DESIGN AND CONSTRUCTION OF AN ULTRASONIC MOTION DETECTOR

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ABUBAKAR IBRAHIM

MATRICULATION NUMBER:

2004/18767EE

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

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A FINAL YEAR PROJECT SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE AWARD OF THE BACHELOR OF ENGINEERING (B. ENG.) DEGREE IN ELECTRICAL AND COMPUTER ENGINEERING

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DEDICATION

This project work is dedicated to the Almighty ALLAH ("Subuhanahu Watahala") and to my beloved parents:Mallam Baba Abubakar Ndakobo and Mallama Fatimatu Ibrahim who have seen to the fulfillment of my dream in life.

DECLARATION

DECLARATION

I, Abubakar Ibrahim with Matriculation number 2004/18767EE declare that this work was done by me and was not presented elsewhere for the award of degree. It was conducted under the supervision of Engineer Abdullatif Gbadebo Raji, to the department of Electrical/Computer engineering, School of Engineering and Engineering Technology, Federal University of Technology, Minna, Nigeria. I also relinquish the copy right to the Federal University of Technology,Minna.

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ABSTRACT

This is a project designed to detect motion of an object whether moving farther away from or closer to a vicinity. In the design, a 567 PLL IC was used to operate in a dual- function mode as a signal generator as well as signal receiver. It uses ultrasonic transmitter/receiver transducer pairs.

The receiving transducer operates as a sensitive microphone. The two transducers are positioned 10cm apart and aimed in the same direction towards a non moving solid object. The signal from the transmitter will always reflect back to the receiver, and the frequency of the 567's input will be the same as the one being transmitted. Hence, the output will be zero when the two frequencies are the same.

However, when an object is moving away from the transducers, the received frequency will be lower, and the reverse is the case when the object is moving closer to the transducers. Also, an audible alert is generated as the object comes into the range, as well as the glowing of the LED which generally indicates the detection of an intruder around the vicinity.

ACKNOWLEDGEMENT

First and foremost, I give thanks to Allah ("subuhanahu watahala"). I thank Him, seek His help, seek His forgiveness and seek refuge in Him from the evil of my own soul and from the wickedness of my deeds. Whoever He guides shall never go astray, and whomever He allows to stray shall never be guided. I testify that there is no deity worthy of worship except Allah alone, who has no partner, and I testify that the prophet Muhammad ("Sollallahu Alaihi Wasallam") is His slave and His messenger.

Secondly, my profound gratitude goes to my marvellous parents: Mallam Baba Abubakar Ndakobo and Mallama Fatimatu Ibrahim for their parental care right from my childhood to date. May the almighty Allah reward them abundantly.

Thirdly, I cannot forget to express my gratitude to magnanimous supervisor, in person of Engr. Abdullatif Gbadebo Raji for guiding and counseling me throughout my project work.

Fourthly, I offer my deepest appreciation to my caring and loving guardian: Mallam Nma Nako and "M.F.P (I)" who have been contributing in one way or the other in order to ensure the completion of my programme. May the blessings of Allah be showered upon them.

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TABLE OF CONTENT

CHAPTER ONE

INTRODUCTION

1.1Preamble

Motion involves a change of position of a body, depending on time. Motion is basically of four types

- . Random motion – As the case of gaseous particles, which is a disorderly motion with no pattern to it
- Translational motion – Rigid objects that move in space without rotating are said to undergo a translational motion; for instance, a hard ball moving from one end to another.
- Rotational motion – This involves motion that takes place in a circular path about a center or an axis. Example of this is motion of a spinning wheel or a rotating fan
- Oscillatory motion – this deals with a to- and fro type of motion as in the case of a swinging pendulum

1.2 Motion Detectors

An electronic motion detector contains a motion sensor that transforms the detection of motion into electric signal. This can be achieved by measuring optical or acoustical changes in the field of view

There are two major types of motion detectors, namely:

a. Active detectors

b. Passive detectors

- Active detectors – These are detectors which send out waves of energy and receive waves reflected back from objects. Any disturbance in the reflected waves caused by for example, a moving object will trigger an alarm. Microwave and ultrasonic detectors are good example of active detectors.

* Passive detectors – These are detectors which donot sendout signals but merely receive signals, such as temperature change, change in light intensity and so on. Most infrared detectors are passive detectors.

A motion detector may be connected to a burglar alarm that is used to alert the home owner or security service after it detects motion. Such a detector may also trigger a red light camera. An occupancy sensor is a motion detector that is integrated with a timing device. It senses when motion has stopped for a specified time period in order to trigger a light extinguishing signal. These devices prevent illumination of unoccupied spaces like public toilets.

Motion detectors can sense motion in total darkness without an intruder becoming aware that an alarm has been triggered. Motion detectors usually protect in door areas, where conditions can be more closely controlled. Detectors for use in homes usually detect movement in spaces about 11m x 11m (35ft X35ft) in area. Detectors for large warehouses can protect areas with dimensions as large as 24m X37m (80ft X120ft). Buildings with valuable or important assets such as museums also use motion detectors to detect break – in at Vulnerable point such point include walls, door, windows, skylight and even air ducts. Special motion detectors can protect the inside of exhibit cases where items such as diamonds are placed. Other can be focused to a narrow area of coverage, somewhat like a curtain that projected in front of a painting to detect even the slightest touch.

1.3 History of Ultrasonic Motion Detectors

The use of ultrasonic waves to detect motion dates back to 1910 when ultrasonic waves were little more than a scientific curiosity, through the possibility of making use of ultrasonic beam for practical purposes dates back to 1880`s . When James prescott Joule (in 1846) investigated the phenomenon that a ferromagnetic bar expands when it is weakly magnetized but contracts when magnetic saturation is reached, such mechanical (dimensional) changes due to changes in magnetic field are refred to as magne to static effects (this phenomenon was later extensively investigated by George Washington pierce). When these changes are linear in nature, they are known as the Joule effect, which is of great importance in producing ultrasonic oscillations for commercial applications. The piezoelectric or pressure electrical phenomenon was first discovered and studied by Pierre curie, a French scientist as at early 1880 discovered that asymmetrical crystals, such as Rochelle salt Quartz generate an electric change on their surface when mechanical is applied. When pressure is applied to such crystal, its surface becomes electrically charged (ie one side become positive and the other negative), when tension is applied these electrical changes are transformed into electrical oscillations. This phenomenon is called the "direct piezoelectric effect ". Pierre curre and his brother also discovered that if a difference in voltage is set up in metal plates held against opposite faces of the crystal, a small compression is induced in crystal; this phenomenon is refred to as inverse piezoelectric effect can be used to produce ultrasonic waves. If a voltage is applied to remove rapidly, the crystal expands and contracts rapidly. By speeding up the applied voltage cycle sufficienthy, one can produce ultrasonic beams, if the voltage cycle is equal to the natural frequency of the quartz crystals and the beam will build up to a considerable strength.

In 1917, after the development of electron tube, the French physicist Paul Lange VIN succeeded in setting up an electric circuit that produced strong ultrasonic beams. This was during the First World War and Langevin attempted to use such beams to detect submarines under water.

Ultrasonic pulses can be sent methodically outward in ever changing direction (scanning), and when a pulse sestrikes a submarine, it is reflected. The direction from which a returning pulse is reflected is the direction of the submarine and the distance of the submarine can be eatimated by noting the time lapse between the transmission and the return of the reflected pulse by knowing the velocity of sound in water.

In the 1920's, ultrasound was put to work in peaceful ways; used in measuring the depth of sea bottom, providing a vast improvement over the usual method of dropping a sound line over board. The location of schools of fish, hidden could also be determined using ultra sound. More so, during the Second World War, the use of ultrasonic pulses for detection of enemy vessel came to maturity.

Ultrasonic waves have been used also for the purpose other than echoelation. Strong rapid vibrations can shake grime loose, and therefore, they have been used to penetrate steel girders in search of gas bubbles and other flaws

However, just as it is customary to regard light and heat as radiation, invisible, ultra – violet and infrared sections of electromagnetic spectrum, sound also can be regarded as mechanical vibrations having frequencies from a few cycle to ultrasonic vibrations. An important difference however, exists between the vibrations producing light and those producing sound.

Light vibration are transverse, (the vibrations produced are perpendicular to the direction of propagation) but in the case of sound, vibrations are longitudinal (that is the vibrations that takes place in the same direction of propagation.

1.4 Aims and Objectives

The aims of this project are to design and construct an Ultrasonic Motion Detector device with a 500Hz alarm system. The device detects Motion from 60cm away. Once that occurs, an LED lights up and an alarm (buzzer) sounds there by indicating the detection of motion.

1.5 Applications

As the name of the device implies, it is used to detect motion. In the case of a security system, it detects an intruder and consequently prevents intrusion. Ultrasonic motion detectors have several advantages over other types of motion detectors being that they have a faster response and are very sensitive. No physical contact is required with the object; they are environment friendly and reliable. The employ the use of ultrasonic waves that are not visible and audible, they are not sensitive to objects of different colours and they have light reflective properties. One major drawback (ie Disadvantage) of this kind of detector is that they respond even to normal environmental vibrations.

CHAPTER TWO

LITERATURE REVIEW

A Motion Detector is a device connected to a burglar alarm that is used to detect motion. If it detects motion and the burglar alarm is set, it sets off the alarm. An electronic motion detector is a device that transforms the detection of motion into an electrical signal. Motion detector system uses a variety of methods to detect movement. Each method has its advantages and disadvantages.

2.1 Types of Motion Detectors

There are different types of motion detectors, and the most common ones include

- Photo electric motion detectors
- Radar motion detectors
- Video motion detectors
- Micro wave motion detectors
- Passive infrared (PIR) Motion detectors.

2.1.1 Photo Electric Motion Detectors

A Photoelectric motion detector consists of two components: a transmitter and a receiver. The transmitter uses a light Emitting Diode (LED) as a light source and transmits a consistent infrared beam of light to a receiver. The receiver consists of light of a photoelectric cell that detects when the beam is present. If the photoelectric cell fails to receive at least 90% of the transmitted signal for as brief as 75 milliseconds (time of an intruder cruder crossing the beam), an alarm signal is generated. The beam is modulated at a very high frequency, which changes up to 1,000 times per second in a pattern that correlates with the receiver's expectation to guard against a bypass attempt by using a substitute light source. In order to bypass sensor, the angle of the beam and modulation frequency would have to be matched perfectly

2.1.2 Radar Motion Detectors

RADAR (Radio Detection and Ranging) is an active sensor that has undergone a substantial refinement and enhancement since its first operational use as a detection sensor in the early 1940s. Radar uses ultrahigh frequency radio waves to detect intrusion of a monitored area. Radar sensors transmit signal from an energy source in the ultrahigh frequency range of 100 MHz to 1GHz. The Radar signal "bounces" off objects in the detection Zone, and a processor to determine the relative size; azimuth and distance of the object then analyzes the reflected signal. The information is then converted to symbols and displayed as part of an integrate presentation on a local cathode Ray Tube (CRT). Photoelectric beam sensors transmit a beam of infrared light to a remote receiver creating an "electronic fence ". These sensors are often used to "cover" openings such as door ways or hall ways, acting essentially as a trip wire. Once the beam is broken / interrupted, an alarm signal is generated.

2.1.3 Video Motion Detectors

Video motion Detectors (VMD) use closed circuit Television (CCTV) systems (visible, low level light and infrared) to provide both an intrusion detection capability and a means for security personnel to immediately and safely assess alarms (possible intrusions). CCTC systems provide the added benefit of documenting the events of an intrusion and the characteristics of an intruder. Video motion Detector sensors detect changes in the monitored area by comparing the "current" scene with a pre-recorded "stable" scene of the area. Video motion Detectors monitors the video signals being transmitted from the camera. When a change in the signal is received, indicating a change in the image composition caused by some sort of movement in the field of surveillance, an alarm signal is generated and the intrusion scene is displayed at the monitoring station.

2.1.4 Microwave Motion Detectors

A movement in the zone disturbs the field and sets off an alarm. Microwave motion detectors may be used in interior and exterior applications. They transmit microwave signal in the "X" band. These signals are generated by a Gunn diode operating within preset limits that do not affect humans or the operation of pacemakers. Although very little power is used, the system provides enough energy for a detector to project a signal up to 400 feet in an uninterrupted line of signal. The detection of intrusion is directly related to the Doppler frequency shift principle. Most sensors are tuned to measure the Doppler shift between 20Hz and 120Hz. These frequencies are closely related to the movements of humans. Objects that fail to produce a signal or produce a signal outside the tuned frequencies are ignored. Objects that fall within the range cause the sensor to generate an alarm signal.

2.1.5 Passive Infrared (PIR) Motion Detectors

Passive infrared (PIR) motion detectors are electronic devices which are sensitive to infrared wavelengths of energy. Infrared energy can be detected as heat and this type of detector senses the heat that human or other animals emit. PIR have lenses that allow them to "see" an area as several distinct zones within the range of the detector. These zones spread out vertically and horizontally from the detector's lens as a series of finger like areas, fanning out from the lens across of the protected area and down to the floor. Electronic circuits enable the detector to recognize the normal amount of heat that is usually present in the area.

When an intruder enters, the heat from the intruders` body adds to the amount of heat normally present in the area. As the intruder moves from one zone to another within the detector's field of view, the detector senses an increase in infrared energy and signals an alarm.

Infrared energy is also used in active infrared motion detectors. These detectors project a beam of infrared energy from one unit (the transmitter) to another (the receiver). An intruder who moves through the beam breaks a circuit in the receiver, triggering an alarm.

2.2 Ultrasonic Motion Detectors

These are electrical devices, which use ultra-sound (that is, sound of very high frequency) to detect motion. In such a detector, a transmitter sends out sound of a frequency that is too high for the human ears to hear. A receiver pinks up the sound wave reflected from the area under protection. The motion of some one or something in the space between the receiver and the transmitter will cause a change, or shift in the frequency of sound, (the frequency shift is known as the "Doppler effect", which results from the behaviors of sound waves when they are compressed by a moving object), a circuit in the device detects any unusual shift in frequency. A small shift in frequency, such as that produced by an insect or rodent, is ignored. When a larger shift such as one produced by a moving person, is detected, the device triggers the alarm.

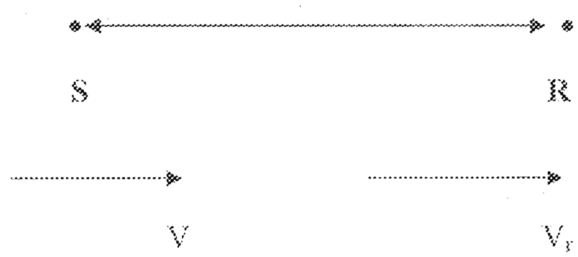
2.2.1 Mode of Operation

The Ultrasonic motion detector uses a phenomenon known as the "Doppler effect" in detecting the motion of an object. The Doppler Effect is the apparent difference between the frequencies at which sound or light waves leave a source and that at which they reach an observer, caused by relative motion of the observer and the wave source. Example of the Doppler Effect includes:

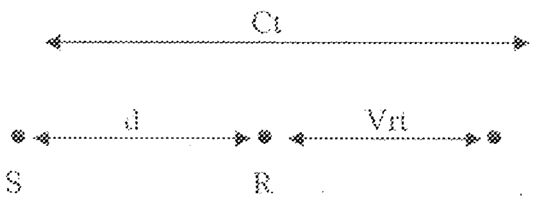
- As one approaches a blowing horn, the perceived pitch is higher until the horn is reached and then becomes lower as the horn is passed.
- The light from a star, observed from the earth, shift towards the red end of the spectrum (lower frequency) if the earth and the star are receding from each other, and towards the violet (higher frequency) if they are approaching each other.

2.2.2 Doppler Shift Derivation

Considering the relationship between the frequency of sound produced by a source moving with velocity V and the frequency received by a receiver moving with Vr. For simplicity, we assume that both the source and the receiver are moving in a straight line in the same direction. At time t = 0, the source (s), and receiver (R) are separated by a distance (d).



The source emits a wave that propagates at a velocity c, and reaches the receiver after time t as the receiver has moved Vrt metres



Therefore, $Ct = d + Vrt$ -------------------equ 2.1

But, making t, the subject, we have:

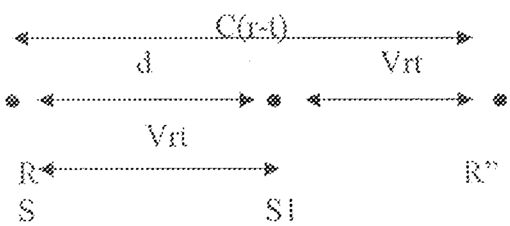
$Ct - Vrt = d.$

⇨ $t(c\text{-}Vr) = d.$

⇨ $t = \frac{d}{C - Vr}$ ---------------- equ 2.2

C- VR

At time t, the source (s) would have moved vst (m). Let the wave receive ® at time, in this time, the receiver would have moved VRt' (m)



$C(t\text{-}t) = (d - VS\ T) + Vrt'$ ---------------------equ 2.3

Thus, for the receiver, the interval between the waves has been gotten as

Hence, $t^1 = \frac{d + (C - Vr)r}{C - Vr}$ ………………equ2.3

CHAPTER THREE

DESIGN AND CONSTRUCTION

The ultrasonic molten detector system embodied the following under listed subsystems.

i. System's power supply

ii. 567 tone decoder/PLL

iii. LM358 small signal amplifier

iv. LED system status indicator/a sounder.

The block diagram of the design is as shown below:

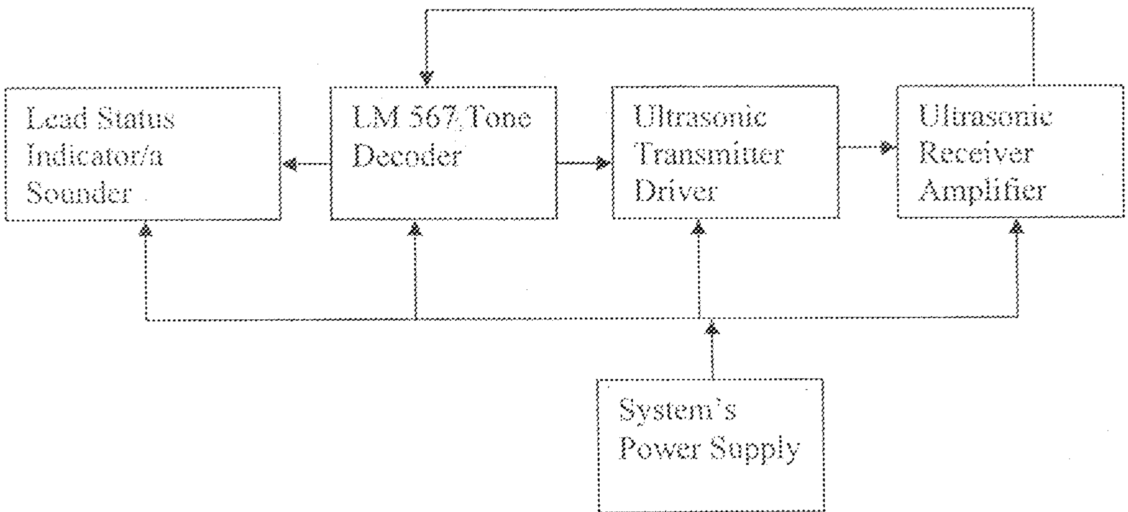


Fig 3.1 Block Diagram of the Ultrasonic Motion Detector

3.1 System's power supply

A regulated 5-volts supply was required for system functionality. The 5-volt supply was derived from a 12V 1A step down transformer, a full wave bridge rectifier and a 7805 three terminal voltage regulator.

The supply is also shown below:

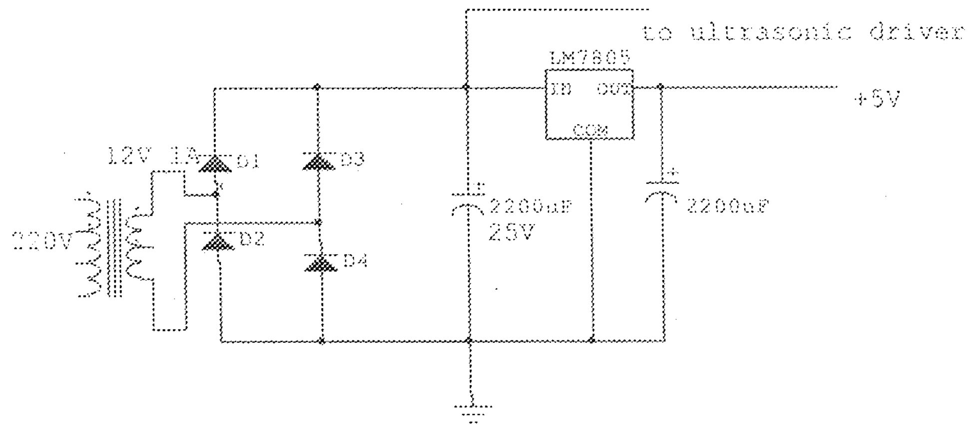


Fig 3.2 System's power supply.

Note: D1 –D2 : IN 4001

The low voltage AC was rectifies into a pulsating DC of amplitude:

$V_{dc} = (V_{rms}\sqrt{2}) - 1.4$

$V_{dc} = 12\sqrt{2} - 1.4 = 15.6V$

The dc voltage was smoothened by a capacitance evaluated using the expression:

$C = \frac{It}{dV}$ where

I=load current

$t = \frac{F}{2}$(FWBR)

dV=peak-to-peak ac ripple voltage.

The load current was fixed at the maximum value deliverable by the transformer (i.e., 1A). The peak-to-peak ripple voltage was determined by the minimum input voltage into the 7805 regulator device. For a regulated 5V output, the minimum input voltage is 7V (obtainable from the device's datasheet).

On a 15.6V peak dc input voltage, the peak-to-peak ripple voltage is thus (15.6-7)V=8.6V. Calculating for C yields:

$$C = \frac{1 * \frac{1}{2*50}}{8.6} = 0.0023256F$$

$$C = 2326uF$$

The value was chosen as 2,200uF for improved system performance.

The regulated 5V output was further buffered by a 2200uF capacitance. The unregulated dc voltage was fed to the ultrasonic transmitter via a 39Ω resistance as depicted in the fig. 3.2.

3.2 567 PLL/Tone detector

To detect the received ultrasonic waves, a 567 tone decoder/PLL device was used. The 567 was configured as shown in fig 3.3. The device also provided a high frequency drive to the transmitter via a PNP/NPN switching network.

The derivation of the ultrasonic waves from the PLL assured easier tracking of the generated frequency. The 567 provides a saturated transistor switch to ground when an input signal is present within its pass band. The device consists of an I and Q detector driven by a voltage controlled oscillator (VCO) which determines the centre frequency of the detector. External components are used to set, independently, the center frequency bandwidth and output delay. The 567 is drawn in the diagram below:

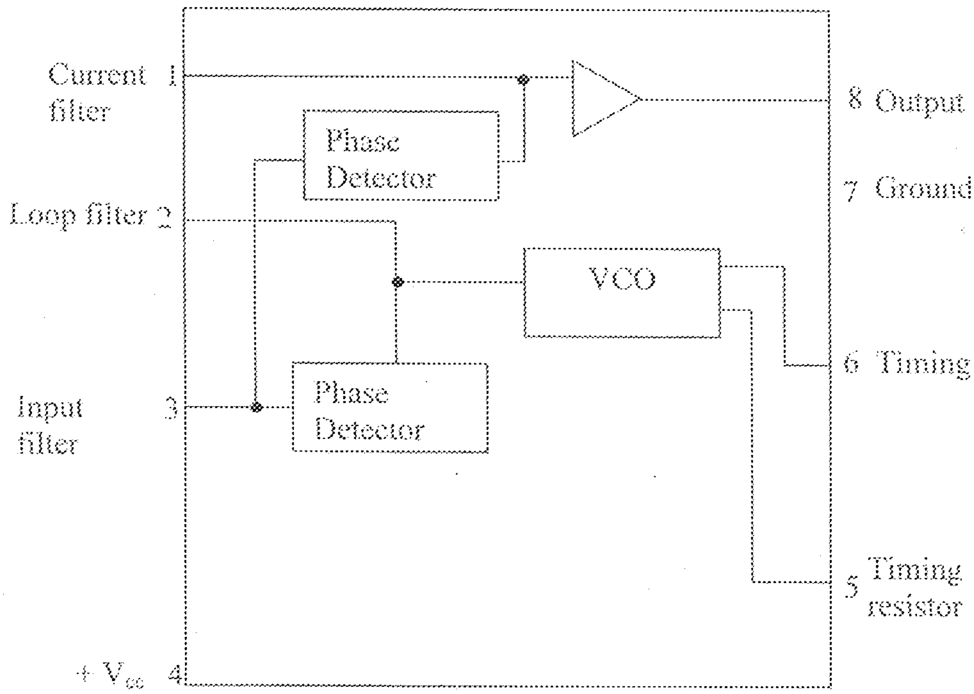


Fig. 3.3 LM 567 tone decoder/PLL

The centre frequency of the tone decoder is equal to the free-running frequency of the VCO. This is given by;

$$f = \frac{1}{1.1 R_T C_T}$$

RT = Resistance between pins 5 and 6

CT = Capacitance to the ground from pin 6.

The bandwidth of the filter is found from the approximation.

$$BW = 1070\sqrt{\frac{V_i}{f_0 c_2}} \quad \text{in \% of } f_0$$

Where,

Vi = Input voltage (volts rms), Vi < 200mV

C2 = capacitance at pin 2 (uF)

The 567 was configured as shown below in this realization:

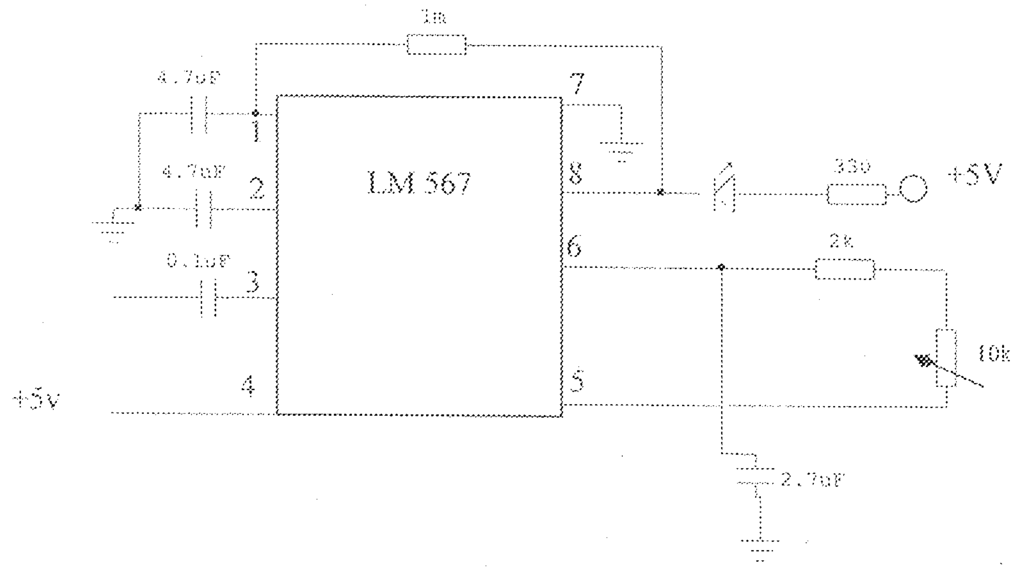


Fig.3.4 : Tone Decoder Configuration.

The input of the decoder was fed with the output signal from the ultrasonic receiver amplifier. The centre frequency was adjusted by a 10k resistance to 40kHz being the frequency at which the transmitter/receiver pair exhibit response.

An LED from Vcc to pin 8 will glow, whenever the frequency of the input matches the VCO reference frequency. The bandwidth of the decoder in terms of the capacitance at pins 1 and 2 yields a value of about 2% in terms of the output frequency i.e about 800Hz relative to 40kHz centre frequency.

3.3 Ultrasonic Transmitter driver

The wave form at pin5 was used to drive a PNP transistor, which in turn drives the transmitter as indicated in fig. 3.5.

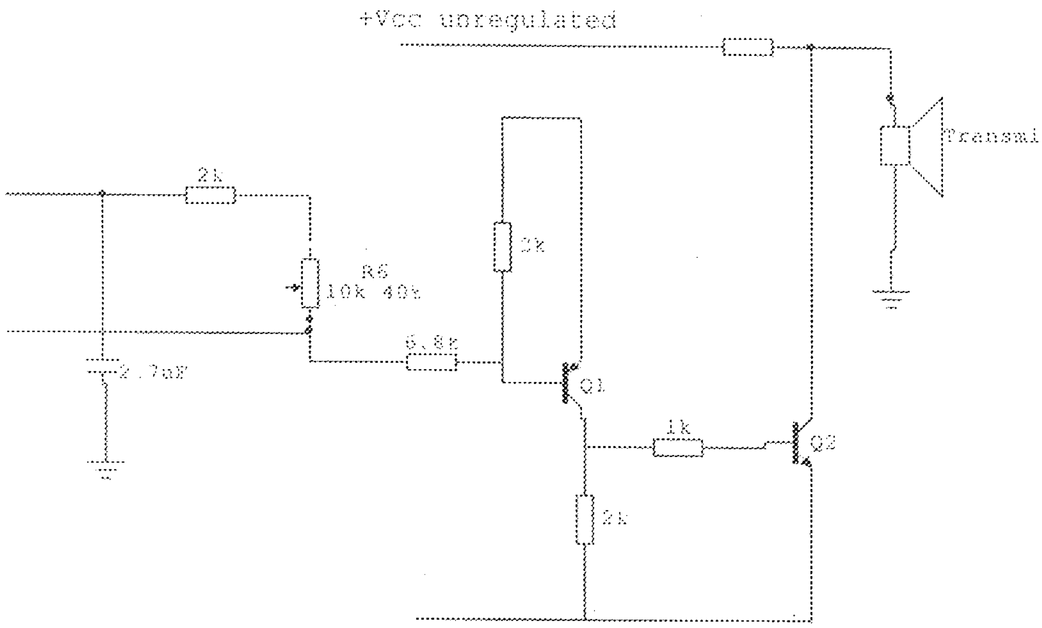


Fig. 3.5 Ultrasonic Transmitter driver

The square wave form'on pin 5 switches Q1, a 2SA1015GR device On and Off at the centre frequency of 40kHz. The transistor Q2 is alternately saturated and cutoff at this same pulse repetition frequency.

The collector of Q2,a 1- amp transistor comprises a high voltage 39Ω resistance and the ultrasonic transmitter.

The switching action of Q2 causes the voltage at its collector to vary in consonance with Q2's switching frequency, generating an AC voltage across the transmitter at 40kHz.

The generated frequency is radiated away from the transmitter which is aligned parallel with the receiver.

3.4 Ultrasonic Receiver/ Amplifier

To receive the transmitted high frequency, a receiver is required. The receiver has to be connected to a non inverting amplifier with a variable gain adjustment as shown below.

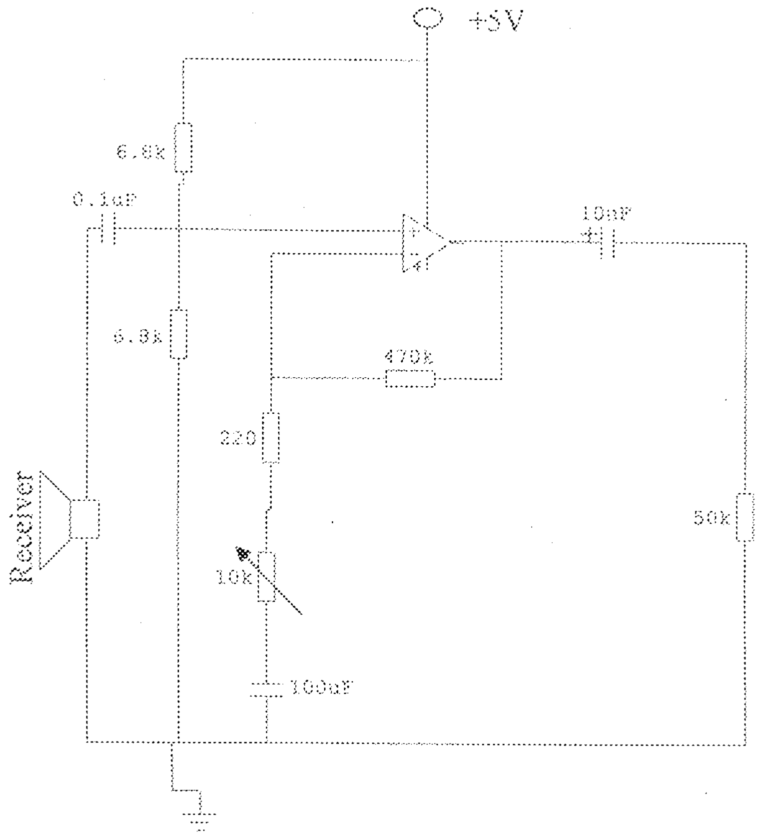


Fig. 3.6 Ultrasonic Receiver/ Amplifier

An LM 358 device was configured as a non-inverting amplifier. The gain was set by a 470kΩ feedback resistance and a 10kΩ variable/220Ω received resistance to grounds.

The maximum AC gain of the amplifier is given by:

$$\left(\frac{470,00}{220} + 1\right) \approx 2137$$

The maximum gain is also given by:

$$(\frac{470{,}00}{10{,}220}+1)\approx 47$$

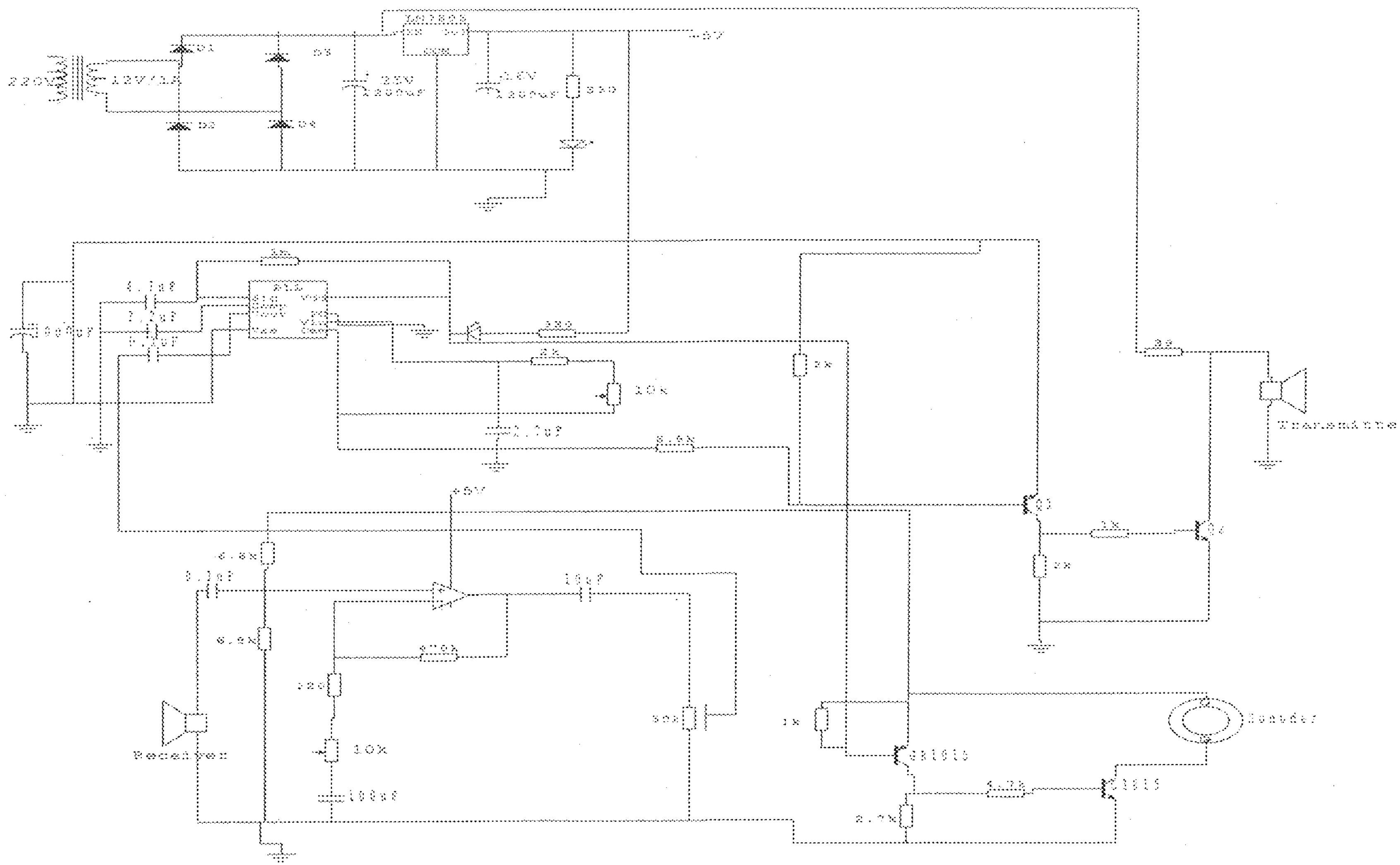
The gain is made variable for easy system setup

3.5 LED Status Indicator/ a Sounder

An LED was connected from Vcc to pin 8. The LED glow when pin8 switches low, i.e when the frequency amplifier by the LM 358 matches the centre frequency of the 567's VCO. The LED remains on a along as the received frequency lies in the pass band of the 567 devices; (i.e 40KHz ± 400Hz). The LED is extinguished when the frequency at pin 3 does not match the VCO's centre frequency.

Furthermore, a sounder was incorporated and the transistor that drives the sounder was connected to pin 8. This implies that as the LED glows; the sounder will also be producing sound, indicating that there is an intruder around the vicinity.

3.6 Complete Circuit Diagram



CHAPTER FOUR

TESTS AND RESULTS

4.1 Testing

After obtaining the components necessary for the design, it was first and foremost built on a bread board to ensure its functionality, before transferring it to the vero board. When soldering it, each step was tested to avoid bridging. Also after the soldering was completed, the whole work was tested before encasing it.

However, the transmitter and receiver transducer pair were set such that the transmitting and receiving frequencies annul each other if and only if there is no obstruction. Therefore, the design was tested after casing using an obstruction to alter the receiving frequency so as to cause the LED indicator and the sounder to be energized.

More so, a meter rule was used to measure the distances covered so as to determine the sensitivity of the detector. Therefore, the results obtained are shown in table 4.1 below:

4.2 Results

Table 4.1: Result of Sensitivity Tests

SERIAL NUMBER	RANGE OF DISTANCES IN (CM)	SENSITIVITY OR SOUND INTENSITY
1	0 – 6	Very high
2	7 – 12	Relatively high
3	13 – 18	Relatively low
4	19 – 24	Very low
5	25 – 30	Almost un-noticed
6	31 and above	No response at all

4.3 Discussion of Results

From the result obtained when the device was properly tested, it was observed that the range for which the design can cover was very small. This is due to the ultrasonic transmitter/ receiver transducer pair used and the manufacturer's design limitations.

CHAPTER FIVE

CONCLUSION

It could be deduced from the foregoing report that the design of ultrasonic motion detectors, just like any other electronic design, needs extra careful planning and implementation.

Therefore, from the result obtained in chapter four, it can be concluded that the aim and objectives of this project work has been achieved.

REFERENCES

[1] B. L Theraja and A.K Theraja, a text book of Electrical Technology, Edition 1994.

[2] Horwitz and Hill, Arts of electronics, Low priced Edition, University of Cambridge, New York 1995.

[3] S.N sen Acoustics, waves and oscillations, John Wiley and Sons New York Chichester Singapore Page 126-127.

[4] Robert Hutchings, Bath(Advanced Physics) 2nd Edition page 35.

[5] Encyclopedia of Physics Science and Technology, Volume 24, Page 164.

[6] Encyclopedia, American, Griolier encorporated. Vol. 27, 1981, Page 258

[7] Collecier's Encyclopedia Macmillan Education Company New York, 1981, Page 579.

[8] www. Nationalsemiconductor/IM324/tutorial.com

[9] www.555tutorial.com

[10] www.motionsensor/edu/tutorial

[11] www.ultrasonics.com

[12] www.ultrasonicmotiondetector.com

[13] www.security/alarm

[14] www.dopplereffect/tutorials com