

**DESIGN AND CONSTRUCTION OF  
A MOSQUITO REPELLER**

**BY**

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TECHNOLOGY, MINNA.**

**NOVEMBER, 2005.**

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**FEDERAL UNIVERSITY OF TECHNOLOGY MINNA.**

**IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR  
THE AWARD OF BACHELOR OF ENGINEERING (B. Eng)  
DEGREE IN ELECTRICAL AND COMPUTER  
ENGINEERING**

**NOVEMBER, 2005**

# CERTIFICATION

his to certify that this project work has been duly supervised read and approve.  
laving been found to have met the standard requirement for the partial fulfillment for  
he award of Bachelor of Engineering Degree in Electrical Engineering.

Mrs. Alenoghena C.O.

SUPERVISOR

Alenoghena 5/12/05

SIGN & DATE

.....  
HEAD OF DEPARTMENT

 27/02/06

SIGN & DATE

.....  
EXTERNAL SUPERVISOR

SIGN & DATE

## DECLARATION

I, Blessing Eneh Ubah, hereby affirm that this project title is the original work and has never been submitted anywhere else before neither has it been wholly or partially presented for any other degree. All sources of information have been duly acknowledged by means of references.

Blessing E. Ubah

NAME OF STUDENT

~~xxxxxx~~ 2/21/05

SIGNATURE AND DATE

## ACKNOWLEDGEMENT

First and foremost, I appreciate God almighty for his mercies, faithfulness and grace throughout my years in school, my parents, you've been wonderful, my sisters, brothers, niece; nephew and my sister in-law, I love you all.

I also thank the department of Electrical/Computer Engineering for impacting knowledge into me, my initial supervisor; Mr Bartholomew, my present supervisor; Mrs. Alenoghena, for the corrections and encouragement, lecturers of the department and my head of department: Engr M.D. Abdullahi, my friends here and abroad, I cherish you all.

However, I also appreciate my in-laws to be, the Dodos and finally to my best friend, Mr. Tanimu Dodo, you are incomparable, thanks.

## DEDICATION

This project is dedicated first and foremost to the person of the trinity: God the father son and the Holy Spirit, to my beloved dad in blessed memory, Mr Augustine Ubah, my dearest mummy, Mrs. M. Ubah, my lovely brothers; Mr Harrison, Abel, Moses, Ben and Charles; my sweet sister; Ann, Vicky, Faith, my cousin; Julie; my sister in-law; Mrs Mary, to my niece; Dollar, nephew; Crefflor and finally to Mr Tanimu Dodo, you are the best

## ABSTRACT

A mosquito repeller is a circuit that repels mosquito in a modern and clean way without using any potentially harmful chemical repeller.

The theory behind this circuit is quite simple and amazingly effective. When female mosquitoes( the ones that bite ) are pregnant they prefer to stay away from the male mosquitoes in search of food(blood). This circuit produces the ultrasonic sound that the male mosquitoes produce and this in turns repels the female mosquitoes.

Research has proven that the sound produced by the male mosquitoes is about 40KHz which is an ultrasonic sound within a certain radius of 3m as designed.

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# CHAPTER ONE

## 1.0 INTRODUCTION

Mosquitoes are one of the most dangerous insect enemies of man. They are found in almost all the world, from arctic regions, such as Alaska and Greenland to the tropical swamps of Africa, South America and South-East Asia.

The eggs are laid on or near the ponds of water, pools and marshes. They're sometimes found or deposited in the water that has been collected empty tin-cans or discarded automobile tyres. After a short time the eggs hatch into the aquatic larvae called wigglers. These feed upon minute animals and plants or floating particles in the water, they frequently come to the surface to breathe. The pupae are also active wigglers. Adult males have active feather-like antennae, while the antennae of the female are slender and hairy, only the females bite.

All over the world, mosquito annoy man by sucking his blood, however they cause the greatest amount of human misery, they carry several major diseases that are deadly to man. Malaria is transmitted by the species called the Anopheles, yellow fever is transmitted primarily by *Aedes aegypti*, but also by other species of *Aedes* and *Hemagogus*. Dengue is also carried by *Aedes aegypti* and some of its close relatives. Filariasis is transmitted by various species of *Culex* and *Aedes*. The mosquito which is invertebrate in nature utilizes the body fluids of other animals as food with the help of their elongated mouthpart. [5]

## 1.2 THE EFFECT OF MOSQUITOES

When an infected mosquito bites a healthy person, it introduces parasites at the sporozoites migrate to the liver, multiply and develop into gametocytes. A mosquito picks up this gametocyte when it bites an infected person which develops in the

mosquito's stomach where they reproduce sexually to form sporozoites. These migrate to its salivary gland and are eventually transmitted to a healthy person through its bites and causes malaria.

### 1.3 SYMPTOMS OF MALARIA

Symptoms of malaria include cyclic occurrence of chills (violent shaking), fever, shaking. These symptoms occur when the merozoites destroy the red blood cells causing toxins to be released into the blood. Headache and nausea are the other common symptoms. The secondary effects are mainly anaemia, jaundice and enlargement of the

Spleen. [ 5 ]

### 1.4 CONTROL OF MALARIA

Malaria can be controlled by getting rid of the mosquitoes by the use of insecticides which is the common way, but mosquitoes are becoming resistant to insecticides and the use of it may result to respiratory diseases such as catarrh when inhaled for a long period of time. The circuit (mosquito repeller) was designed to get rid of mosquito from our environment not by killing but by repelling the females which do the biting.

## CHAPTER TWO

### 2.0 LITERATURE REVIEW

Energy is familiar to us in many ways as light, heat, kinetic and potential, electrical and magnetic energy. In the same way sound is also a form of energy. Just as it is customary to regard light and heat as radiation invisible, ultraviolet and infrared sections of electromagnetic spectrum, sound can also be regarded as mechanical vibrations having frequencies ranging from a few cycles per second(Hertz) to approximately 20kHz and this range is called the audible range. Above this frequency, above this frequency, the vibrations is called ultrasonic vibrations

An important difference however exists between the vibrations producing light and sound. In the study of sound, the frequency ranges of sound are categorized as infrasonic (low frequency), sonic (audible, medium frequency), or ultrasonic (high frequency).

The prime criterion for the production of sound is that the body producing the sound must be in the state of vibration. In some cases, these vibrations can be seen as a blurred outline of the sound body whereas in other cases it may be necessary to use some amplifying devices and has been established beyond any doubt that unless a body is in a state of vibration no sound can be produced. [7]

### 2.1 GENERATION OF ULTRASONIC WAVES

There are number of ways by which ultrasonic waves can be generated. The method to be employed depends upon the power output necessary and the frequency range to be covered. Generators of mechanical type such as tuning forks and Gal ton's whistle can be used up to 10,000Hz. [7]

## 2.2 GALTON'S WHISTLE

To determine the limit of audibility, Alton devised a miniature organ pipe in the form of a whistle. At one end of the pipe there is moveable plunger or reflector and its position can be varied by means of a micrometer screw. By means of this length of the air column within the pipe and consequently the of the pitch of the note can be varied. Edelman later designed the pipe which later blown from an annular nozzle fitted with a screw to vary its distance from the edge of pipe. By adjusting this distance and the the pressure of the air blast, the pipe is set into resonant vibration at a frequency corresponding to the length and diameter. Sounds of very high frequency can thus be produced. [7]

## 2.3 APPLICATIONS OF ULTRASONICS

Some applications of ultrasonic include;

### i. Medical uses:

In modern surgery, ultrasonic has a dominant role to play; it has been used for the treatment of arthritis and other similar diseases. The use of ultrasonic for measuring the rate of flow of blood has been suggested. Location of tumor and gallstone has been done with ultrasonic. [7]

### ii. Chemical effects:

Many chemical changes take place in the presence of ultrasonic which in absence do not occur. Oxidation and iodine reactions occur more rapidly in the

presence of ultrasonic. Both dispersive and coagulate effects take place more rapidly under irradiation and oscillations varying from 20 to 100 kHz are rapidly used.

iii. Heating by ultrasonic:

It is observed by early workers that even when ultrasonic energy is concentrated in various materials considerable amount of heat is produced, and there is definite ratio between the heat produced and the ultrasonic energy absorbed. With the increase of frequency of ultrasonic waves, the heat generated is increases due to increase absorption. [7]

iv. Ultrasonic flaw detector:

In metals specially there may arise the presence of foreign materials, or there may be a crack in the body of the metal which is not visible to the naked eyes. The presence of these discontinuities may seriously hamper the contraction of metal parts. Ultrasonic finds a very useful application in detecting these flaws and irregularities. [7]

## 2.4 FUNTIONS OF THE COMPONENTS USED

i. Transformer:

This is a static (or stationary) piece of apparatus by which electric power is transformed into electric power of the same frequency in another circuit. It can raise or lower the voltage in a circuit but with a corresponding increase or decrease in current. [1]

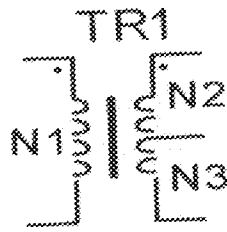


Fig 2.4i. Symbol of transformer

ii. Rectifier:

It is a circuit which employs one or more diodes to convert ac voltage into pulsating dc voltage. The transformer connected to the rectifier supplies the rectifier with electrical isolation and alter ac supply voltage. [ 1 ]

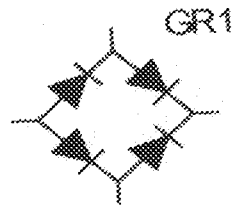


Fig 2.4ii. Symbol of bridge rectifier

iii. IC Regulator

This regulator has much improve performance; they have a number of built-in features current limiting, self-protection against over temperature, remote control operation over a wide range of input voltages and feedback current limiting. [ 2 ]

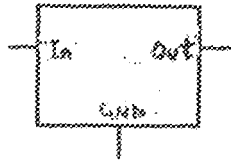


Fig 2.4iii. Symbol of IC regulator

iv. zener diode

This is used for voltage regulation and makes use of the breakdown property of diode when reverse-biased. The diode is designed to breakdown if the reverse current suddenly changes from a very small value to a very large which is independent of the voltage ( $V_z$ ). [1]



Fig 2.4iv. Symbol of a zener diode

v. Resistor ;

These are used to limit the flow of current in a circuit. The limitation to this flow is called resistance which is measured in ohms. [3]





Fig 2.4 v. Symbol of a resistor

vi. Variable resistor:

This is a type of resistor whose resistance value can be adjusted. [ 3 ]

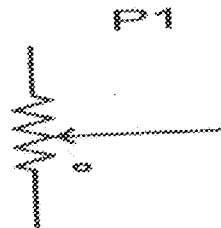


Fig 2.4 vi. Symbol of a variable resistor

vii. Capacitor:

This stores electrical charges. Basically has two plates separated by an electrical insulator called dielectric. [ 4 ]

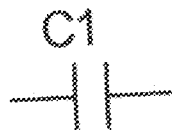


Fig 2.4 vii. Symbol of a capacitor

viii. Diodes:

This is a semiconductor device which allows current to flow through it in one direction. [ 6 ]

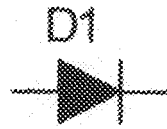


Fig 2.4 viii. Symbol of a diode

ix. Loudspeaker:

A varying current passing through the coil of the speaker causes it to vibrate in and out of the pole pieces of the permanent magnet. The core of the speaker is attached to the coil and therefore vibrates at the frequency, this in-turn causes the surrounding air to vibrate and sound is produced at a frequency as that of an ac. [ 8 ]

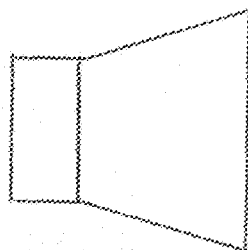


Fig 2.4 ix. A symbol of a loud speaker

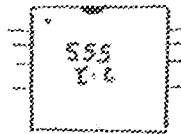


Fig 2.4x. Symbol of a 555 timer IC

xi. Transistor:

This is an active component device that conducts current in one direction. The transistor here amplifies the vibration. [2]

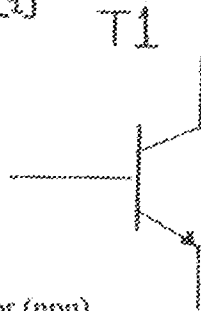


Fig 2.4 xi symbol of a transistor (npn)

xii. Light emitting diode (LED)

This gives off light when a current passes through them in a forward direction. An LED is a transducer which is used to change electrical energy into a light energy and is made from the semiconductor gallium arsenide phosphate. The LED must be connected in a circuit the correct way, if it is to work, its anode must be positive and cathode must be negative. [10]

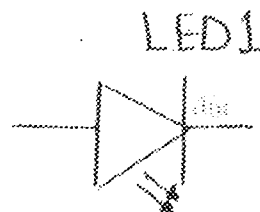
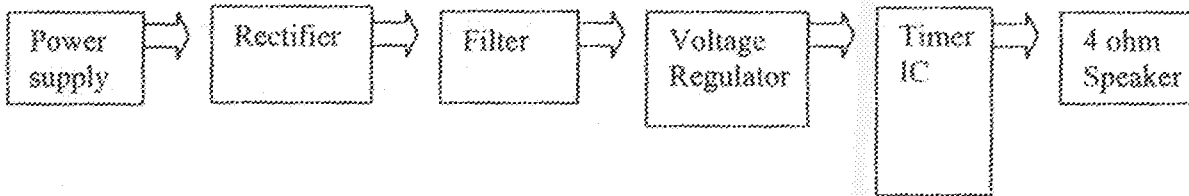


Fig 2.4xii symbol of an LED

## CHAPTER THREE

### 3.0 THEORY AND DESIGN OF CIRCUIT

#### 3.1 BLOCK DIAGRAM OF A MOSQUITO REPELLER



Figs 3.1 BLOCK DIAGRAM OF THE CIRCUIT

Each block represents a stage in the circuit of the mosquito repeller. There are basically six stages: the power supply, rectifier, filter, voltage regulation, timer ic and the speaker (output). [8]

#### 3.2 POWER SUPPLY

It's known that the standard voltage supply in this country is 240v, but the timer needs +12v to power the system. So the service of a step-down transformer is required to step-down the 240 ac volts to 12 dc volt, so a 12v. [1]

300mA half-wave transformer was used.

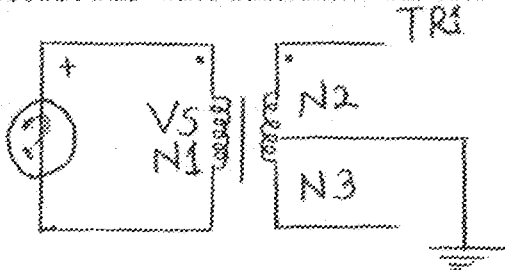
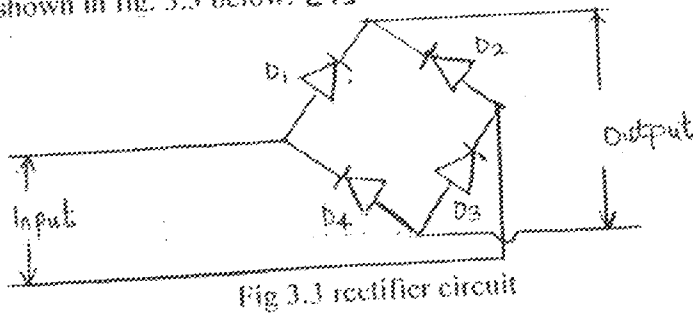


Fig 3.2 power supply circuit

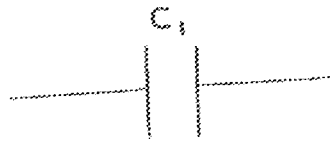
### 3.3 RECTIFIER

The bridge rectifier used as a silicon chip with wires embedded in it; two of the legs are for the input ac supply from mains, while the other two are for the output dc supply. The input and output signals of the power system so described will appear as shown in fig. 3.3 below. [4]



### 3.4 FILTER

At this stage the current and the voltage obtained as the output of signal of fig 3.2 and 3.3 above will have ripples in them. The remedy for the ripples is to use a filter consisting of a high value electrolytic capacitor of 100 $\mu$ f. [13]



### 3.5 VOLTAGE REGULATOR

The times used in this work can make use of supply voltages in the range of +12 to +18volts and can drive loads up to 200mA. But in this circuit, it needs +12volts to

drive the timers. So a voltage regulator of 7812IC is used to produce a stable +12v from the already rectified A.C input. [9]

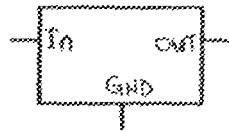


Fig 3.5 voltage regulator symbol

$$\% \text{regulation} = \frac{V_{\text{max}} - V_{\text{min}}}{V_{\text{max}}} * 100$$

$V_{\text{max}}$  = maximum d.c output voltage

$V_{\text{min}}$  = minimum d.c output voltage

$$V_{\text{max}} = 12\text{v}, V_{\text{min}} = ?$$

From  $P = \frac{V^2}{R}$

$$P = 3\text{w}, R = 4$$

All from the loudspeaker.

$$3 = \frac{V^2}{4}, V^2 = 12$$

$$V = 3.464\text{v} \approx 3.5\text{v}$$

$$\text{Therefore } \% \text{ regulation} = \frac{12 - 3.5}{12} * 100$$

$$= 70.8\%$$

### 3.6 TIMER I.C

An NE 555 integrated circuit can be used to generate an ultrasonic sound wave of this nature (40kHz) if wired as an ultrasonic oscillator, that is, it can produce a sweep of 40kHz square wave that can drive a 4ohm speaker. To get a very accurate frequency here, it is advised to use a low capacitor of say 0.1uF and also make that Ra value is very small compared to Rb. The figure 3.8 below shows a 555 timer wired as an ultrasonic oscillator. [8]

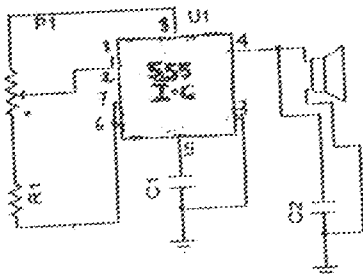


Fig3.6: A 555timer wired as an ultrasonic oscillator

### 3.7 DESIGN CALCULATION OF TIMER

The value of the variable resistor (Ra) used in the oscillator for the mosquito repeller is one of the major parameter that can be altered to get the desired frequency which is 40kHz. The frequency of the oscillator (f) is given by the expression

$$f = \frac{1.45}{(R_a + 2R_b) C} \quad \dots\dots\dots i$$

T=period of oscillation;

$$T = 1/f \quad \dots\dots\dots ii$$

Taking 40kHz as the frequency of the 555 timer

$$C = 0.1\mu f, R_b = 0.13k$$

From equation i

$$F = 1.45 / (R_a + 2R_b) C$$

$$\text{Therefore } R_a + 2R_b = 1.45 / (40E^3 * 0.1E^{-6}) = 1.45 / 4E^{-3}$$

$$R_a + 2R_b = 362.5$$

$$\text{If } R_a = 0.1k$$

$$2R_b = 362.5 * 0.1E^3$$

$$2R_b = 262.5$$

$$R_b = 262.5 / 2 = 131.25 \text{ohm}$$

$$T = 1/f = 1/40E3$$

$$T = 2.5 * 10^{-5} \text{sec}$$

$$T = 0.25 \text{usec}$$

From the circuit also  $R_1$  is given by the formula

$$R_1 = V_{cc} - 1.7 / 0.01$$

$$V_{cc} = 12v$$

$$\text{Therefore } R_1 = 12 - 1.7 / 0.01 = 1,030 = 1.03k \text{ohm}$$

To confirm the frequency,  $f$ ,

$$F = 1.45 / (R_a + 2R_b)$$

$$= 1.45 / (0.1E3 + 2 * 0.13E3) 0.1E^{-6} = 40kz$$



### 3.8 MOSQUITO REPELLER OPERATION

The complete circuit operation of the mosquito repeller is as shown;

The transformer acts as an electrical isolator between the mains and the circuit. The transformer also steps-down the mains voltage from 240v to 12v.

The diodes forms the rectifier, it converts the ac voltage to dc voltage.

The capacitor C1 is a filter capacitor; it provides a path for the ac to go to the ground while the dc components go to the regulator. The regulator IC takes in the fluctuating dc and provides a constant output voltage of 12 dc volts. The 12v Zener diode ensures that the power supplied multivibrator does not exceed 12v, the excess voltage is passed to the ground.

The 555 timer was configured in the stable mode using Ra, Rb and C. It was biased to generate a frequency of 40 kHz. The output of the stable multivibrator is passed to a speaker; the sound is not audible for the human ear but audible for insects and pets like dogs. That sound output of about 40 kHz by the speaker scares the female mosquitoes since the circuit produces sounds like the male Mosquitoes. [8]

### 3.9 CIRCUIT DIAGRAM

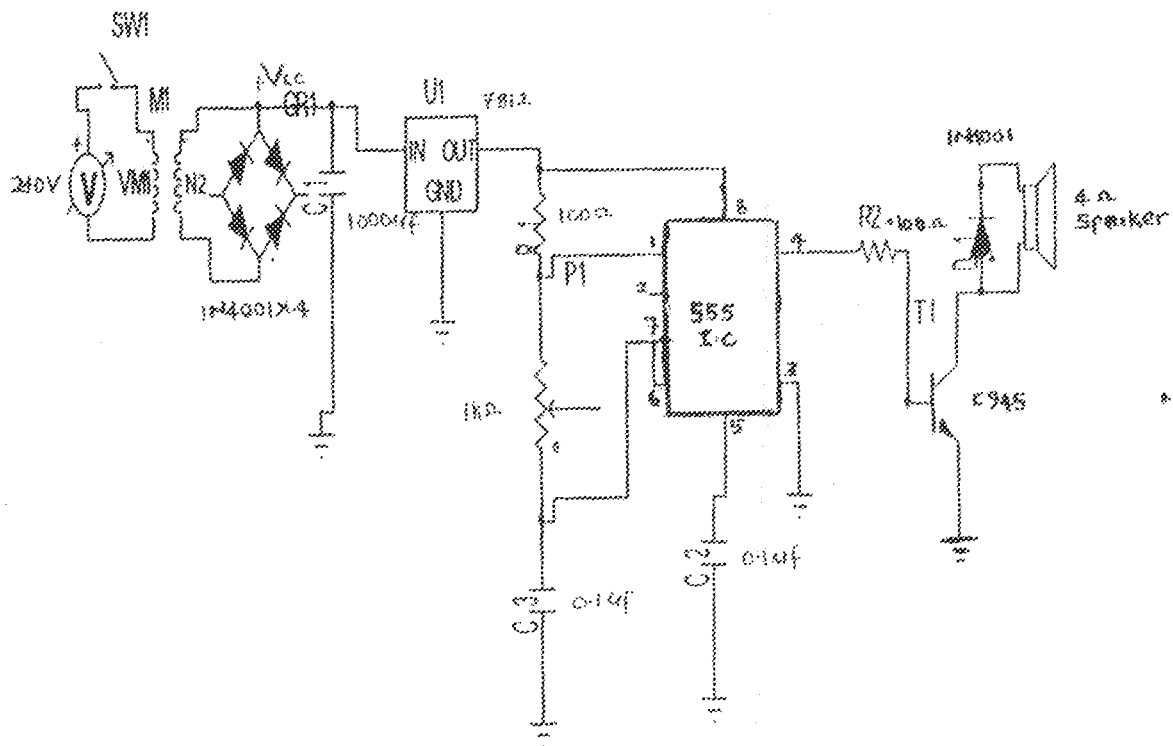


Fig 3.9 circuit diagram of a mosquito repeller

## CHAPTER FOUR

### 4.0 CONSTRUCTION, TESTING AND RESULT

#### 4.1 CONSTRUCTION

at this point the various components bought were soldered on a Vero board as shown in the circuit diagram. The soldering was done at interval i.e. stage by stage. Each stage was tested to see if it gave the desired output.

The step down transformer first mounted on the board and connected to the mains supply and its voltage measured with a multimeter. The output was observed to be 12v in the ac form which was fed to a silicon bridge rectifier which converted it to dc form.

The dc voltage so obtained was fed to a filter to remove the ripples in the circuit using a 1000 $\mu$ F capacitor which was soldered on the Vero board.

The 555 timer was wired as an ultrasonic circuit and was fed with +12v, the output signal of the 555 timer was a square wave with a voltage level of approximately 8v. This was fed into the speaker through the output pin three coupled via a capacitor of 0.1 $\mu$ F. The ultrasonic sound generated was measured with a frequency counter and found to be within the range of calculated value.

#### 4.2. TESTING

The following test was carried out after construction.

- i. Output frequency test

A frequency counter was used to test the output of the repeller circuit and was found to be 40 kHz.

ii. Effect on mosquitoes (repeller action)

The circuit was taken to class and on for about 30 minutes and no mosquito came near me.

It was also slept with in my room and no effect of mosquito was felt.

### 4.3 RESULT

The frequency output is 40kHz after construction, there was no audible sound produced by the 4ohm speaker but vibration was observed.

### 4.4 BILL OF ENGINEER QUANTITY

COMPONENTS	QUANTITY	UNIT PRICE (N)	COST (#)
i. Step-down transformer	1	140	140
ii. Speaker	1	120	120
iii. Rectifier	4	40	160
iv. Capacitor	3	10	30
v. Voltage regulator	1	50	50
vi. Resistor	2	10	20
vii. Variable resistor	1	20	20
viii. Zener diode	1	40	40

i. 555 IC	1	50	50
ii. Transistor amplifier	1	30	30
iii. Vero board	1	100	100
iv. Soldering lead	1	60	60
v. Switch	1	40	40
vi. Plug	1	20	20
vii. Connecting wires	1	40	40
Case construction			300
<b>TOTAL</b>			<b>1220</b>

#### 4.5 CASE CONSTRUCTION

- i. Type of casing; a wooden casing was used for the casing to prevent the components from being exposed to dust and to make it more handable.
- ii. Dimensions; the dimension of the case is 11cm by 7.5 cm.
- iii. Diagram of case;

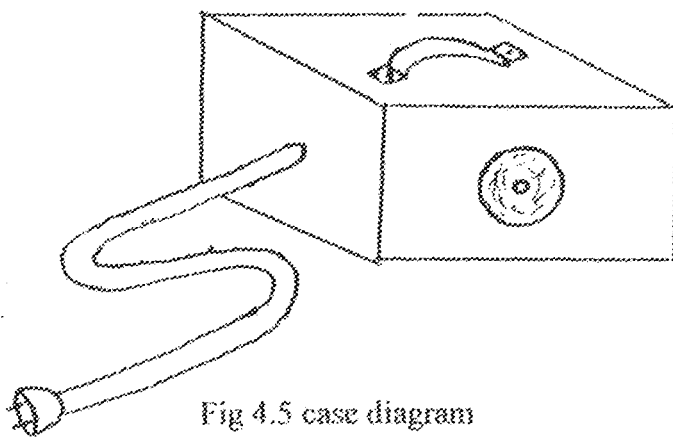


Fig 4.5 case diagram

#### 4.6 PROBLEMS ENCOUNTERED

The construction was first done on a breadboard and during testing, it was observed that the 555IC became hot after some minutes; also the vibration on the speaker was not observable.

#### 4.7 SOLUTION PREFERRED

The transformer was giving out current of 0.5A, while the speaker needed about 0.9A of current. Because of this imbalance, some components were removed to balance the circuit and an amplifier transistor was used to amplify the vibration of the speaker

## CHAPTER FIVE

### 5.0 CONCLUSION AND RECOMMENDATION

#### 5.1 CONCLUSION

Malaria is transmitted by certain species of mosquito called anopheles.

Malaria is a major cause of infant mortality and is the only insect borne parasitic disease comparable with world's major diseases; diarrhea, acute respiratory infections, tuberculosis and AIDS.

Although malaria could be controlled through the use of malaria vaccines such as chloroquine, maloxine, fansidar, metacalfin and use of mosquito treated nets, but the "Guardian" of reports says that malaria vaccines could create more virulent strains of malaria.

The mosquito repeller is a circuit constructed to repeller female mosquitoes which bite. This circuit produces an ultrasonic sound at 40kHz which is the sound produced by the male mosquitoes which makes the female mosquito to stay away especially when they are pregnant in search of food. This ultrasonic sound at 40kHz is not audible to the human ears but can repel the female mosquitoes at a certain radius of 3m as designed. With this project, the problems of mosquitoes at home, offices, schools, hospital, e.t.c can be controlled.

This project has given me an insight on how 555 timers can be used to generate ultrasonic sound frequency that scare away mosquitoes, this sound can be achieved by varying certain parameters in the circuits during design

## 5.2 RECOMMENDATION

Although, this project has been designed to specification, there are one or two things that need to be incorporated into the design especially in the circuit, these include:

- i. The circuit should be incorporated with a burning filament that can produce enough heat to react with little oxygen to produce carbon (IV) oxide and also a suck attracted mosquitoes into an enclosure.
- ii. The power system should be provided with a rechargeable system to be able to charge battery, if it is to be incorporated.
- iii. The radius of coverage can be increased



## REFERENCES

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