DESIGN AND CONSTRUCTION OF A MOBILE PHONE SNIFFER WITH A VISUAL DISPLAY OUTPUT

BY

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Niger state.

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DEDICATION

This work is dedicated to God Almighty for His love upon my life and making me a

Success also to the loving memory of my late mother Mrs. Felicia Aghedo and all

Who have in one way or the other contributed to my education especially Mr. Victor Aghedo.

DECLARATION

I, EJALEN IDAHOSA DOMINION hereby delcare 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, Niger state.

Eialen Idahosa Dominion 10/11/2011

(NAME OF STUDENT) (SIGNATURE AND DATE)

CERTIFICATION

I hereby certify that this project "Design and Construction Of a Mobile Phone Sniffer With a Visual Display Output" was carried out by Ejalen Idahosa Dominion with matriculation number 2006/24452EE and meets the standard deemed acceptable by the department of Electrical and Computer Engineering, school of Engineering and Engineering Technology, Federal University of Technology Minna, Niger state.

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ABSTRACT

This project deals with the design and construction of a mobile phone sniffer that can detect and display on an electronics display-board the presence of a mobile phone within a radius of eight meters. It can detect incoming calls, outgoing calls, SMS and video transmission even if the mobile phone is kept in the silent mode. The moment the sniffer detects radio frequency (RF) transmission signal from an activated mobile phone, it starts sounding a beep alarm with an LED sensor whose blinking intensity is proportional to the strength of the RF signal and a visual display is made on the electronics display-board. The alarm and the visual display continue until the signal transmission ceases.

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CHAPTER ONE

1.0 INTRODUCTION

A mobile phone is an electronic device used to make mobile telephone calls across a wide geographic area served by many public cells, allowing the user to be mobile. A mobile phone can make and receive telephone calls to and from the public telephone network which includes other mobiles and fixed-lines across the world. In addition to telephony, mobile phones also support a wide variety of services such as text messaging (SMS), multimedia messaging services (MMS), email, internet access, short-range communication services (infra-red, Bluetooth), business applications.

The advent of the mobile phone technology and the relentless push towards micro-miniaturization of devices increase the temptation to exploit and misuse this technology for illegal purposes. Consequently a very real need exists today for individuals, businesses, institutions and governments to take measures to detect and identify the unauthorized use of mobile phones within the bounds of their controlled premises and facilities.

This pocket-size mobile transmission sniffer or detector [20] can detect the presence of an activated mobile phone within a radius of eight meters by detecting the RF signal and displaying visually on an electronics display-board while blinking a sensor LED whose intensity is proportional to the strength of the RF signal. It represents an improvement over the one and half meter-radius attained in the past by researchers in the field.

This project also goes a long way to help in combating security problems in places where mobile phones are restricted and is also a medium for bugs and other surveillance devices.

1.1 AIMS AND OBJECTIVES

1.1.0 AIMS

The aim of this project is to detect the presence of RF signals used by mobile phones within a radius of eight meters.

Thus, the main aim is to detect the presence of mobile phones in places where they may compromise security such as in examination halls, confidential rooms.

Another aim is to detect the use of mobile phones for spying and unauthorized video transmission, also for it to be used in bugging and other surveillance devices.

1.1.1 OBJECTIVE

The objective is to display visually on an electronics display-board the presence of a mobile phone while blinking an LED sensor on detecting the presence of a radio frequency (RF) signal used by mobile phones.

1.2 METHODOLOGY

The signal received by the antenna is delivered as electric pulses into the negative feedback operational amplifier, through the feedback resistor the gain of the amplifier is increased as the input voltage and then delivered to the next negative feedback operational amplifier which further amplifies the signal and delivers it to the comparator. The comparator selects the most pronounced voltage at the input and delivered it to the inverter. The output of the inverter triggers up the by-pass transistor to conduct a current to form a rail line for the board-display, the board displays a word immediately a signal is detected from the mobile phone. The board is made up of 555 Timer which helps the word to be written in discrete, the 555 Timer delivers a pulse every second which is revealed at the decade counter output to display the word, the decade counter display each word in section by the help of the LED's which delivers the voltage one after the other by sequential flow of the pulses, these pulses are also delivered to the loud speaker.

1.3 SIGNIFICANCE (IMPORTANCE) OF STUDY

With mobile phones getting ever smaller, they are increasingly being used in areas where they may compromise security. In various establishments this project is found useful and applicable in restricting and limiting the use of mobile phones in an unauthorized environment.

1.4 SCOPE OF STUDY

This design will be using high intensity light emitting diode (LED) as the display component and not seven segment LED to aid the simplicity of the design, also other components and IC (integrated circuit) are used in the design to aid the stability of performance and reliability.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1.0 BACKGROUND OF STUDY

The beginning in the history of mobile phone is based upon the radio technology that was developed from the 1940's. The concept of the mobile phone was developed from the innovation of radios used in taxi cabs, ambulances and other vehicles that used two ways radios to communicate with one another or a main headquarters. The technology of modern day mobile phone started with breakthrough innovation for mobile phones by engineers from Bell Labs in 1947. Although these technologies had been created, electronics and other technologies would take decades to develop, for example electronics that were first used for the first mobile phones were created in the 1960's.

By the late 1960's mobile phones technology was available but the catch was that the mobile user had to stay within a certain broadcast area. If a mobile user left a broadcast area, the service station was unable to pass on the call to another broadcast station.

This changed in 1970 when engineers at Bell Labs developed the call hands off system, allowing users to continue calls in other broadcast areas when they left their original broadcast area. While the technology had been developed it wasn't until 1971 that AT&T (American Telephone and Telegraph) submitted a request to the FCC (Federal Communication Commission) for mobile phone services. It took more than ten years for the slow moving FCC to approve this in 1982. [23]

The person who is credited with inventing the first working portable mobile phone is Martin Cooper of Motorola in April 1973. [22]

2.1.1 FIRST GENERATION MOBILE PHONES (1G)

The first call also made by someone was Martin Cooper to his rival Dr. Joel Engel of Bell Laboratories, [22] because of the delay in the FCC to approve the mobile network the first commercial mobile phone went on sale in 1983. It was the Motorola DynaTAC8000X, it only boasted one hour of talk time and eight hours of standby time. This particular phone took fifteen years to make and cost over one hundred million dollars ($100,000,000) in research because of this high production cost the starting price for this phone was three thousand nine hundred and ninety five dollar ($3,995). The Motorola DynaTAC8000X a massive phone of 13inches long and 3.5 inches wide and 1.7inches thick, because of its size and shape it was nicknamed the "BRICK". This generation of mobile phone is known as the 1G or first generation mobile phones. [23]

2.1.2 SECOND GENERATION MOBILE PHONES (2G)

Mobile phones from the early nineties are considered to be the second generation of mobile phones (2G). The difference between 1G and 2G technology is that, 1G are analog network and 2G are digital networks, this enabled quicker network signaling and increased the call quality. As 2G networks were replacing 1G network the analog network became obsolete.

Mobile phones based on 2G technology were much smaller than the huge mobile phones from 1G technology of the 80's they were also much lighter than their predecessors. Advance in battery technology as well as computer chip technology also helped to make 2G mobile phone much smaller than the 1G mobile phone. 2G technologies also brought in features to mobile phones such as SMS, E-mail. [23]

2.1.3 THIRD GENERATION MOBILE PHONES (3G)

Third generation mobile phones is the technology that is currently available today and it's commonly referred to as 3G, while 3G came only a few years after 2G mainly due to many innovations in technology and services. Standards for 3G are usually different depending on the network. It is usually stated that 3G is not necessarily a rigid standard but it is a set of requirements that most network and mobile phone providers follow. There are two main requirements for a 3G network they include two megabits of maximum data rates for indoor use and 384kilobits for outdoor use.

3G mobile phones usually include innovations to receive much more than phone calls for example SMS is available and some 3G phones also offer E-mail and Internet access. Currently technologies are continuing to improve, and new innovations such as streaming radio and streaming television as well as WiFi (wireless fidelity) are currently breaking into the market.

However there are some difficulties in the 3G network from taking over the 2G network, these include

1. The high input fees for the 3G service licence.

2. Lack of coverage of 3G because it is still a new service.

3. The high price of 3G mobile services.

4. The cost of 3G phones.

5. The high debt that many telecommunication companies have, which make it more difficult to build the infrastructure of 3G. [23]

2.1.4 FOURTH GENERATION MOBILE PHONES (4G)

In telecommunications, 4G is the fourth generation of cellular wireless standards. It is a successor to the 3G and 2G families of standards. In 2009, the ITU-R organization specified the IMT-Advanced (International Mobile Telecommunications Advanced) requirements for 4G standards, setting peak speed requirements for 4G service at 100 Mbit/s for high mobility communication (such as from trains and cars) and 1 Gbit/s for low mobility communication (such as pedestrians and stationary users).

A 4G system is expected to provide a comprehensive and secure all-IP based mobile broadband solution to laptop computer wireless modems, smart-phones, and other mobile devices. Facilities such as ultra-broadband Internet access, IP telephony, gaming services, and streamed multimedia may be provided to users.

Pre-4G technologies such as mobile WiMAX and first-release Long term evolution (LTE) have been on the market since 2006 and 2009 respectively, and are often branded as 4G in marketing materials. The current versions of these technologies did not fulfill the original ITU-R requirements of data rates approximately up to 1 Gbit/s for 4G systems.

IMT-Advanced compliant versions of the above two standards are under development and called “LTE Advanced” and “Wireless MAN-Advanced” respectively. ITU has decided that “LTE Advanced” and “Wireless MAN-Advanced” should be accorded the official designation of IMT-Advanced. On December 6, 2010, ITU announced that current versions of LTE, WiMax and other evolved 3G technologies that do not fulfill "IMT-Advanced" requirements could be considered "4G", provided they represent forerunners to IMT-Advanced and "a substantial level of improvement in performance and capabilities with respect to the initial third generation systems now deployed.

In all suggestions for 4G, the CDMA spread spectrum radio technology used in 3G systems and IS-95 is abandoned and replaced by OFDMA and other frequency-domain equalization schemes. This is combined with MIMO (Multiple Input Multiple Output), e.g., multiple antennas, dynamic channel allocation and channel-dependent scheduling.

2.1.5 NEXT GENERATION MOBILE PHONES

The next generation of mobile phones is shaped like a human and their "faces" will replicate the person with whom the user is talking.

Scientists at the Advanced Telecommunications Research Institute International [24] and Osaka University [25] in Japan have teamed up to produce the prototype of a future mobile phone, which they have called Elfoid. It resembles a small person with its bodily features simplified so that it is "capable of being interpreted equally as male or female, old or young," according to the institute, while the gadget's human-shaped exterior is covered with a urethane material that is designed to feel like human skin. The scientists hope to eventually be able to make the Elfoid's features move in an exact replication of those of the person on the other end of the line. The movement of eyes, lips and other parts of the face will be copied through the use of a monitor in one phone passing on details of facial movements to micro actuators, robotic devices that are already being used to mimic the actions of humanoid robots, in the other mobile phone. They also hope to depart from the conventional button-pressing approach to rely solely on image and voice recognition technology.

The new technology is designed to "allow individuals in remote locations to converse in such a way that they feel each other's presence" through voice, appearance, touch and motion, the researchers said. The scientists are presently working with NTT DOCOMO to develop the concept into a working phone. [24, 25]

2.2.0 THEORETICAL BACKGROUND

Mobile phone uses RF with a wavelength of 30cm at 872 to 2170MHz. That is, the signal is a high frequency with huge energy. When the mobile phone is active, it transmits the signal in the form of sine wave which passes through space. The encoded audio/video signal contains electromagnetic radiation which is picked up by the receiver in the base station. Mobile phone system is referred to as "Cellular Telephone system" because the coverage area is divided into "cells" each of which has a base station. The transmitter power of the modern 2G antenna in the base station is 20-100 watts.

When a GSM (Global System of Mobile communication) digital phone is transmitting, the signal is time shared with 7 other users. That is at any one second, each of the 8 users on the same frequency is allotted 1/8 of the time and the signal is reconstituted by the receiver to form the speech. Peak power output of a mobile phone corresponds to 2 watts with an average of 250milliwatts of continuous power. Each handset within a 'cell' is allotted a particular frequency for its use. The mobile phone transmits short signals at regular intervals to register its availability to the nearest base station. The network data base stores the information transmitted by the mobile phone. If the mobile phone moves from one cell to another, it will keep the connection with the base station having strongest transmission. Mobile phone always tries to make connection with the available base station. That is why the back light of the phone turns on intermittently while travelling. This will cause severe battery drain. So in long journeys, battery will discharge within a few hours. Waves at higher frequencies but within the RF region is called Micro waves, mobile phone uses high frequency RF wave in the micro wave region carrying huge amount of electromagnetic energy. The strongest radiation from the mobile phone is about 2 watts which can make connection with a base station located 2 to 3 km away. The mobile phone detector circuit can detect the incoming and outgoing calls, SMS and video transmission even if the mobile phone is kept in the silent mode. The moment the detector detects RF transmission signal from an activated mobile phone, it starts sounding a beep alarm and the LED blinks. The alarm continues until the signal transmission ceases.

An ordinary RF detector using tuned LC circuits for detecting low frequency electromagnetic radiation in the AM band whose frequency lies between 180KHz to 1.6MHz and FM band whose frequency lies between 88MHz to 180MHz is not suitable for detecting signals in the GHz frequency band used in mobile phones. The transmission frequency of mobile phones ranges from 0.9 to 3 GHz with a wavelength of 3.3 to 10 cm. So a circuit detecting gigahertz signals is required for a mobile sniffer/detector.

CHAPTER THREE

3.0 DESIGN AND CONSTRUCTION

This section will give a thorough description of the whole system that was designed and constructed as well as the components that were used.

HARDWARE DESIGN AND CONSTRUCTION

The system consists of four basic units, which includes;

3.1.0 The power supply unit

3.2.0 The antenna and sensing unit

3.3.0 The comparator and amplification unit

3.4.0 The output and display unit

The block diagram for the system is given below

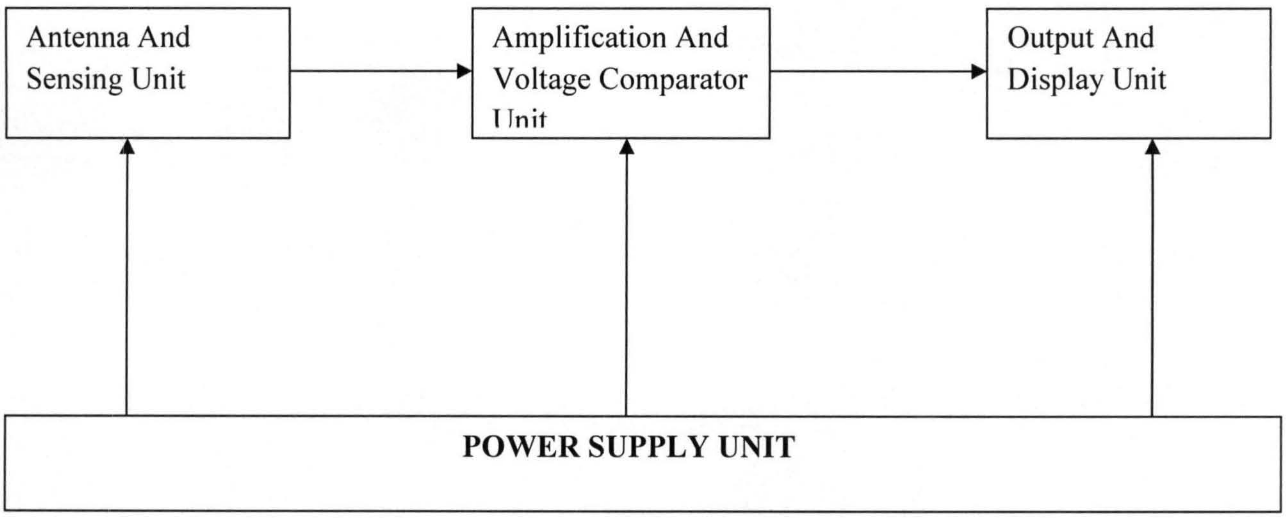


Figure 3.0: Block Diagram of a Mobile Phone Detector

3.1.0 THE POWER SUPPLY UNIT

The power supply unit supplies power to the whole system, the system will not operate at all without this unit. This unit contains an appropriately regulated six (6) volts D.C battery, since it is a mobile device and the power unit needs to be incorporated into the mobile device. [3,6]

3.2.0 THE ANTENNA AND SENSING UNIT

This unit includes the Antenna that captures the radio frequency signal of the mobile phone, the band-pass filter circuit that selects the bandwidth of the frequency of operation of the mobile phone and an operational amplifier that amplifies the weak signal captured by the antenna. [2]

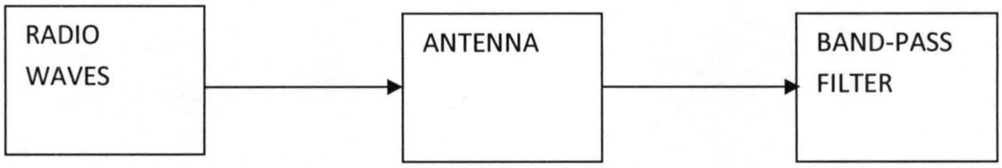


Figure 3.1: Block diagram of antenna and sensing unit

3.2.1 ANTENNA

Antenna, also referred to as an aerial, is a device used to radiate and receive radio waves through the air or through space. [13, 14] Antennas are used to send radio waves to distant sites and to receive radio waves from distant sources. Many wireless communications devices, such as radios, broadcast television sets, radar, and cellular radio telephones use antennas.

3.2.2 How the Antenna Works

As radio frequency signals traveling through free space reach the antenna, they set up, or induce, a weak electric current within the antenna. The current pushes the oscillating energy of the radio waves along the antenna, which is connected to a band-pass circuit. The antenna is as shown below. [13]

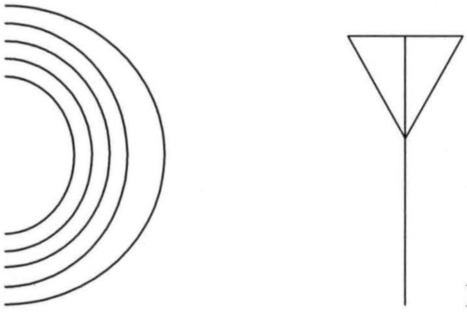


Figure 3.2: Radio waves and Antenna

The power transmitted to the antenna from the phone is denoted as Pt and is given as 100mW.

The power density developed within a radius of 8M is given as

$$P_d = \frac{P_t}{4\pi r^2} \quad ...1 \ [14]$$

Where P_t = 100mW and $r = 8M$

To find the current induced on the antenna, we calculate the characteristic impedance (Z) within a radius of 8 meters

$$Z = \sqrt{\frac{\mu}{\varepsilon}} \quad ...2 \ [8, 15]$$

$$\text{And } \mu = 4\pi \times 10^{-7} and\ \varepsilon = 8.854 \times 10^{-12}$$

Substituting them into the relation, $Z = \sqrt{4\pi \times \frac{10^{-7}}{8.854 \times 10^{\wedge}-12}} \approx 377\Omega,$

For a radius of 8meters,

$$\Rightarrow Z = 377 \times 8 = 3016\Omega.$$

The current induced on the antenna is given as,

$$P = I^2 \times R = I^2 \times Z \quad ...3$$

$$\Rightarrow \quad I^2 = \frac{P}{Z}, \Rightarrow I = \sqrt{0.1243 \div 3016} = 0.203mA. \ [8]$$

3.2.3 THE 741 OPERATIONAL AMPLIFIER BAND-PASS FILTER CIRCUIT

This 741 Operational Amplifier acts as band-pass circuit that allows the passage of frequecies within a particular bandwidth of 890MHz to 960MHz frequency with a central frequency of 900MHz which is also the operating frequency of the mobile phone as shown below. [11, 12]

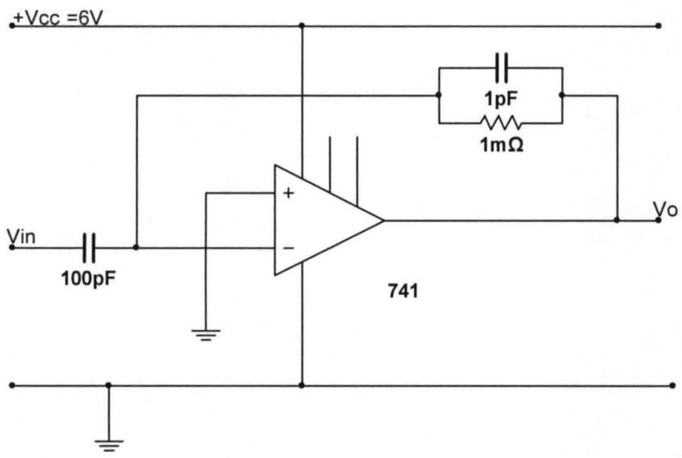


Figure 3.3: the op-amp band-pass filter

The reactance of $C_1 = X_{C1} = \frac{1}{2\pi f C_1} ... 4$

where $f = 900MHz$ and $C_1 = 1pF$

And by direct substitution, $X_{C1} = \frac{1}{2\pi \times 900 \times 10^6 \times 10^{-12}} \approx 176.84\Omega$.

Since R_1 and X_{c1} are a parallel connection, it implies that the total resistance R_t is given below

$$R_t = \frac{R_1 \times X_{C1}}{R_1 + X_{C1}} \quad ... 5 \ [8]$$

And by direct substitution,

$$Rt = \frac{10^6 \times 176.84}{10^6 + 176.84} \approx 176.81\Omega$$

The reactance on the capacitor C_2 is given as

$\frac{1}{fC_2}$ ...6

substitution,

, since the frequency is very high the reactance

... 7

$7 = 3.6 \times 10^{-4} \approx 0.36mV$.

tage (V_{in}) which is found by means of voltage

$\frac{\times 10^{-3}}{1.77} \approx 3.57 \times 10^{-6}V$

..8 [8, 12]

substation,

≈ 99.893

given as $V_o = V_{in} \times G$ ...9

$99.893 \approx 0.36mV$.

VOLTAGE COMPARATOR UNIT

nplifier, the comparator, inverter, the 555 timer

oltage comparator unit

$X_{C2} =$

Where f = 900MHz $C2 = 100pF$ and by di

$X_{C2} = \frac{1}{2\times\pi\times900\times10^{6}\times100\times10^{-12}} = \frac{1}{0.5655} \approx 1.7$

of the capacitor falls.

The voltage drop on $X_{C2} = I \times R = I \times X_{C}$

⇒ Voltage drop on X_{C2}= $0.203 \times 10^{-3} \times$

The voltage at the point X (V_x) is the input

divider theorem,

$$V_{in} = V_x = \frac{1.77 \times 0.}{176.81}$$

The gain of the amplifier is given as $G = \frac{R_f}{R_{in}}$

where

$R_f = 176.81\Omega$ and $R_{in} = 1.77\Omega$ and by dire

$$G = \frac{176}{1.}$$

The output voltage after the first amplificatio

$$V_0 = 3.57 \times 10$$

3.30 THE AMPLIFICATION AN

This unit includes the 741 operationa

and the by-pass transistor.

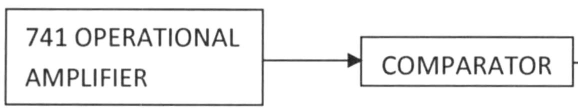


Figure 3.4: block diagram of amplification an

3.3.1 THE 741 OPERATIONAL AMPLIFIERS (SECOND STAGE AMPLIFICATION)

Amplifier is device for increasing the amplitude, or power, of an electric signal. It is used to amplify the weak electric current drawn from the antenna of a radio-receiving set, the weak output of a photoelectric cell (electric eye), the diminished current in a long-distance telephone circuit, the electrical signal representing sound in a public address system, and for many other purposes. [3, 11, 12]

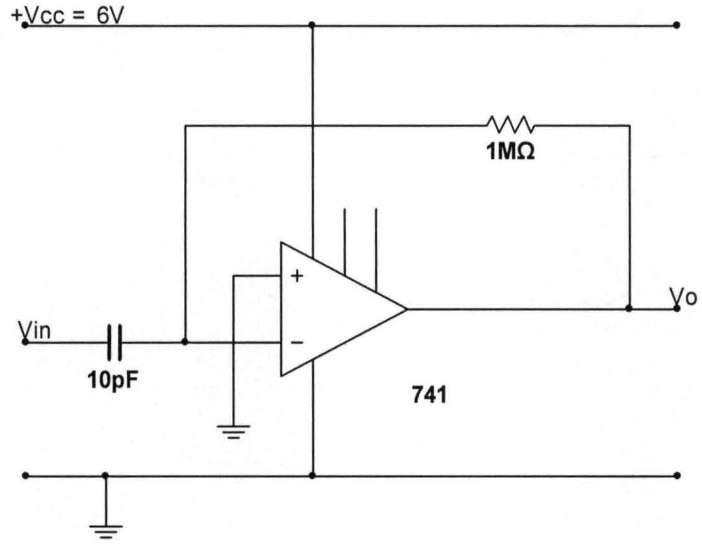


Figure 3.5: 741 operational amplifier

The Voltage output after the second stage amplification is given as $V_0 = V_{in} \times G$,

But G is given as $\frac{R_f}{R_{in}}$

given

$R_f = 10^6 \Omega$ and $R_{in} = X_C = 1 \div (2\pi fC)\Omega$

where

$f = 900MHz$ and $C = 10pF$

And by direct substitution, $X_C = 1 \div (2 \times \pi \times 900 \times 10^\wedge 6 \times 10 \times 10^\wedge - 12) = 17.7\Omega.$

Therefore $G = 10^6 \div 17.7 = 56497.2,$

But $V_0 = V_{in} \times G$

$\Rightarrow$ $V_0 = 0.36 \times 10^{-3} \times 56497.2 \approx 20.34V$

3.3.2 THE 741 VOLTAGE COMPARATOR

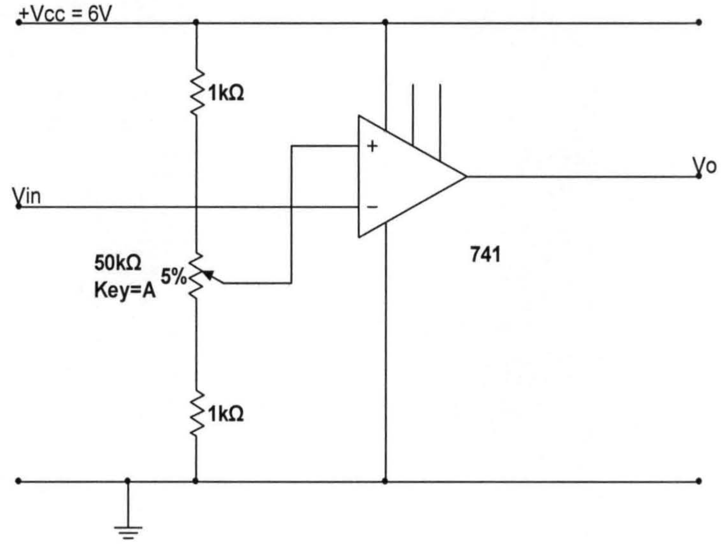


Figure 3.6: voltage comparator

The voltage comparator now compares the voltage coming to it and then produces a difference voltage for the circuit. [2, 7] The 50Ω variable resistor works suitably at $35/15$ mark, given a voltage divider of $(35 + 1)$ and $(15 + 1)$ on either side.

Since the rail voltage is $6V$, the voltage at the inverting input will then be

$$(36 \times 10\text{^}3) \div (36 \times 10\text{^}3 + 16 \times 10\text{^}3) \times 6 = 4.15V$$

That is, when the non-inverting input is at a higher voltage than the inverting input the high gain of the op-amp will cause the output to saturate at the highest positive voltage it can output as shown in the figure above. The high gain comparator (about 10,000 for the 741 comparator) amplifies this voltage difference

$V_0 = A(V1 - V2)$. The voltage output will however not go above the rail voltage. [11, 12]

3.3.3 THE 741 INVERTER

This unit is made up of an operational amplifier with input voltage to the inverting input and a unit gain i.e. no input resistance and no feedback. This helps to invert the voltage value coming from the comparator unit into a negative voltage [11, 12] which is use to trigger on the 555 timer.

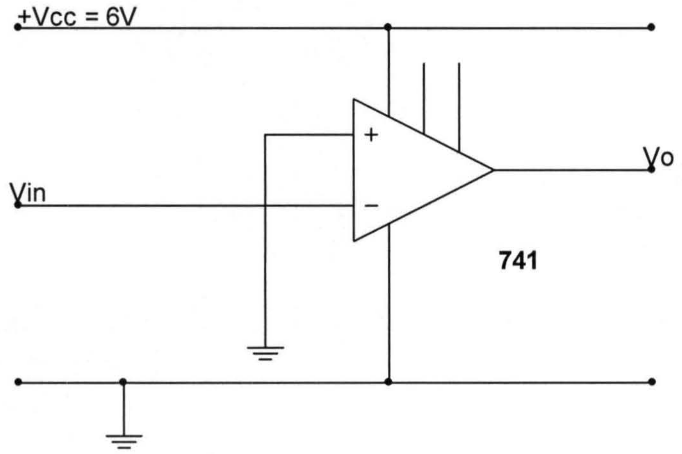


Figure 3.7: Inverter

3.3.4 THE MONOSTABLE 555 TIMER

These devices are precision timing circuits capable of producing accurate time delays or oscillation. In the time-delay or mono-stable mode of operation, the timed interval is controlled by a single external resistor and capacitor network. In the astable-mode of operation, the frequency and duty cycle can be controlled independently with two external resistors and a single external capacitor.

The threshold and trigger levels normally are two-thirds and one-third, respectively, of VCC. These levels can be altered by use of the control-voltage terminal. When the trigger input falls below the trigger level, the flip-flop is set, and the output goes high. If the trigger input is above the trigger level and the threshold input is above the threshold level, the flip-flop is reset and the output is low.

The reset (RESET) input can override all other inputs and can be used to initiate a new timing cycle. When RESET goes low, the flip-flop is reset, and the output goes low. When the output is low, a low-impedance path is provided between discharge (DISCH) and ground. The output circuit is capable of sinking or sourcing current up to 200mA. Operation is specified for supplies of 5 V to 15 V. With a 5-V supply, output levels are compatible with TTL inputs. [16, 18]

The figure below shows the internal circuitry of a 555 Timer

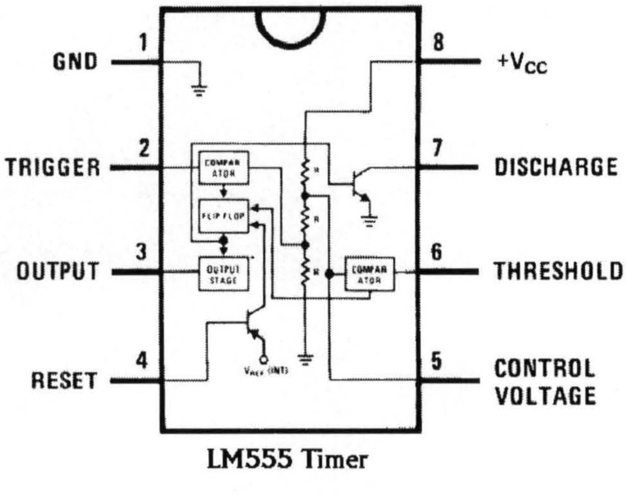


Figure 3.8: LM555 Timer Internal Circuit Block Diagram

For every negative voltage applied to the 555 timer, it is delayed to keep the output voltage for a specific period of time t which is based on its configuration as shown below.

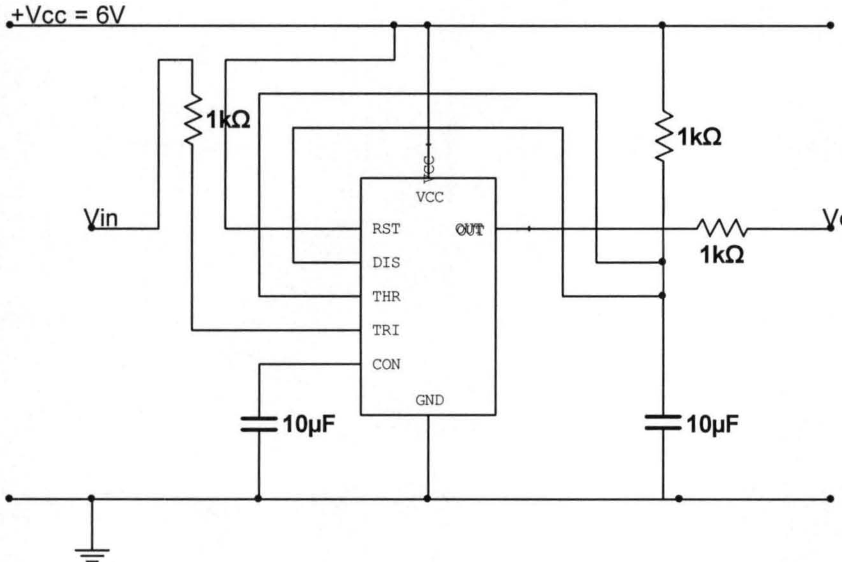


Figure 3.9: 555 timer configuration

$$T = InRC \approx 1.1RC \quad ...10,$$

Where $R = 1K\Omega$ and $C = 10\mu F$,

And by direct substitution

$$\Rightarrow \qquad T = 1.1 \times 1000 \times 10 \times 10^\wedge - 6 = 0.011s.$$

This means the 555 timer will delay the output voltage by 0.011s to switch on the transistor.

3.3.5 THE BY-PASS TRANSISTOR

The by-pass transistor will receive the six (6) volts from the 555 timer which was shared at the input of the by-pass transistor through voltage divider theorem as shown below. [4, 7, 8]

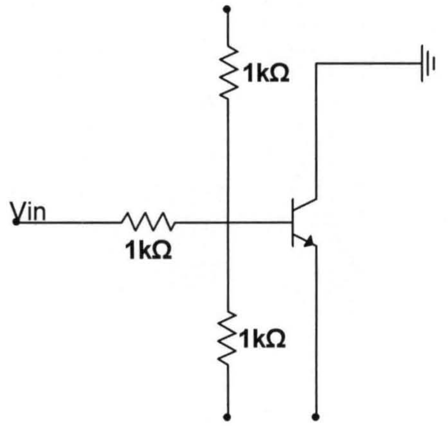


Figure 3.10: Switching Transistor

——— ———

The by-pass transistor then delivers 3V to power the next circuit.

3.4.0 THE OUTPUT AND DISPLAY UNIT

This unit comprises of another 555 timer, Buzzer, Decade counter, diodes, Common collector amplifier and the LED which was used to display the output.

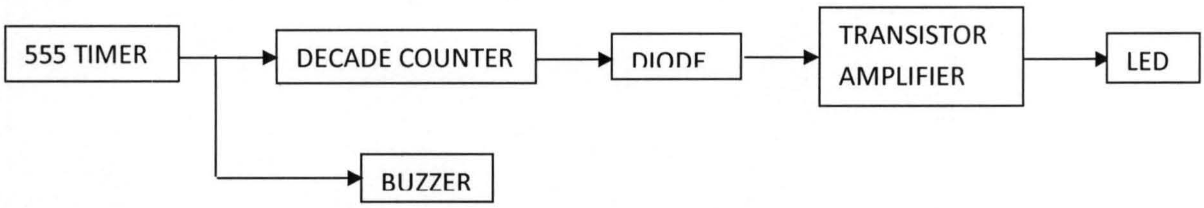


Figure 3.11: block diagram of output and display unit

3.4.1 THE 555 TIMER AND BUZZER

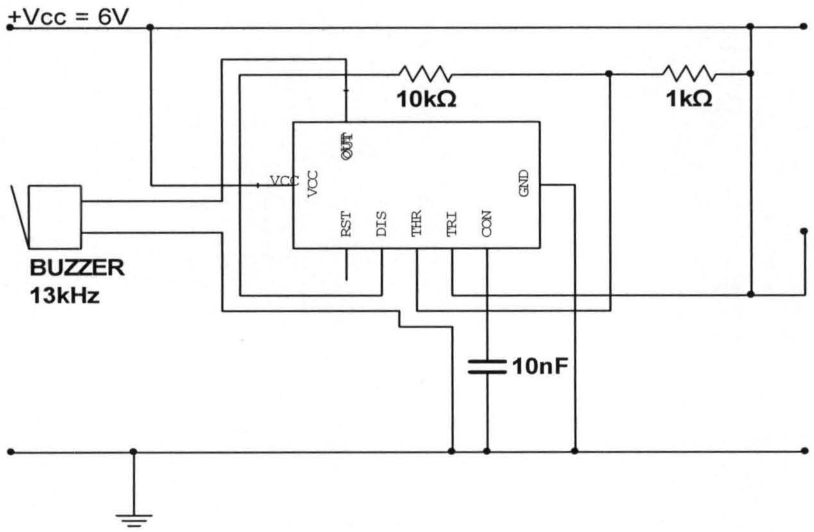


Figure 3.12: 555 timer and Buzzer

The 555 timer through its configuration of the RC circuit delivers a high pitch (frequency) to the buzzer [9, 17] as shown below,

$f = 1.44 \div (R_1 + R_2) \times C_1$ ...11 [8, 11, 12]

$\Rightarrow \ f = \frac{1.44}{10\times10^3+10^3} \times (10 \times 10^{-9}), f = 13091Hz,$

which is high enough to produce a good sound from the buzzer.

3.4.2 THE DECADE COUNTER

The IC 4017 decade counter is a versatile IC of the CMOS family which has got wide range of applications. Internally it consists of a 10 stage decade counter/divider. When a clock pulse is applied to it externally, its outputs become logic 'hi' and 'lo' sequentially (one after the other). The 4017 decade counter takes a clock pulse in and then steps the output from negative to positive in a series of ten steps, with only one pin being on at a time. It has the unique capability of counting up to a certain number and then restarting the count, counting up to a certain number and halting, or it can be cascaded to more 4017's for a higher count. [17, 18, 19] The 555 timer voltage was delivered to it with the help of the transistor which acts as a switch and the diode which acts like a valve so that the current can flow only in one direction the letters were then displayed through the LED.

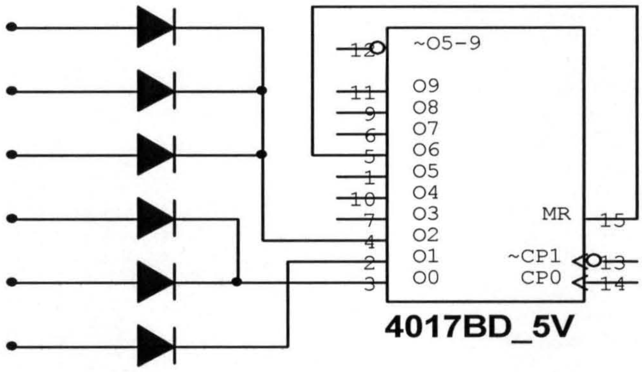


Figure 3.13: decade counter and diodes

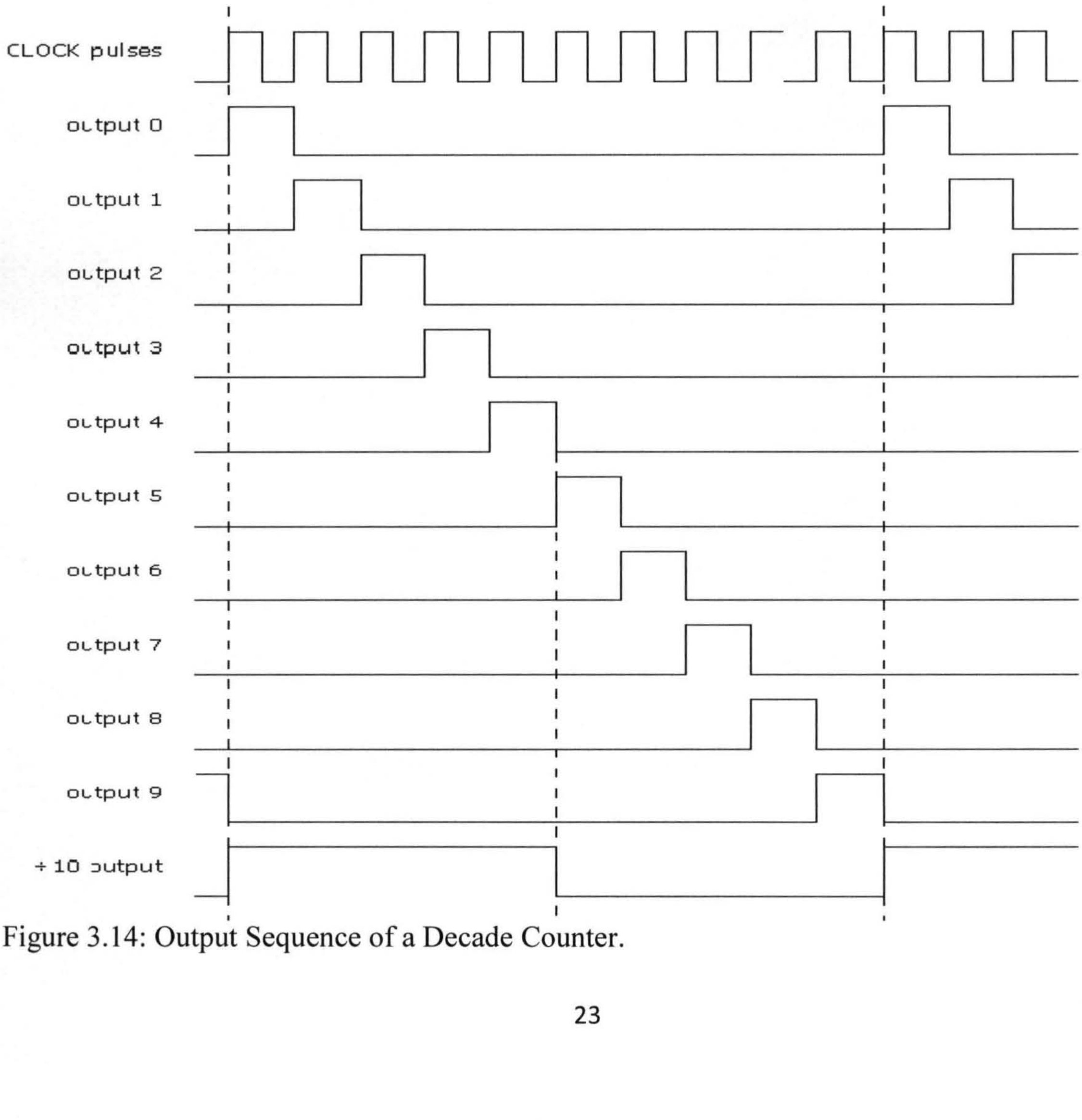


Figure 3.14: Output Sequence of a Decade Counter.

Just one of the individual outputs is HIGH at a time. As one can see, the ÷10 output is HIGH for counts 0-4 and LOW for counts 5-9. The 4017 is an extremely useful device. Internally the 4017 contains five bi-stable subunits. These are interconnected in a pattern known as a Johnson counter. The outputs of the bi-stables are decoded to give the ten individual outputs.

3.4.3 THE COMMON COLLECTOR TRANSISTOR AMPLIFIER

The transistor used is the common collector transistor amplifier as shown below. The input signal is injected into the base-collector circuit and the output signal is taken out from the emitter-collector circuit. [8, 9, 10]

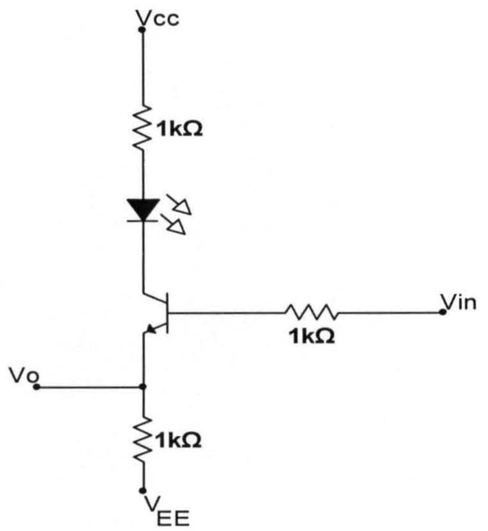


Figure 3.15: Common Collector Transistor Amplifier

The input voltage Vin is given as

$Vin = \frac{Vs \times rin}{Rs + rin}$ ...12 [8] Where:

$Vs = Vcc$ = source voltage,

rin = input resistance and

Rs = source resistance.

But $rin = R_B // \beta(r_e + r_o)$ ...13

Where: R_B = Base Resistance,

β = Amplification factor (200)

r_e= Dynamic resistance and

r_o= Resistance between emitter and ground.

But $r_e = \frac{25mV}{I_E}$ … 14

where $I_E = \frac{V_{CC}}{R_E}$ … 15

Now V_{CC}= 6V and R_E = 1000Ω,

$$\Rightarrow I_E = \frac{6}{1000} = 6\text{mA}.$$

Substituting I_E into 14,

$$r_e = \frac{25mV}{6mV} \approx 4.2\Omega$$

Also $r_o = R_E // R_L$ … 16

Where R_E = 1000Ω and R_L = 1000Ω and substituting into 16

$$\Rightarrow r_O = 1000//1000, = \frac{1000\times1000}{1000+1000} = 500\Omega$$

Substituting these values into 13

$$r_{in} = 1000//200(4.2+500), = 1000//100840$$

$$\Rightarrow r_{in} = \frac{1000\times100840}{1000+100840} \approx 990.2\Omega$$

By substituting these values gotten into 12,

$$V_{in} = \frac{r_{in} \times V_S}{r_{in}+R_S}, = \frac{990.2\times6}{990.2+1000} = 2.99V$$

$$\Rightarrow V_{in} = 2.99\,V.$$

The voltage output V_O is given as

$$V_O = V_{in} \times \text{Gain},$$

Where gain $G = \frac{r_o}{r_o + r_e}$

And substituting the values into the relation,

$$\Rightarrow G = \frac{500}{500 + 4.2} = 0.99$$

$$V_o = 2.99 + 0.99$$

This means that 2.97V was used to power on the LED which display sequentially in relation to the decade counter to display the letters.

3.4.4 LIGHTING EMITTING DIODE

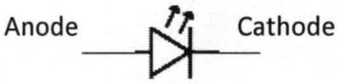


Figure 3.16: Electronic symbol of LED

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices and are increasingly used for other lighting. Introduced as a practical electronic component in 1962, [1] early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet and infrared wavelengths, with very high brightness.

When a light-emitting diode is forward biased (switched on), electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the color of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor. An LED is often small in area (less than 1 mm^2), and integrated optical components may be used to shape its radiation pattern, LEDs present many advantages over incandescent light sources including lower energy.

consumption, longer lifetime, improved robustness, smaller size, faster switching, and greater durability and reliability. LEDs powerful enough for room lighting are relatively expensive and require more precise current and heat management than compact fluorescent lamp sources of comparable output. [5]

Light-emitting diodes are used in applications as diverse as replacements for aviation lighting, automotive lighting (particularly brake lamps, turn signals and indicators) as well as in traffic signals. The compact size, the possibility of narrow bandwidth, switching speed, and extreme reliability of LEDs has allowed new text and video displays and sensors to be developed, while their high switching rates are also useful in advanced communications technology. Infrared LEDs are also used in the remote control units of many commercial products including televisions, DVD players, and other domestic appliances.

The output voltage from the amplifier serves as the input voltage into the light emitting diode and the current entering the LED is gotten from Ohm's law; [10, 15]

Figure 3.17: Circuit configuration of LED

$V_o = I \times R$,

$\Rightarrow I = V_o / R$

Where

$V_o = 2.97V$

$R = 1000\Omega$ and by direct substitution,

$I = 2.97/1000, = 2.97mA, \qquad \Rightarrow I = 2.97\ mA.$

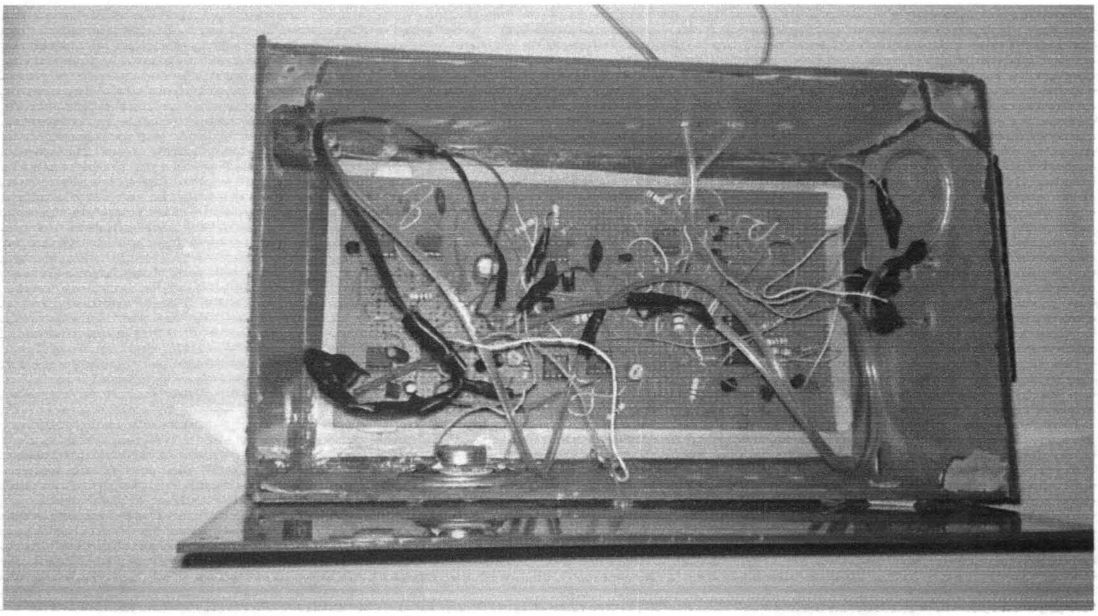


Figure 3.18: The constructed circuit

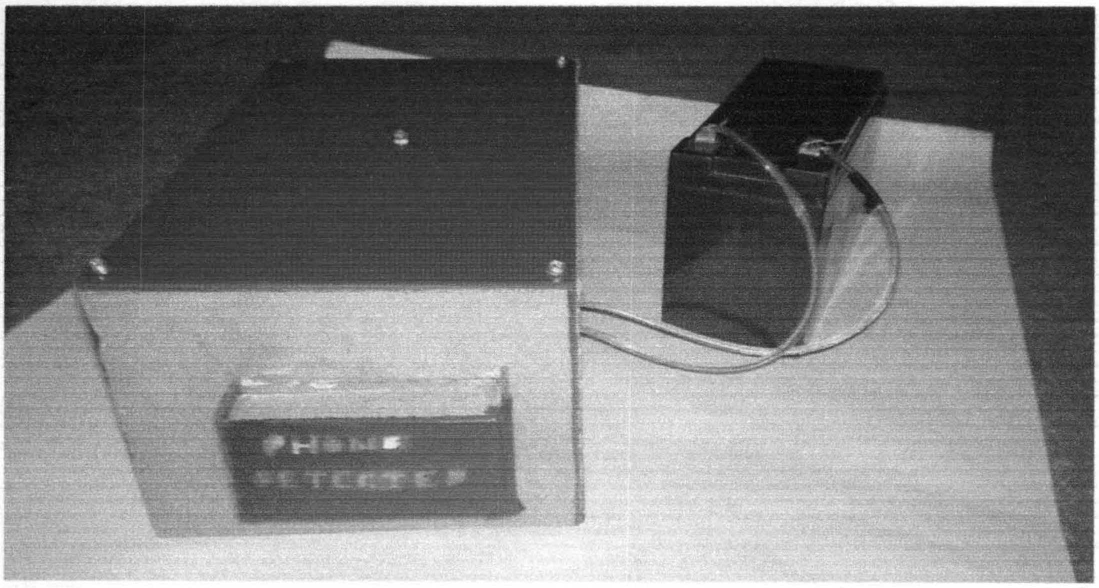


Figure 3.19 Front view of the mobile phone detector

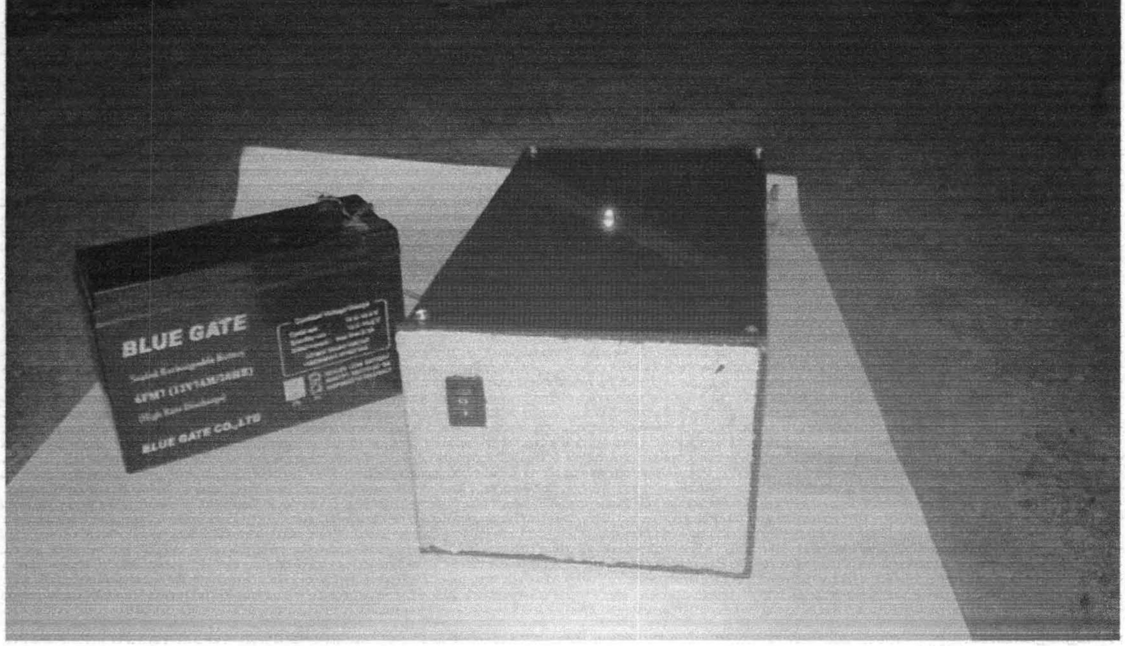


Figure 3.20: rear view of the mobile phone detector

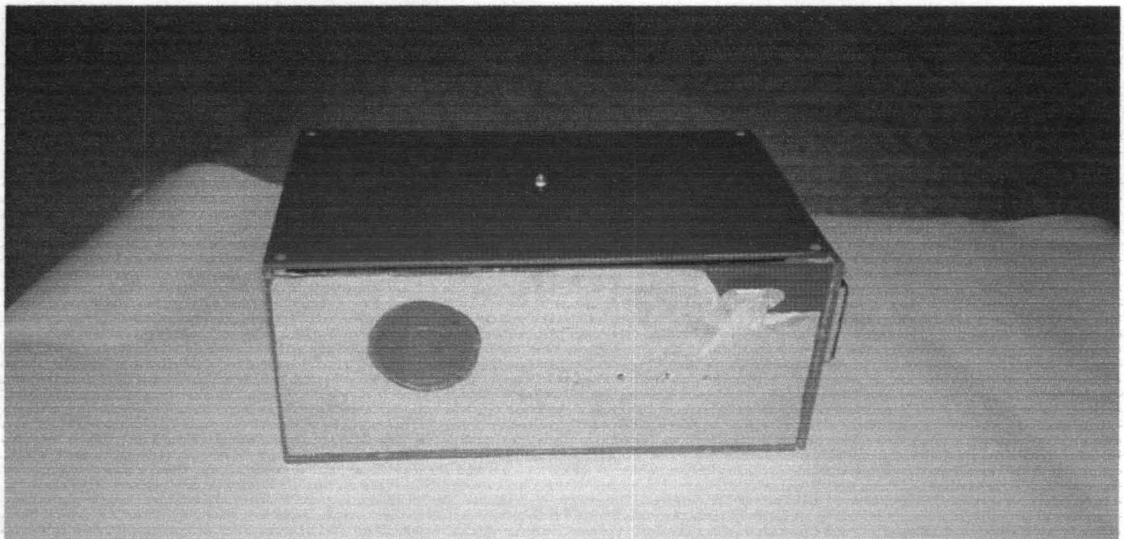
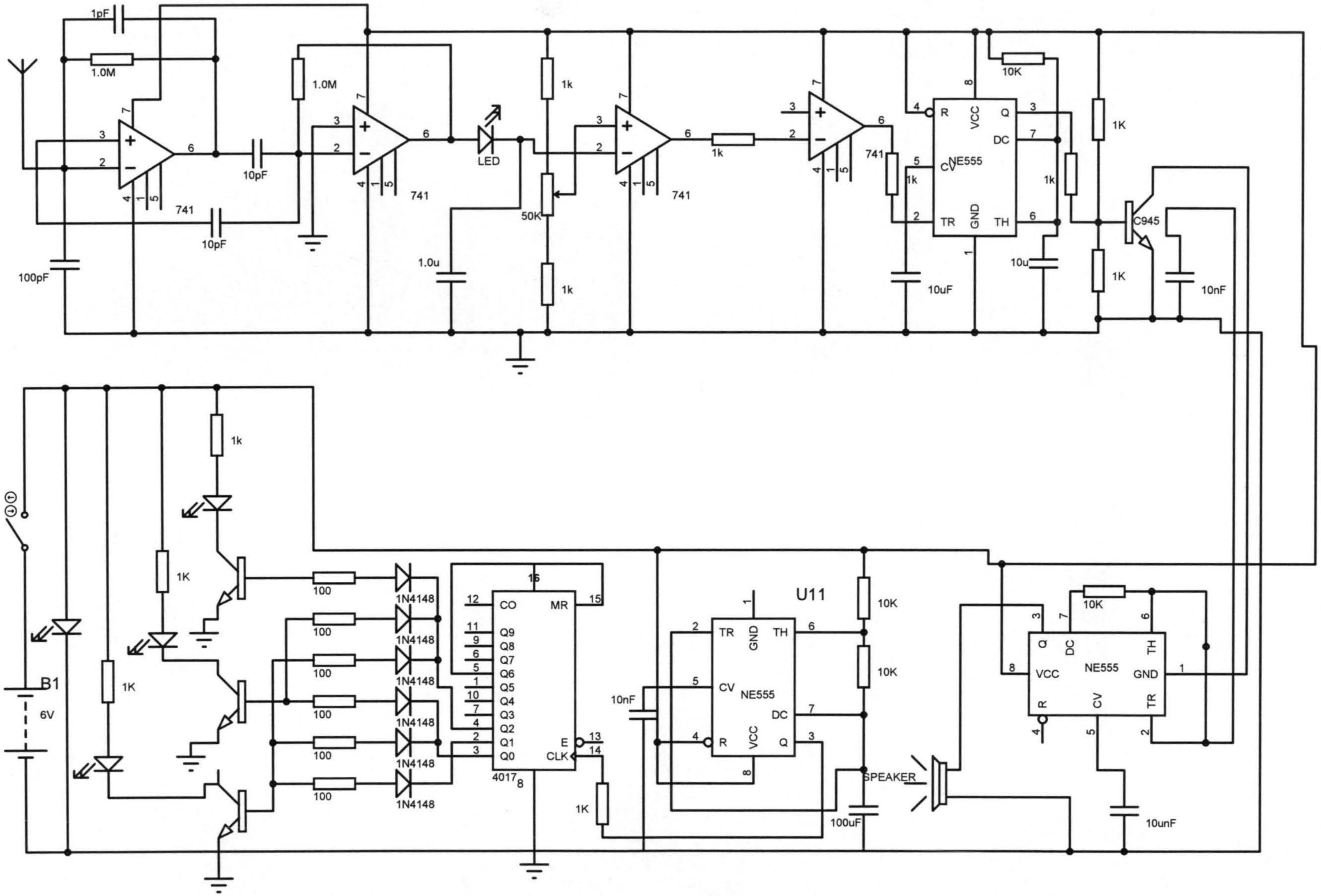


Figure 3.21Side view of the mobile phone detector



1pF
1.0M
100pF
741
10pF
10pF
1.0M
741
LED
1.0u
1k
50K
1k
741
1k
741
1k
NE555
R
VCC
Q
DC
CV
TR
GND
TH
10K
1k
10u
10uF
1K
1K
C945
10nF
1k
1K
1K
B1
6V
100
1N4148
16
CO
MR
Q9
Q8
Q7
Q6
Q5
Q4
Q3
Q2
Q1
Q0
E
CLK
4017
1K
U11
TR
GND
TH
CV
NE555
DC
R
VCC
Q
10nF
10K
10K
SPEAKER
100uF
10K
NE555
VCC
GND
10unF

CHAPTER FOUR

4.0 TEST, RESULT AND DISCUSSION

After carrying out the paper design and analysis, the project was implemented and tested to ensure it's working ability and was finally constructed to the desired specification.

The various units and the project as a whole were tested to see the working condition.

4.1 UNITS TEST

(a) The power supply unit, this is to ensure that the battery is a six volts D.C battery to prevent it from short circuit.

Figure 4.0 a six volts battery.

This battery supplies the rail voltage needed to power the whole or entire device

(b) The antenna and sensing unit were neatly soldered on the Vero board and tested to ensure good signal capturing of radio waves. The figure below shows the simulated output of radio waves using a 900MHz frequency generator, since the mobile phone operates within this frequency range.

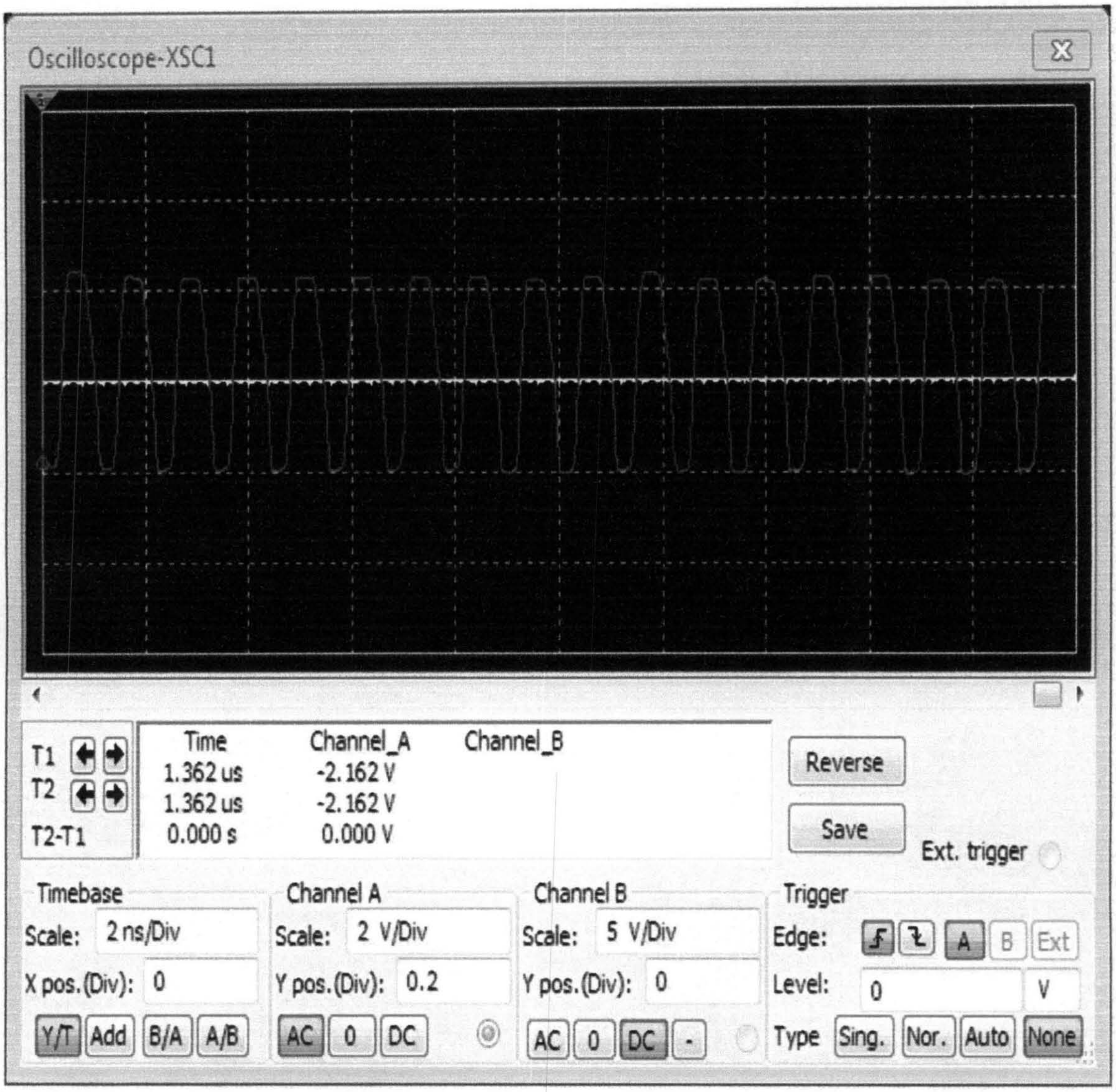


Figure 4.1 Showing frequency generator of Radio waves

The input value in milliwatt of power to this unit is 100 which is an International Telecommunication Union (ITU) [20] standard and the output value in millivolts was measured as shown in the tables below.

INPUT QUANTITY	VALUE	UNIT
POWER	100	MILLIWATT (mW)

Table 4.0 Input values

OUTPUT QUANTITY	VALUE	UNIT
VOLTAGE	0.33	MILLIVOLT (mV)

Table 4.1 Measured output values

(c) The amplification and comparator unit were also neatly soldered on the Vero board to prevent unnecessary current inductance. The output of the antenna unit serves as the input to this unit and the output was measured with the aid of a multi-meter and the values obtained are shown in the tables below.

INPUT QUANTITY	VALUE	UNIT
VOLTAGE	0.33	MILLIVOLT (mV)

Table 4.2 Input values

OUTPUT QUANTITY	VALUE	UNIT
VOLTAGE	20.29	VOLT (V)

Table 4.3 measured output values.

The 20.29V shows that the gain is high and since it is higher than the rail voltage, this means that the by-pass transistor will be trigger on.

(d) The output and display unit were also well soldered on the Vero board and tested to ensure that the LED and buzzer were given out good output by flashing of the LED and also by the humming of the buzzer. The voltage at the LED was measured and the value obtained is as shown in the table below.

INPUT QUANTITY	VALUE	UNIT
VOLTAGE	3	VOLTS (V)

Table 4.4 Input values

OUTPUT QUANTITY	VALUE	UNIT
VOLTAGE	2.97	VOLTS (V)

Table 4.5 Measured output values

4.2 FINAL TEST

The project as a whole was tested by solely directing it to its aim which is to detect the presence of mobile phones. This was done by connecting it to the six volts battery and turning on the switch, first with mobile phones present and secondly in the absence of mobile phones.

4.3 RESULT

A successful result was obtained which must be attributed to the flashing of the LED to display the word "PHONE DETECTED" and the humming of the buzzer when mobile phones were present and no display of the LED and no humming of the buzzer in the absence of mobile phones.

In the presence of a mobile phone the intensity of the output in volt was measured against distance in meters using a multi-meter and a table of values was obtained as shown below.

S/N	INTENSITY (V)	DISTANCE (M)
1	2.97	0
2	1.98	1
3	1.58	2
4	1.28	3
5	0.99	4
6	0.73	5
7	0.41	6
8	0.24	7
9	0.01	8
10	0	9

Table 4.6 the measured values of Intensity in Volts with respect to Distance in meters.

A graph of intensity was plotted against distance and it is as shown below.

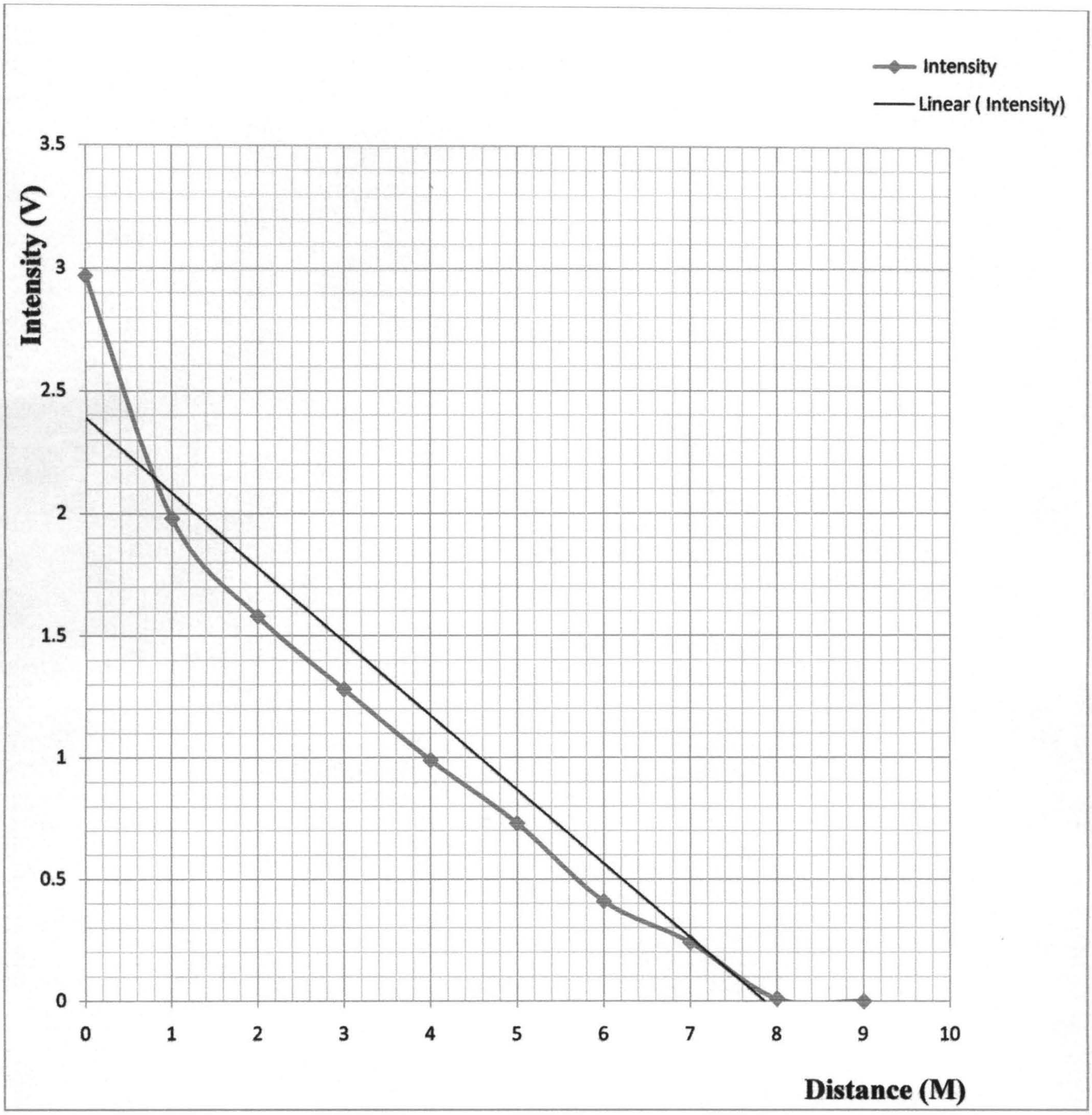


FIG 4.2 a Graph of intensity against distance

4.4 DISCUSSION OF RESULT

From the table of values obtained and the graph of intensity against distance plotted, the sensitivity of the device was an appreciable one within the first three meters radius and decreases gradually beyond this range up to the eight meters radius.

Beyond the eight meters radius it was no longer able to detect or capture any signal of the mobile phone frequency spectrum.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 CONLUSION

The result obtained after test met the desired specification, also the good performance of this project is as a result of the good and neat construction work that was done, such as good positioning of components on the Vero board as well as neat soldering of the components on the Vero board that were carried out.

Although some limitations to performance may exist which include poor mobile phone signal, low battery, improper handling etc.

The portability of this project work makes it very accessible, quite affordable and easy to use, thereby making mobile phones detection an easy task. This project work has enhanced my understanding of theoretical electronics components in a more practical way and also exposed me to the beauty and importance of electronics components to the telecommunication industry as well as the use of electronics components in solving societal problems.

Although the project work was quite challenging and tedious but to the Glory of God and the beauty of engineering it was a success, I wish to sincerely thank the department and my supervisor for giving me the opportunity to do this project and also for his fatherly advice and support.

5.2 RECOMMENDATIONS

Like every aspect of human endeavor especially in engineering and particularly in electrical engineering there is always room for improvement and further research on this project,

The following are recommended:

1. I will recommend that further work be done on the antenna and sensing unit so as to increase its sensitivity thereby increasing the radius of coverage beyond the present eight meters.

2. I will recommend that the use of microcontroller be employed so as to simplify the complex circuit and make it less tedious and make the device more portable.

3. I will recommend that the school through the department should request for mobile phone sniffers to combat the use of mobile phones in exam halls and other related exam malpractices.

4. I will recommend that the department acquire more research-oriented books in the department library and also improve access to Internet facility to make access to research materials and work easier.

5. I will also recommend that all the national examination bodies, security agencies as well as corporate organizations should appreciate and patronize this work to ensure our technological advancement thereby creating employment and wealth in the society.

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