the demodulation of the received signals, the appropriate frequency filters are applied to separate the respective signals. Nowadays digital procedures are more commonly used. When you take off the back cover of the control you can see that there is really just a few parts that are visible: a printed circuit board that contains the electronics and the battery contacts.

The components that you see here are typical for most remotes. You can see an integrated circuit (also known as a chip). The chip is packaged in what is known as 18 pin Dual inline package, or a DIP. To the right of the chip you can see a diode, a transistor, a resonator, two resistors and a capacitor. Next to the battery contacts there is a resistor and a capacitor. In this circuit, the chip can detect when a key is pressed. It then translates the key into a sequence something like morse code, with a different sequence for each different key. The chip send that signal out to the transistor to amplify the signal and make it stronger for proper reception for the receiver. (www.howstuffworks.com).

2.4 TYPES OF REMOTE CONTROLS

Alternatively, universal remote controls combine multiple remotes into one, usually with some sort of switch or button indicating which device the remote is currently controlling. Universal remote run from inexpensive basic models to a Linux-powered model from Sony. The first Universal Remote Control was developed by William Russell Mcintyre in the mid 1980s, while employed at North American Philips Consumer Electronics Corporation. McIntyre's software design was awarded patents, since it was the first remote which could be pointed at an electronic device and learn its operational control.

Remote or radio control exist for many other devices as well: model airplanes, helicopters and other radio controlled models are popular children's toys; many robots are remotely controlled, especially those which are designed for doing perilous tasks; and some state of the art military fighter jets are operated by remote control. Remote controlled fire arms are sometimes used to birds and other animals.

2.4.1 TECHNIQUE

With a single channel remote control the presence of a carrier signal can be used to trigger a function. For multi-channel remote controls more sophisticated procedure are necessary: one consist of modulating the carrier with signals of different frequency.

After the demodulation of the received signal, the appropriate frequency filters are applied to separate the respective signals. Nowadays digital procedures are more common used.

2.4.2 USAGE

Household: The operation of electronics and other devices for the ease of use.

Industry: Remote control is used for controlling substations, pump storage power stations and HVDC-plants. For these systems often PLC-systems working in the long wave range are used.

Weapons: Remote controlled weapons have been used since World War II.

Space: Remote control technology is also used in space travel, for instance the Russian Lunokhod vehicles were remote-controlled from the ground. Direct remote control of space vehicles at greater distances from the earth is not practical due to increasing signal delay times.

Bells: Remote control bell can be used to signal a receptionist from the manager's office.

2.5 HOW AN ELECTRIC BELL WORK.

The bell system is a circuit consisting of an electromagnet, a switch, set to off, which the ringer presses, a power source, a gong, a hammer (which forms part of a second switch) and electrical contact point. Once the ringer presses their switch the circuit is completed, and the electromagnet becomes active and attract the hammer.

The hammer moves toward the magnet, striking the gong, but as it does so the circuit is broken and the hammer falls back.

Once it has fallen back into place, the circuit is completed and it moves forward, striking the gong and breaking the circuit again, which cycle is repeated until the ringer releases their switch.

When the switch is pressed, the circuit closed and the current begins to flow through the solenoid. The core gets magnetized and attracts the armature. Due to the movement of the armature, the hammer moves and strikes the gong and the bell ring.

The movement of the armature breaks the contact & the current stops flowing. The electromagnet loses its magnetism and the armature returns back to its original position. This completes the circuit once again and the action is repeated. As a result, the hammer vibrates and the bell continues to ring as long as the push-button is pressed.

CHAPTER THREE

DESIGN AND IMPLEMENTATION

The infrared power control switch is design around two major subsystems viz:

a) The Infrared (IR) Transmitter

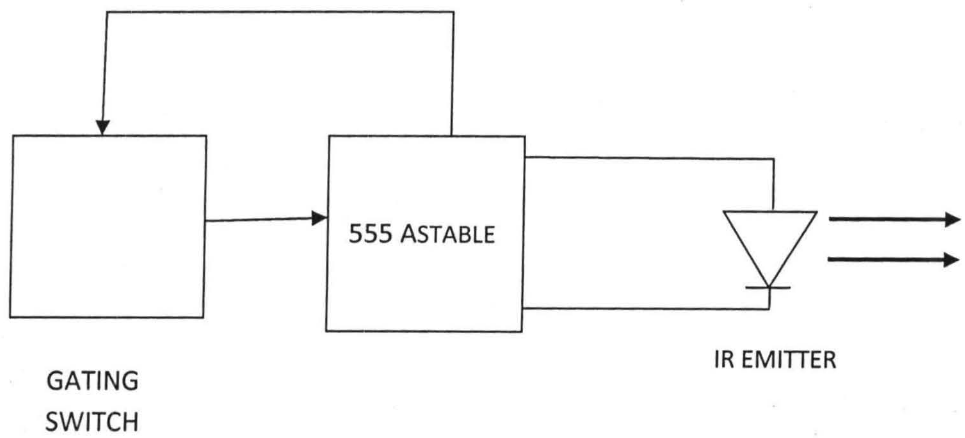
b) The Infrared receiver/control unit

The various subsystem are interconnected as shown in the block diagram of fig 3.2

3.1 Infrared Transmitters

The transmitter is a gate 38 KHz oscillator designed to meet the operating requirement of the 3-terminal sensor used in the construction work. It produces a discontinuous burst 38KHz frequency that is sensed at the receiver to toggle the Power control circuitry on/off.

The schematic diagram of the IR transmitter is shown in fig 3.13 on page



IR TRANSMITTER UNIT

Fig.3.1 Block diagram of the IR Transmitter unit.

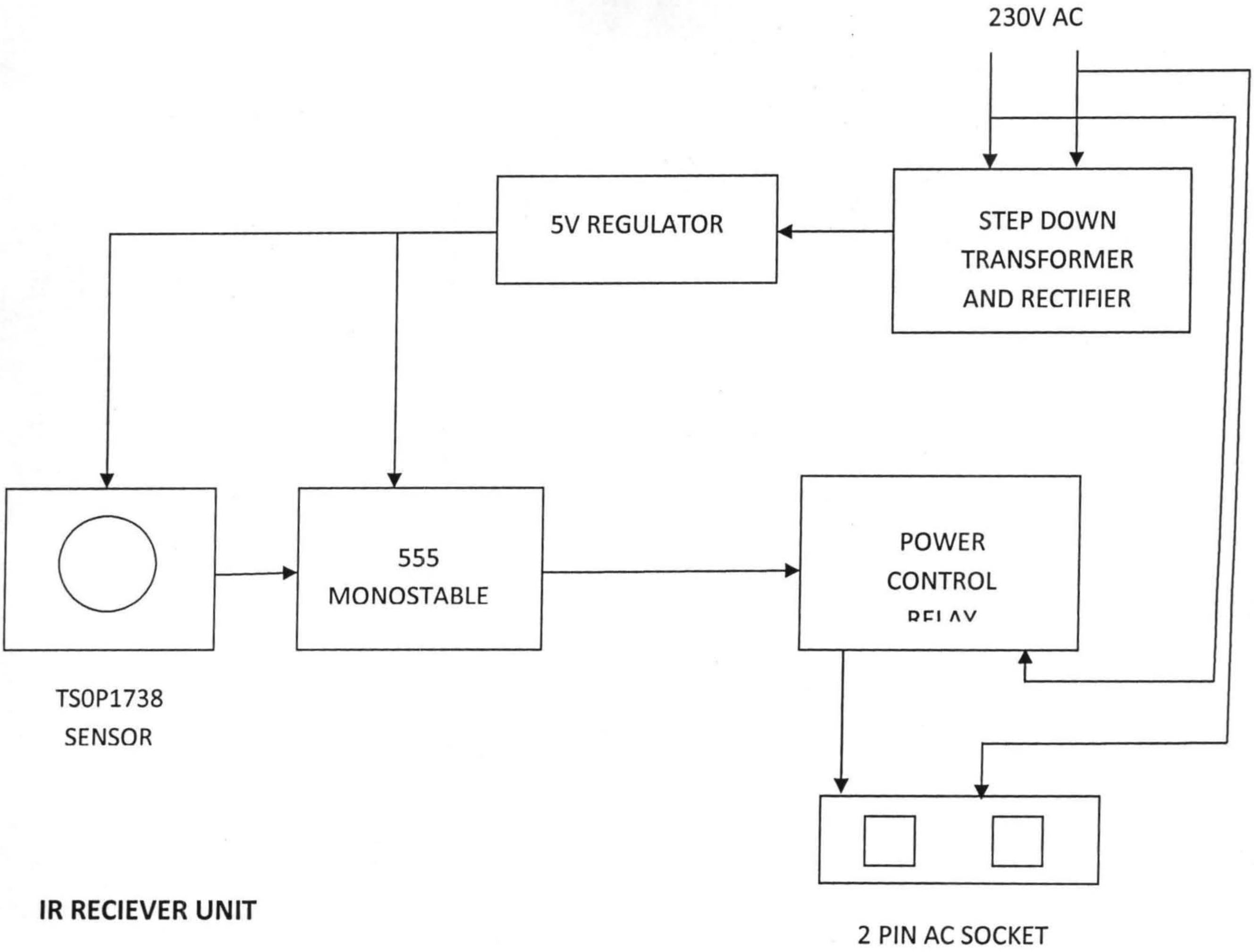


Fig.3.2 Block diagram of IR Receiver unit.

The 555 multivibrator devices configured as a gated free-running astable oscillator with an output frequency of 38 KHz (measured with a frequency meter)

The frequency of the oscillation is given by the expression:

$$F = {}^{1.44}/_{(Ra + 2Rb)} \quad \text{[3.0]}$$

From the component value shown, Ra=1K Ω, Rb= 5k Ω adjustable, C = 0.001.

Inserting value into the above expression yield a value of Rb equal to:

F= (Ra+2Rb) C=144

Ra+2Rb=$1.44/_{FC}$

2Rb= $(1.44/_{FC}) - Ra$

=1,395 Ω

A 5k Ω adjustable resistance was used to allow for precise frequency generation

The output high time is given by:

T1=0.693 (Ra+Rb) C

And the discharge time (output low) is given by:

T2=0.693 (Rb) C

Thus the total period is:

T=T1+T2=0.693 (Ra + Rb) C

The frequency of the oscillation is:

$$F= \frac{1}{T} = \frac{1.44}{(Ra+2Rb)C}$$

The duty cycle (high –to-total ratio)

$$\frac{hightime}{totaltime} = \frac{0.693(Ra+Rb)C}{0.693(Ra+2Rb)C}$$

$$= \frac{Ra+Rb)}{Ra+2Rb)}$$

From the components values shown

$$\text{Duty cycle} = \frac{1000+1395}{1000+2790} = 63.2\%$$

I.e. in every $^1/_{38000}$ second, the output is high for 63.2% and low for 36.8% of the total period

Q1 is used to gate ON and OFF the oscillation of the 555 Timer when OFF/ON. This start-stop frequency generation of the high frequency IR provides an OFF/ON output at the receiver. The 555 oscillate only when pin 4 is at logic 1, i.e. pulled high to V_{CC}\ via the 47kΩ resistance.

When pin 4 is low, oscillation is inhibited, i.e. no frequency is generated.

The reset voltage is typically between 0.4V and 1V, i.e. when pin 4 is held at a voltage between these two extremes the devices is deactivated. The reset amount is typically 0.1mA.

Q1's base is high enough to saturate it producing a very low $V_{CE\ (SAT)} = V_{CC} - I_C R_C$, and β=347, a value of R_B is deducted.

Using the maximum allowable reset voltage of 1V, and 0.1mA reset current:

$V_{CE\ (SAT)} = V_{CC} - I_C R_C$,

$1 = 9 - 10^{-4}$

$R_C = {}^8/_{10}{}^{-4} = 80K\Omega$

Using the typical reset voltage of 0.4V and 0.1mA current:

$V_{CE\ (SAT)} = V_{CC} - I_C R_C$,

$0.4 = 9 - 10^{-4}$

$R_C = 8.4 \text{-} 10^{-4} = 86K\Omega$

A value of 47KΩ for RC was chosen to meet the reset current requirement

$I_C = \beta \times I_B$

$10^{-4}\ A = 347 \times I_B;\ I_B = 10^{-4}/347 = 3.47mA$

A 47kΩ was used to ensure saturation at all points in time since the operation points will always change as the battery voltage reduced. The 38KHz output drives a C9014 high-frequency transistor ON/OFF in consonance with the high-low transitions at pin3, pulsing current through the IR LED

Calculation of R_s for IR LED

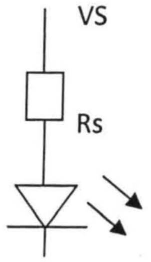


Fig.3.3 schematics showing IR LED and Limiting Resistor

$Rs = V_S - V_{LED}/I_{LED}$.. [3.1]

For the LED used, $V_{LED} = 1.8V$ and

An R_S of 100Ω was used, thus producing a current flow of:

$9 - {}^{1.8}/_{100}$ = 72mA through the LED when pulsed on.

This value ensures longetivity of the diode life as it is operated on a current a magnitude less than rated maximum.

3.2 Operations

When S1 is open, transistor base is pulled high by the 47KΩ Resistance; correspondingly its collector (pin 4) is low. The 555 is held reset, and no frequency is generated.

When S1 is closed, Q1 base is at 0V, Q1 is cut-off, its collector is pulled high to $+V_S$; the 555 is enabled, and a 38 KHz output is generated until S1 is opened again.

Thus pin 3 has an output as depicted below:

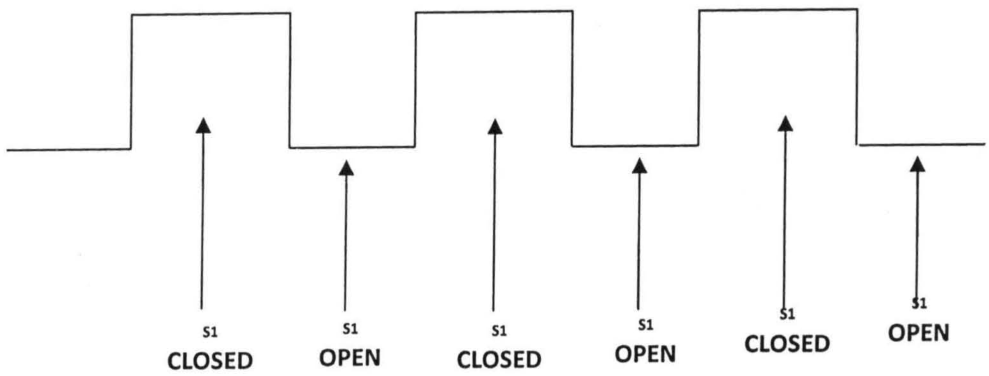


Fig. 3.4 Diagram showing the output waveform of pin3

Pin 5 of the 555 astable multivibrator is bypassed with a 0.1 uF capacitor for improved stability

3.3 Infrared Receiver

The infrared receiver unit/control box is built up from the following different sub-units

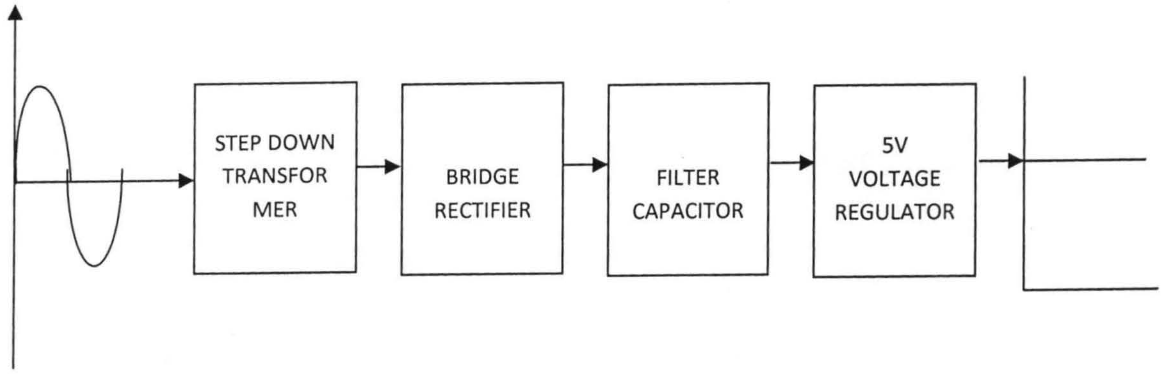
i. The power supply
ii. Infrared sensor
iii. 555 Monostable
iv. Power control relay switch

Each sub-unit is explained in detailed as follows:

3.3.1 Power supply

The purpose of the regulated power supply is to provide a constant 12V d.c to power the control circuit. It is derived from the 240V 50 Hz by use of the 12V low voltage transformer, a four bridge rectifier, a 7805-volt regulator and associated capacitors.

Figure 3.6 and figure 3.6 shows the block diagram circuit diagram of the power Supply respectively



AC input **DC**

output Fig. 3.5 Block diagram of a power supply

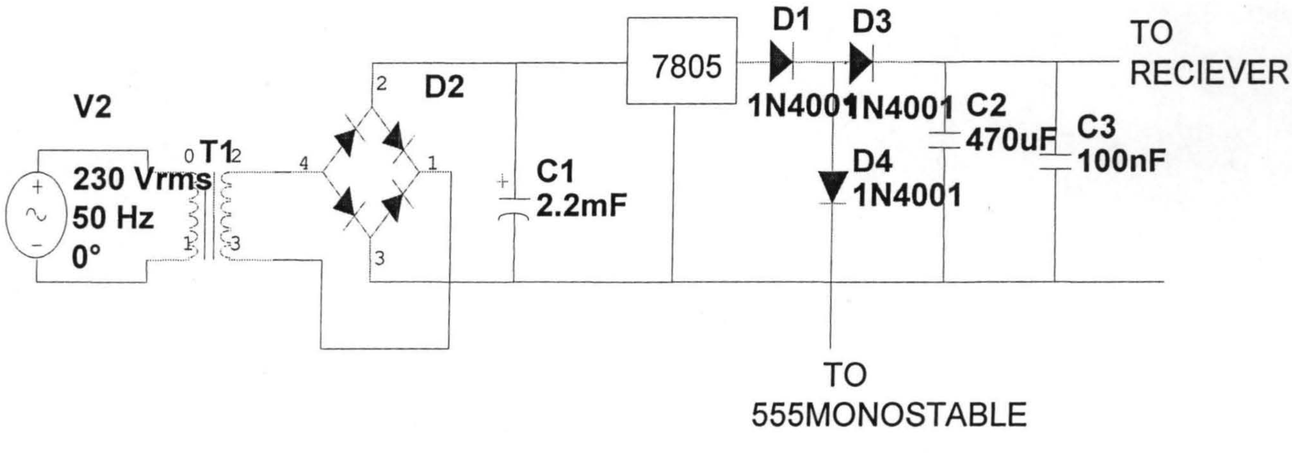


Fig 3.6 circuit diagram of power supply

3.3.1.1 Transformer

The transformer is a step down type rated 240/12V. This implies that whenever 240V a.c main supply is applied to the primary of the transformer, a 12V a,c will be obtained at the secondary of the transformer.

Form the rating of the transformer, the voltage transformation ratio (k) can be calculated as follows:

$K = {secondaryvoltage(Vs)}/{primaryvoltage}(V_P)$ .... [3.2]

$V_S = 12V;\ V_P = 240V$

$K = {12V}/{24V} = {1}/{20}$

$V_S = {Vp}/{20}$

The transformer form factor, $f = {Vrms}/{Vdc}$ .... [3.3]

$F = \left(\frac{Vmax/\sqrt{2}}{2Vmax/\pi}\right) = \pi/2\sqrt{2}$

$\cong 1.11$

3.3.1.2 Bridge rectifier

This circuit employs four diodes to convert a.c voltage into pulsating d.c voltage. The following are the advantages of selecting it in this design

- No center-tap is required on the transformer

- It is suitable for high-voltage application
- Much smaller transformers are required
- It has less peak inverse voltage (PIV) rating per diode

Rectifier design calculation

1.rectifier efficiency, $\int = \frac{\boldsymbol{POWERdc}}{\boldsymbol{POWERrms}}$×100%..[3.4]

$=\frac{\boldsymbol{POWERdc}}{\boldsymbol{POWERrms}} \times 100\%$

From the rating of the transformer,

Vrms=12V

Vdc=$^{Vrms}/_{formfactor(f)}$

=12×2$\sqrt{2}$

=10.80V

f= $^{10.80}/_{12}$× 100%

= 90%

2. Ripple content of the pulsating d.c output, VI (a.c)

VLac=$\sqrt{(\text{VL2} - VL2dc)}$ .... [3.5]

Where VL=Vrms=12V

$$V_L(a.c) = \sqrt{(12^2 - 10.08^2)}$$

$$= 6.51V$$

3. Ripple factor, y

$$Y = {Vlac}/{Vldc} \quad \text{[3.6]}$$

$$= {6.51}/{10.08} = 0.6451$$

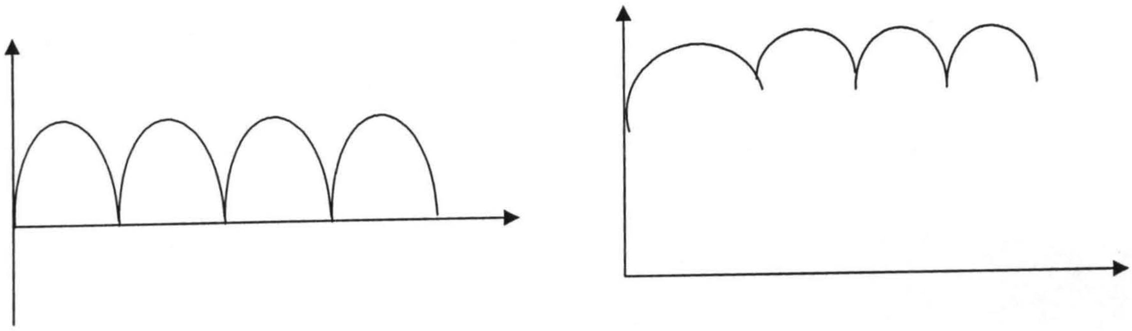
$$\approx 64.5\%$$

3.3.1.3 Filter Capacitor

The main function of the filter capacitor is to minimize the ripple content in the rectifier output voltage. The capacitor, C is connected across the rectifier output and in parallel with the voltage regulator as shown in ***figure 3.4*** to achieve filtering action. These types of filter are known as **capacitor input filter**.

The filter circuit depends, for its operation on the property of a capacitor to charge up during conducting half-cycle. In simple words, a capacitor opposes any change in voltage. When connected across a pulsating d.c voltage, it tends to smoothen out

Or filter out the voltage pulsations (or ripples). The filtering action of the simple capacitor filter in a full rectifier is shown in figure 3.6 above.



(A) RECTIFIER PULSATING DC OUTPUT

(B) MINIMIZED PULSATING DC OUTPUT

Fig. 3.7 filtering action of the capacitor

The smoothened d.c voltage is fed into a 7805 5-volt fixed regulator to provide a ripple free 5V out put power the logic/control circuitry, while the unregulated d.c supply operate the relay and indicators.

3.3.2 Infrared Sensor

An IR sensor (TSOP 1738) provides the interface between the receiver and transmitter. It is three-terminal IR integrated circuit that receivers the IR signal from the transmitting device. It has a detection rate of about five meter and can detect a frequency of about 38 KHz which is mostly generated by television remotes. The three pins represent the power pin, the common ground pin and the output pin of the receiver which is normally activated when it receives a signal on its sensors. The sensor is connected to pin 2 (trigger) of the 555 monostable via 0.1μF capacitor and a 47kΩ resistor from pin 2 to $+V_{CC}$ (+5V) . The TSOP 1738 and its connection are shown below.

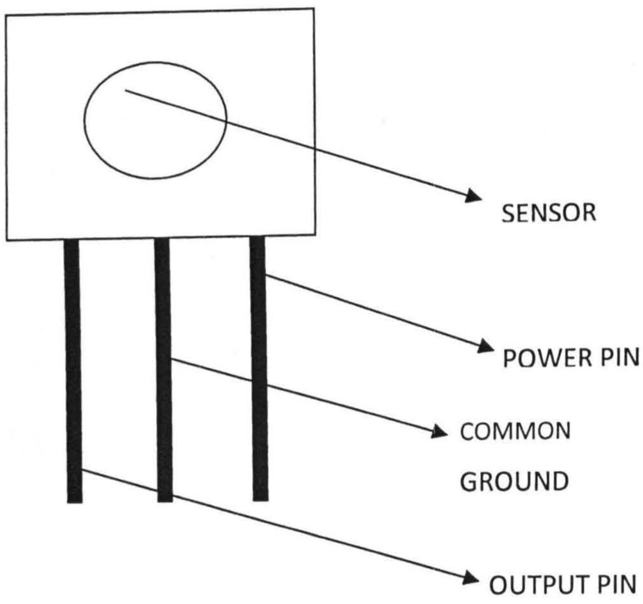


Fig 3.8 TSOP 1738 SENSOR

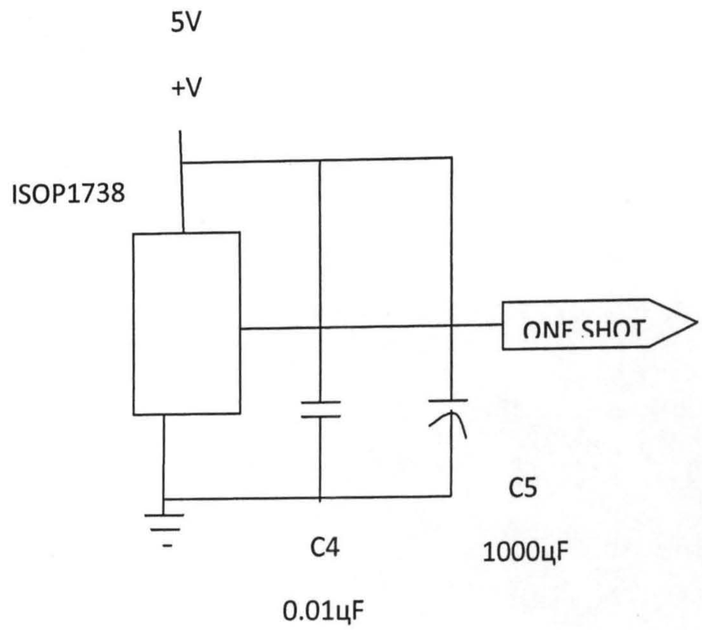


Fig 3.9 TSOP 1738 Sensor connection

3.3.3 555 Monostable

In the monostable mode, the 555 timer acts as a "one-shot" pulse generator. It was used to generate a time of about 2.3 to 2.4seconds to activate the ringer. The trigger pulse from the TSOP1738 was coupled into the trigger input of the 555 device via two pull-up resistor and an 0.1uF capacitance. The pulse begins when the 555 timer receives a signal at the trigger input that falls below a third of the voltage supply. The width of the pulse is determined by the time constant of an RC network, which consists of a capacitor (C) and a resistor (R). The pulse ends when the charge on the C equals 2/3 of the supply voltage. The pulse width can be lengthened or shortened to the need of the specific application by adjusting the values of R and C.

$T=1.1\times R_T \times C_T$ .... [3.7]

Where: R_T is the resistance between V_{CC} and pins (7, 6) and

C_T the capacitance between pin (7, 6) and 0V

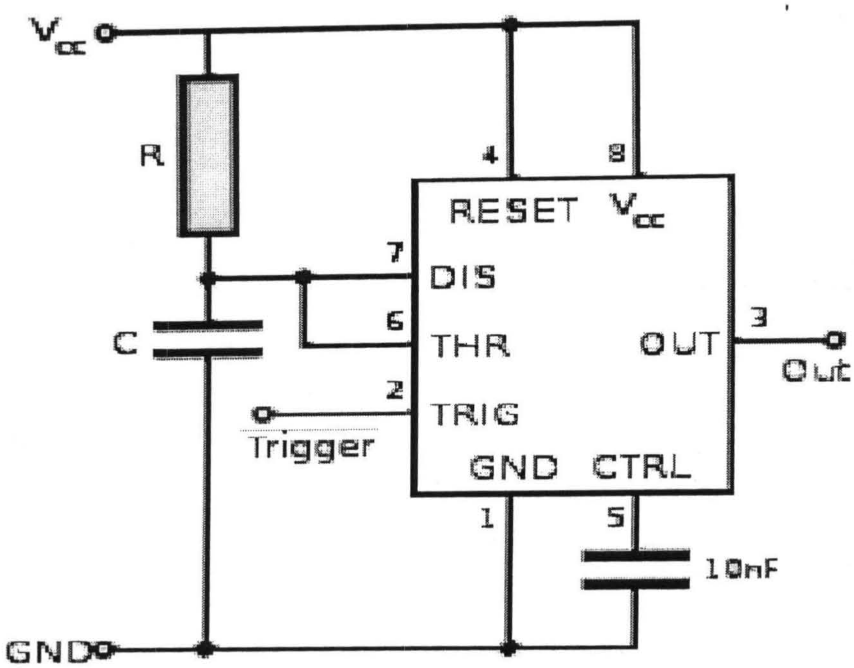


Fig. 3.10: circuit diagram of 555 monostable

The 555 monostable as wired in the control box is shown in the figure 3.9 above.

Normally, the output of the IR sensor is high in the absence of an IR radiation. When there is radiation from a discontinuous IR source, its output switches low, then high. This high –to-low transition pull pin2 (trigger) low, causing pin3 (output pin), to go high.

The output remains high for;

$$T= (1.1\times10^{4} \times22\times10^{2}) (10^{-6}) \text{ seconds}$$

$$=2.425 \text{ seconds.}$$

This period gives the duration of generated clock pulse that drives the CD4013 T- flip flop

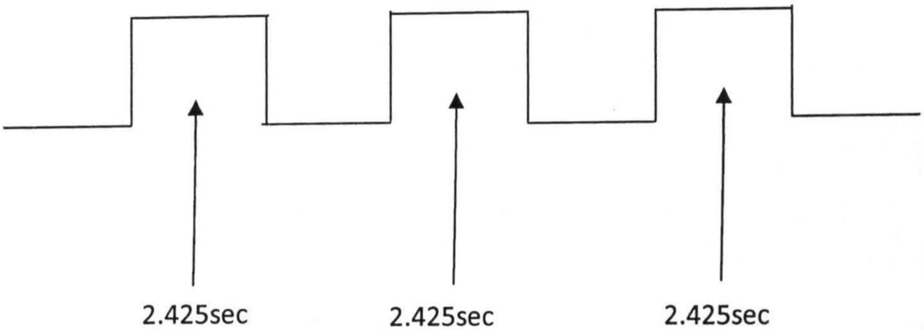


Fig 3.11 wave of the duration of clock pulse driving the T-flip-flop

After 2.425 seconds, the output reverts to its normally low logic state until triggered again by a high-to-low voltage transition on pin 2

3.3.4 Power Control Relay Switch

General purposes electromechanically relay which is common to commercial and industrial applications were used. It is basically a mechanical switch operated by a magnetic coil. It uses d.c for its operation, that is, to open or close the contacts from milli volt to the several hundred volts.

The circuit diagram of the relay as wired in the receiver unit is shown in the figure 3.12 below.

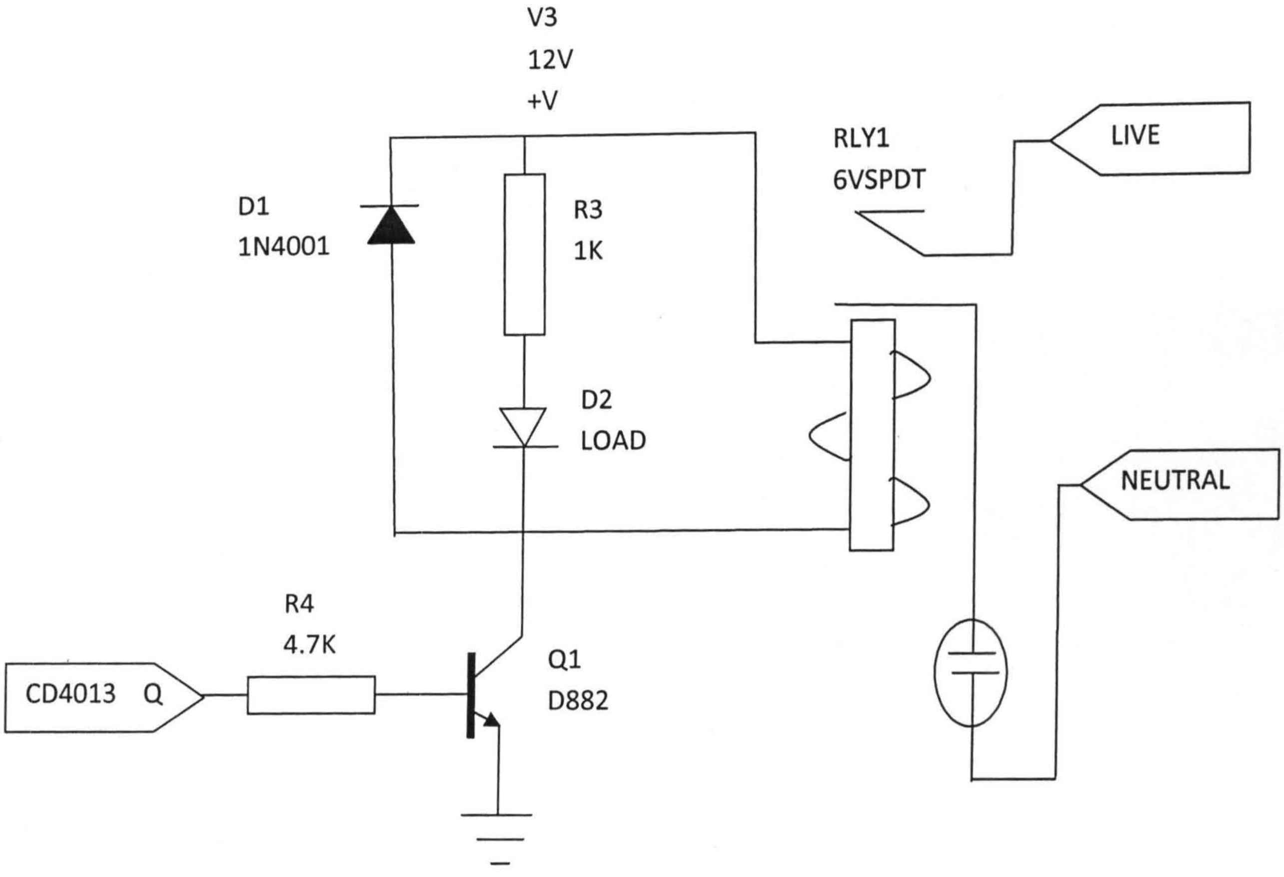


Fig.3.12: circuit diagram of the power control relay switch

The diode D_1 connected across the input terminal of the relay is a free-wheeling diode which absorbs induction kickback which would otherwise destroy the transistor.

The Rs resistor limit current entering the LED

Relay Design Calculation

Relay of rating 20A, 6V d.c was used.

Nominal coil current, I_p need to cause magnetization.

$I_p = {VOLTAGErated}/{RESISTANCErated}$ .... [3.8]

Where Vr=6V, Rr=410Ω

$Ip = {}^{6V}/_{410\Omega}$

$=14.63mA$

Nominal load power P=VpI

Where Vp =240V a.c mains supply

I=current rating of relay

$P=240\times 20$

$=4800$ watts

A nominal load power of 4800 watts is controllable using the relay.

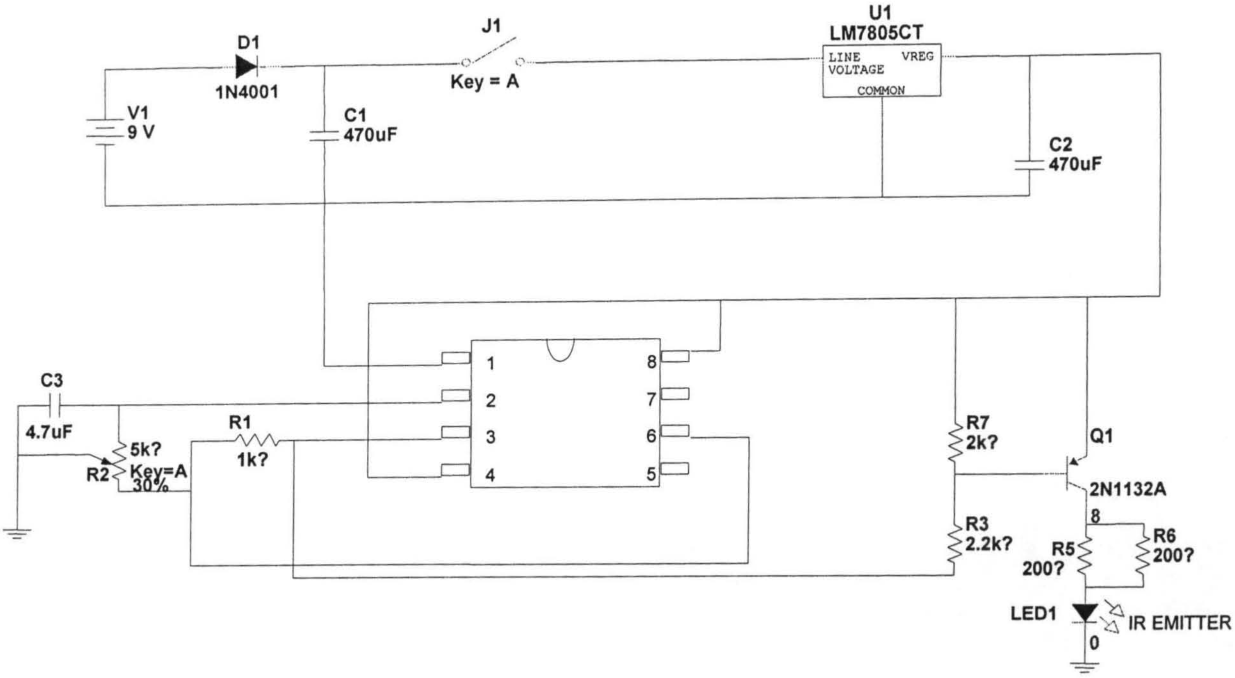


FIG. 3.13 CIRCUIT DIAGRAM OF THE INRARED TRANSMITTER

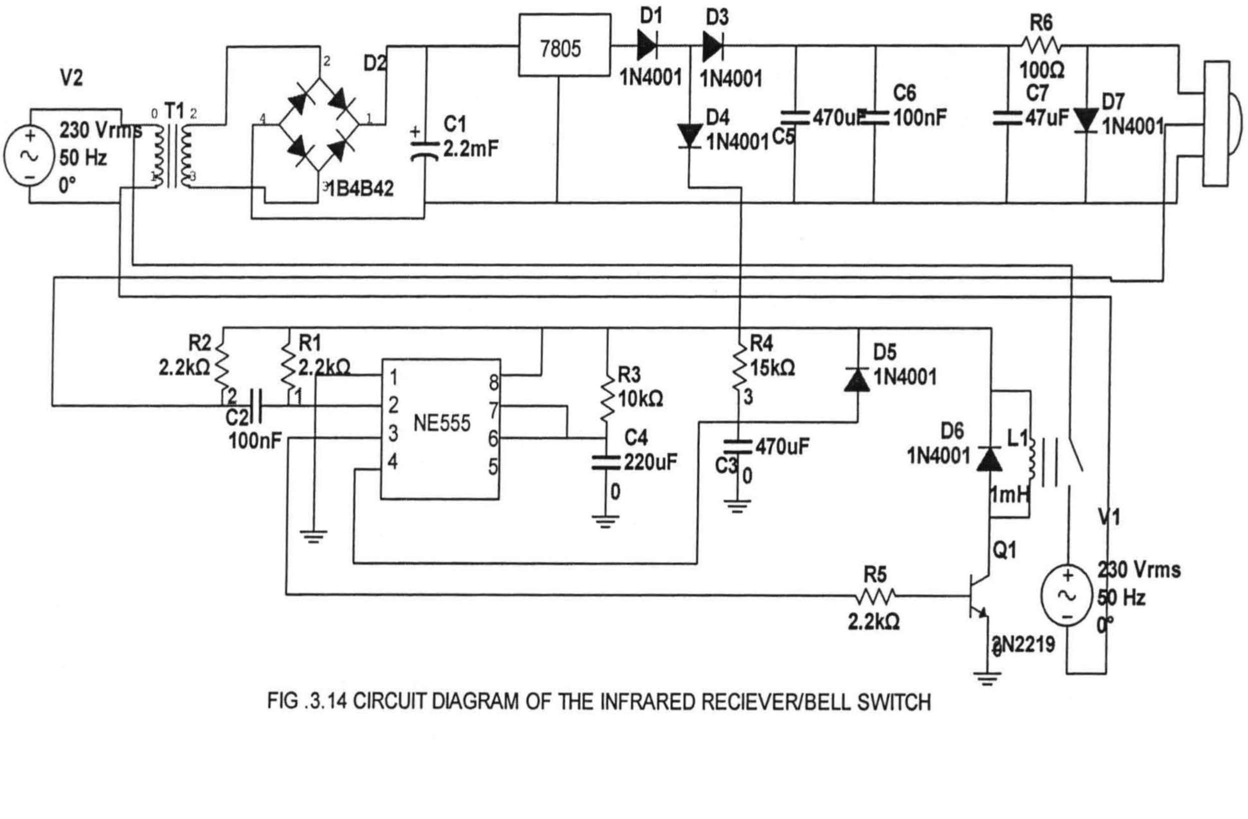


FIG .3.14 CIRCUIT DIAGRAM OF THE INFRARED RECIEVER/BELL SWITCH

CHAPTER FOUR

4.1 Tests, Results and Precaution

The construction was carried out with utmost care. The precautions taken during the construction were:

- The design was first constructed on breadboard before it was transferred to Vero board.
- The component were laid out on a copper-tracked Vero board and soldered firmly in place.
- Particular care was taken to orientate polarized component (i.e. electrolyte capacitor), transistor diodes with respect to potentials.
- A fine gauge solder was used to solder the component together with care taken not to bridge the copper tracks lying side by side together.
- After each soldering, the trip of the soldering iron was cleared.
- Semiconductor components were soldered using a heat shunt so that devices like transistors and diodes would not be degraded in performance by excessive heat.

4.2 Testing And Measurement

The testing was done with respect to the distance covered and operation as follows:

- The constructed Infrared Transmitter was used in conjunction with receiver unit to determine the distance of the coverage and this was done by placing the two units apart using a fresh battery and activating the ON/OFF button on the transmitter.
- The transmission is reliably detected when the receiver unit responds as it should for instance by turning the load ON and OFF.

- This was repeated for different spaces between the two units and maximum distances above which inter-unit communication is not assured was 10 meters.
- The testing was done in such a way that reflection from solid surfaces was eliminated as this would cause multiple reception paths at the receiver end. This was achieved by accurately aligning the 2 units, establishing a line-of-sight contact.

4.4 Results

Infrared link was reliable established between the Transmitter and Receiver units and extension, a convenient control for a remote load was achieved. This is in line with objective of the project work. A measure of the distance over which reliable operation guarantied was measure and seems to lie between 5 and 8 meters.

4.5 Limitation and Possible Remedy

Once there was no encoding used, the control is not specific with respect to the load to control and this is evident in a deployment in which multiple loads are connected to multiple receivers. If the receiver is placed fairly close together, the signal meant for the load can be interpreted by the control meant for another load thereby causing multiple loads to respond to a signal meant for a particular load.

Encoding must be used if the control of the loads is to be specific. This ensures each load responds to its specific command.

4.6 Problem Encountered

It was notice that heavy power surges on the local mains supply cause erratic operation of the receiver unit. This is attributed to a corresponding surge on the d.c supply in, or within the receiver unit. An LC combination noise filter was used on the a.c line to remove high transients thereby ensuring more predictable operation.

The sensor was also found to be over sensitive. The sensor was therefore tamed by placing two 0.01µF capacitors across the output signal path of the receiver which consequently reduces the distance of operation between the transmitter and receiver by a slight degree.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

One of the primary objectives of an engineer is to endeavor to deliver the best or the most efficient services at the lowest rate to the end user. The system has being tested and found to meet the expected results.

The project work is design in line with the project proposal's outline, namely: design and construction of infrared activated electric bell switch. No major problem was encountered in the course of the construction since a careful attention was given to component selection and layout.

5.2 Recommendations

Suggested improvement would be in the area of providing a multi-channel control feature whereby different loads (bell) can be controlled using a single remote control Units (such as in commonly employed in television and audio systems)

Intelligent can also be affected in the control box so that different devices can be programmed to "wake up" or "shut down" at different times.

Since IR transmission is short-range and line of sight (LOS), controlling a device(s) in a location geographically separate from the transmitter unit is possible. A circumvention of this impossibility employs a mix of the IR and RF links in which a source IR data transmission link is converted to RF by a purpose-design system and RF is radiated from a transmitting antenna through space to an RF demodulator placed else where but within the transmission range of the

IR-to-RF converter. The RF receiver demodulates the converted IR command and converts it to baseband IR again for use by the receiving unit.

Engineers trying to improve on this project should generate a better/longer delay for the frequency generated by the transmitter unit and try to use a voice IC to construct the output instead of using an electric bell.

REFERENCES

[1] Scherz, Paul (200)''Practical Electronics for inventors, '' McGraw-Hill/TAB Electronics.ISBN; 978-0070580787. Retrieved 2010-04-05.

[2] B.L Theraja''Foundamentals of Electrical and Electronics'' multicolour edition,

S. Chand & Company LTD.

[3] Engr. (DR) Oria Usifo,''Research Projects Implementation made easy in Electrical and Electronics engineering'', 1st Edition, Ecas (Nig) Ltd, Lagos.

[4] Malvino ,A.P ''Malvinno Electronic principles" 6th Ed, published by Tala McGraw-

Hill publishing co. Ltd, Patel Nagar, New Delhi 11008,1999.

[5] Malvino ,A.P ''Malvinno Electronic principles" 6th Ed, published by Tala McGraw-

Hill publishing co. Ltd, Patel Nagar, New Delhi 11008,1999

APPENDIX A: USER'S MANUAL

- Plug in the power cable into AC main. Then turn on the switch to power the device. The red light on the switch glows, meaning that the device is now powered.
- Press the button on the transmitter (remote control)
- The bell starts ringing.