DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

FEDERAL UNIVERSITY OYE EKITI

DESIGN AND CONSTRUCTION OF A WIRELESS SIGNAL JAMMING CIRCUIT FOR SECURITY APPLICATION

BY

MOGBADUN-OLA RIDWAN BABATUNDE
EEE/12/0846

NOVEMBER, 2017

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A PROJECT REPORT

SUBMITED

TO

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

FEDERAL UNIVERSITY OYE EKITI

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF ENGINEERING (B.ENG) DEGREE IN ELECTRICAL AND ELECTRONICS

NOVEMBER 2017

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This project work titled "Design and construction of a wireless signal jamming circuit for security application " by MOGBADUN-OLA RIDWAN BABATUNDE, meets the requirements for the award of Bachelor of Engineering (B.Eng.) degree in Electrical and Electronics Engineering Department, Federal University Oye-Ekiti.

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ABSTRACT

The dependence on Mobile Networks is worldwide. The success and growing in mobile networks becomes troublesome and annoying by the ringing of mobile, especially in places where silence is required such as Mosques, University lecture rooms, libraries, concert halls, meeting rooms etc. This project will solve this problem by using an intelligent jamming device capable of preventing cell phones which operates within a restricted area. This project gives an explanation to the concept of mobile Jamming and explores jamming in the two popular mobile networks: Global system for mobile communication (GSM) and digital cellular network (DCS). The intelligent jamming system is designed to block only the controller channel, also to operate only if there is active mobile in the restricted area. The system of mobile jamming is analyzed and simulated using the Advance Design System (ADS) for Agilent software package. Based on the result and testing of the Mobile Jammer, the objective of this project has been achieved. The Mobile Detector Phone Jammer successfully jammed all the four operators but the radius of the range did not get as expected in the designed. this project only focuses on blocking the signal transmission between the ranges 935 to 960 MHz.

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CHAPTER ONE

1.1 INTRODUCTION

A wireless signal jammer is a device which blocks transmission by creating interference. This wireless signal jammer can be categorized into the Radio Frequency (RF) jammer and GSM jammer.

A Radio Frequency jammer is a device used to disrupt or prevent communication via a broadcasted RF signal. It is an RF and GSM frequency disrupter commonly known as wideband radio frequency (RF) and GSM cell phone jammer. Simultaneously, they can blocks all commercial FM broadcast band (87.5 MHz to 108 MHz) and GSM signal transmissions within the jammer's transmission range. The device can possibly block these frequencies by transmitting a dirty signal (like noise) on the same frequency at which the GSM and radio system operates.

A Radio Frequency jammer is a device that transmits a radio frequency signal on the same frequency at which the radio system operates and the jamming succeeds when the radio sets in the area where the jammer is located are disabled.

A GSM jammer is a device that transmits a signal on the same frequency at which the GSM operates. The jamming succeeds when the mobile phones in the area where the jammer is located are disabled.

In recent times, where bombs are being planted and detonated by GSM or Radio Frequency signals, this device can be at an advantage by jamming the signals required for the detonation of the bomb. Presently, the mobile jammer devices are becoming civilian products rather than electronic warfare devices, since with the increasing number of the mobile phone users the need to disable mobile phones in specific places where the ringing of cell phone would be disruptive has increased. These places include worship places, university lecture rooms, libraries, concert halls, meeting rooms, and other places where silence is appreciated.

The solution to these annoying and disrupting noises is to install a device which can block the signal transmission from mobile phones and radio sets and thus, disrupt the triggering of bombs by these wireless signals.

1.2 PROJECT BACKGROUND

The technology being used by this device is very simple. The mobile phone transmission is being blocked and interfered by RF which creates high noise. The frequency being generated by the jamming device jams the signal being generated by the cell tower (as illustrated in figure 1.1 below). When the signal has been blocked, the mobile phone will show "NO NETWORK" on the network bar, and radio devices will not be able to tune into any signal. Thus, all phones and radio devices in the 200m radius of the jammer will be having the same situation.

Radio Frequency (RF) and Mobile signal jammer is an illegal device in many countries. It is because the device is blocking the signal which has been approved by government agency as a legal communication transmission system. According to the National Communications Commission (NCC) in Nigeria, "The manufacture, importation, sale, or offer for sale, of devices designed to block or jam wireless transmission is prohibited".

The reason I am developing this device is for educational purpose only. This device was developed and tested in this report just for Final Year Project presentation. There is no intention of manufacturing or selling such device in Nigeria or elsewhere.

In the construction of this wireless signal jammer, the device will be able to jam GSM and Radio Frequency (RF) signals and this can be done alternatively through a switch.

As shown in Fig. 1.1 below, the wireless signal jammer is divided into two major branches: the GSM signal jammer, and the radio receiver jammer. The radio receiver jammer is also sub-divided into the Amplitude Modulated (AM) signal jammer and the Frequency Modulated (FM) Signal jammer. The Cell phones and Radio receivers cannot be blocked simultaneously as they operate at separate frequencies. The frequency can then be varied using a frequency tuner mounted on the jammer

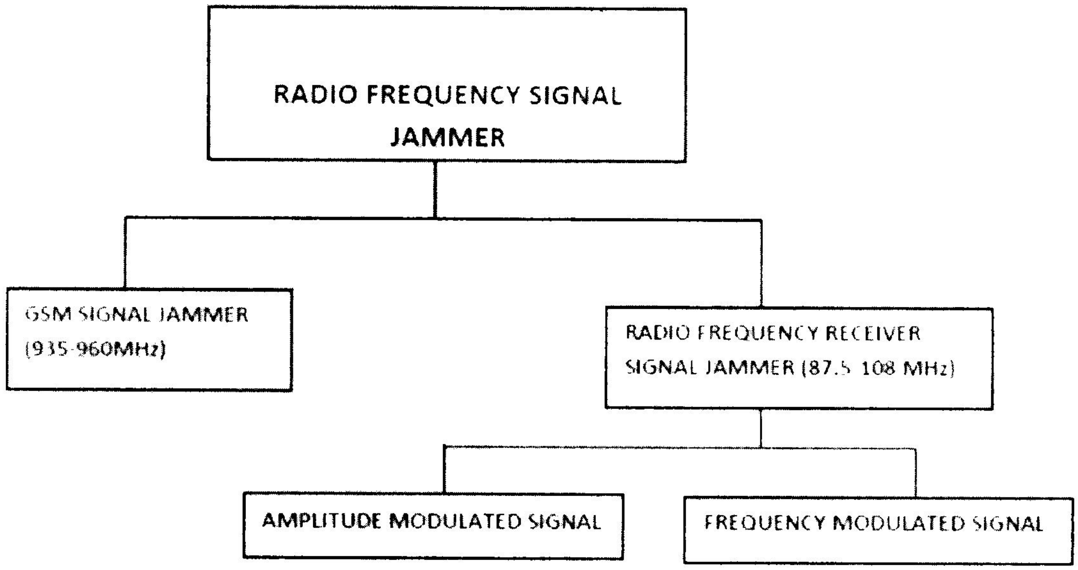

Fig. 1.1 Block Diagram of Signal Jammer

The block diagram in Fig. 1.2 below gives a pictorial representation of the working principle of a wireless signal jammer.

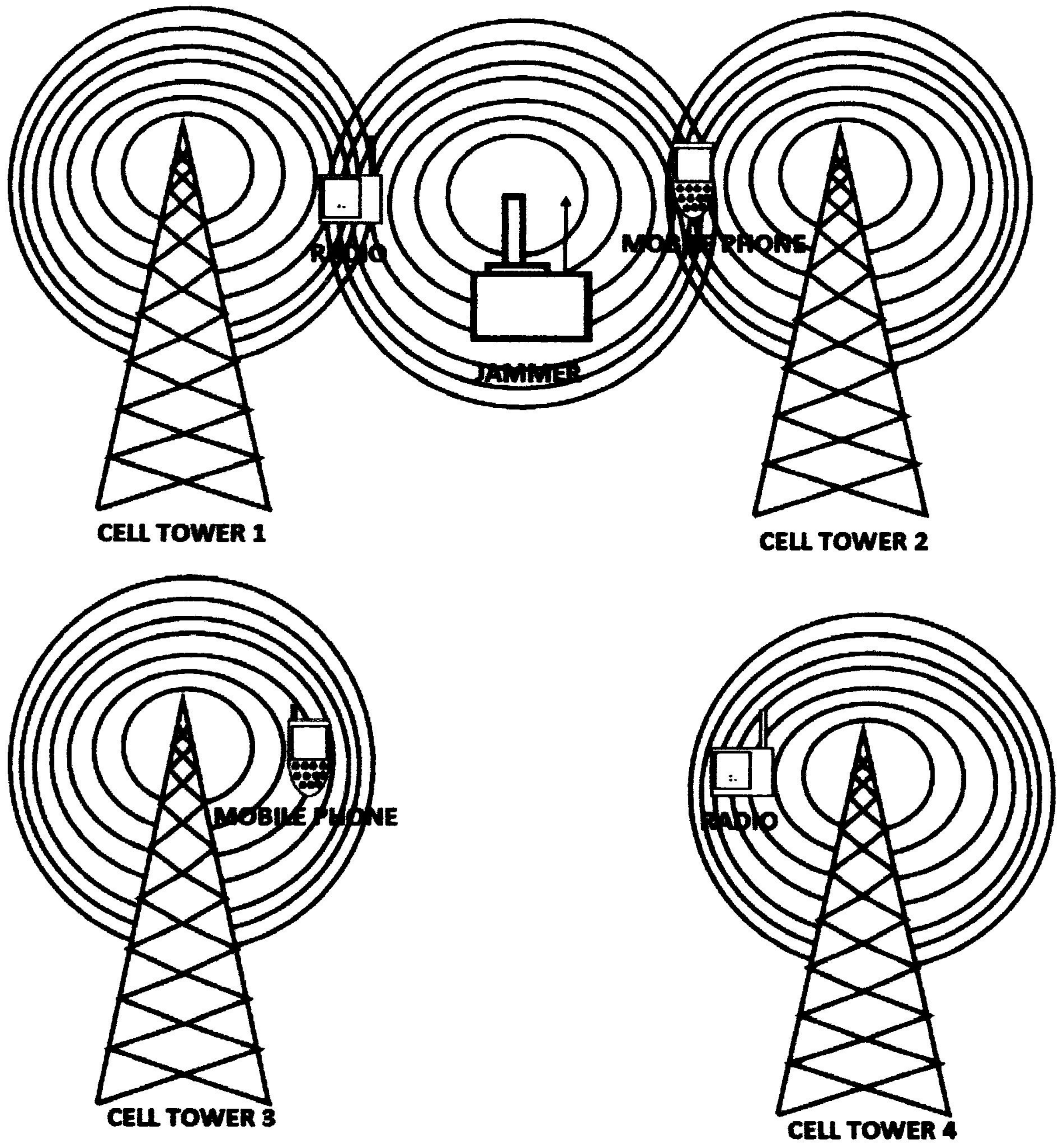

Fig 1.2: Pictorial Representation of a Radio Frequency Jammer

From the Fig. 1.2, the jamming device jams cell phones and radio sets within the range of cell towers 1 and 2.

The cell tower 1, 2, 3 and 4 transmits signals which can be received by GSM or radio sets. The jamming device is placed in-between cell towers 1 and 2 and thus produces a signal which is at the same frequency being operated /transmitted by the cell tower. It can be said that the resultant of the signals is zero.

From Fig. 1.2, the sending object is the jamming device and the target object is the cell towers. However, mobile phones placed within the range of cell towers 3 and 4 will not be jammed due to the fact that they are not within the range of the jamming device.

1.3 PROBLEM STATEMENT

Due to the increasing sophistication and high technology, most people are using mobile phones, and also due to the need for man to stay updated with his environment, the use of radio is also in wide use.

Mobile phones have become a very important communication tool today. With the use of the mobile phones everywhere, it becomes annoying device while working, studying, praying and many more.

Modern technology has contributed to the sophistication of bombs which are being triggered by GSM and Radio signals.

Wireless mobile jammer can be placed in schools, mosque, and conference hall, meeting rooms, library and many more places which need quiet and peaceful environment. This device will block the transmission of Radio and GSM signals.

1.4 OBJECTIVES

The Development of Wireless Signal Jammer for Security Application objective is:

i. To construct a wireless signal jamming circuit for security application

ii. To simulate Intermediate Frequency (IF) section circuit.

iii. To block mobile phones transmission by creating interference.

iv. To block amplitude modulated and frequency modulated signal transmission by creating interference within its range.

1.5 SCOPE OF PROJECT /LIMITATION

This project only focuses on blocking the signal transmission between the ranges 935 to 960 MHz. This is because the components are hard to find in Nigeria for the GSM1800 frequency range between 1805 to 1880 MHz. The components for GSM1800 are also very expensive compared to GSM900.

The second limitations of the project are, the device only can block the four main operators which are ETISALAT, MTN, GLOBACOM and AIRTEL. This is because, the lines are only for Nigerian users and the frequency band range is between 935 to 960 MHz. These requirements fulfill the GSM900 specifications.

The third limitation is that for reliability of the jammer, a Radio Frequency amplifier should be incorporated but the components required for this are difficult to find in Nigeria.

1.6 SUMMARY

This project is mainly intended to prevent the usage of mobile phones in places inside it coverage without interfering with communication channels outside it range, thus providing a cheap and reliable method for blocking mobile communication in the required restricted area only. Although we must be aware of the fact that nowadays lot of mobile phones can easily negotiate the jammer effect are available and therefore advance measures should be taken to jam such type of devices. The main disadvantage of the mobile phone jammer is that the transmission of the jamming signal is prohibited by law in many countries. These disadvantages will restrict the use of Radio Frequency jammer.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter will discuss more about all of the information related to the project. It discusses about the previous history and the present work about my project. The literature review in this paper is based on Internet, journal, books, and articles.

2.2 HISTORY OF RF/ GSM JAMMER

Communication jamming devices were first developed and used by military. This interest comes from the fundamental area of denying the successful transport of the information from the sender to the receiver. Nowadays the mobile jammer devices are becoming civilian products rather than electronic warfare devices, since with the increasing number of the mobile phone users the need to disable mobile phones in specific places where the ringing of cell phone would be disruptive has increased. These places include worship places, university lecture rooms, libraries, concert halls, meeting rooms, and other places where silence is appreciated.

2.3 OPERATION

Jamming devices overpower the cell phone by transmitting a signal on the same frequency as the cell phone and at a high enough power that the two signals collide and cancel each other out. Cell phones are designed to add power if they experience low-level interference, so the jammer must recognize and match the power increase from the phone. Cell phones are full-duplex devices which mean they use two separate frequencies, one for talking and one for listening simultaneously. Some jammers block only one of the frequencies used by cell phones, which has the effect of blocking both. The phone is tricked into thinking there is no service because it can receive only one of the frequencies. Less complex devices block only one group of frequencies, while sophisticated jammers can block several types of networks at once to head off dual-mode or tri-mode phones that automatically switch among different network types to find an open signal. Some of the high-end devices block all frequencies at once and others can be tuned to specific frequencies.

To jam a cell phone, all you need is a device that broadcasts on the correct frequencies. Although different cellular systems process signals differently, all cell phone networks use radio signals that can be interrupted. GSM, used in digital cellular operates in the 900-MHz and 1800-MHz bands in Europe and Asia and in the 1900-MHz (sometimes referred to as 1.9-GHz) band in the United State. Old- fashioned analogue cell phones and today's digital devices are equally susceptible to jamming. Disrupting a cell phone is the same as jamming any other type of radio communication. A cell phone works by communicating with its service network through a cell tower or base station. Cell towers divide a city into small areas, or cells. As a cell phone user drives down the street, the signal is handed from tower to tower.

A jamming device transmits on the same radio frequency as the cell phone, which is 900MHz, thereby disrupting the communication between the phone and the cell-phone base station in the town. This is called a denial-of-service attack. The jammer denies service of the radio spectrum to the cell phone users within range of the jamming device. Older jammers sometimes were limited to working on phones using only analogue or older digital mobile phone standards. Newer models such as the double and triple band jammers can block all widely used systems and are even very effective against newer phones which hop to different frequencies and systems when interfered with. As the dominant network technology and frequencies used mobile phones vary worldwide, some work only in specific regions such as Europe or North America. The power of the jammer's effect can vary widely based on factors such as proximity to towers, indoor and outdoor settings, presence of buildings and landscape, eve temperature and humidity play a role. There are concerns that crudely designed jammers may disrupt the functioning of medical devices such as pacemakers. However, like cell phones, most of the devices in common use operate at low enough power output (less than one watt) to avoid causing any problems.

2.4 PREVIOUS WORK

The rapid proliferation of mobile phones at the beginning of the 21st century to near ubiquitous/ever present status eventually raised problems such as their potential use to invade privacy or contribute to rampant and egregious academic cheating. In addition public backlash was growing against the intrusive disruption cell phones introduced in daily life. While older analogue mobile phones often suffered from chronically poor reception and could even be disconnected by simple interference such as high frequency noise, increasingly sophisticated digital phones have led to more elaborate counters. Mobile phone jamming devices are an alternative to more expensive measures against mobile phones, such as Faraday cages, which are mostly suitable as built in protection for structures. They were originally developed for law enforcement and the military to interrupt communications by criminals and terrorists. Some were also designed to foil the use of certain remotely detonated explosives. The civilian applications were apparent, so over time many companies originally contracted to design jammers for government use switched over to sell these devices to private entities. Since then, there has been a slow but steady increase in their purchase and use, especially in major metropolitan areas.

A rundown of the history of mobile phones is as below:

1. Mobile Telephone Service (1946- 1984): This system was introduced on 17th of June, 1946. Also known as Mobile Radio-Telephone Service. This was the founding father of the mobile phone. This system required operator assistance in order to complete a call. These units do not have direct dial capabilities.

2. Improved Mobile Telephone System (1964-present): This system was introduced in 1969 to replace MTS. IMTS is best known for direct dial capabilities. A user was not required to connect to an operator to complete a call. IMTS units will have a keypad or dial similar to what you will find on a home phone.

3. Advanced Mobile Phone System (1983-2010): This system was introduced in 1983 by Bell Systems; the phone was introduced by Motorola in 1973 and released for public use in 1983 with the Motorola 8000. Advanced Mobile Phone System (AMPS) also known as 1G is an improvement of IMTS.

2.5 PRESENT WORK

The previous research that related to Mobile Phone Jammer is widely used in United Kingdom. There is no company in Nigeria that provides these mobile phone jammers. This project if implemented in the mosque/church will help avoid any disruptive while in the mosques. People who are bringing their mobile phones inside the mosque will have the phone signal jammed, thus, detecting no signal. This Mobile Phone Jammer is using GSM to jam the frequencies.

Global System for Mobile Communications (GSM) GSM is an acronym for Global System for Mobile communications. It accounts for about 70% of the global mobile market. GSM uses a variation of time division multiple access (TDMA) and is the most widely used of the three digital wireless telephone technologies (TDMA, GSM, and CDMA).

2.6 HOW A GSM JAMMER WORKS

Cell phones communicate with a service network through cell towers. Cell towers are placed in specific places to provide service to small areas. As a cell phone is moved between these areas, the towers pass the signals. A GSM jammer transmits on the same airwaves that cell phones do. When the jammer is activated, it is able to disrupt the signal between the cell phone and the nearest tower. Because the GSM jammer and the cell phone use the same frequency, they effectively cancel the other signal.

2.7 HOW GSM JAMMERS ARE MADE

GSM jammers are usually simple devices with typically only a switch to turn it on and off, a light to show that it is working and an external antenna to send the signal. If the jammer is more sophisticated, it might include controls to set the jamming for varied frequencies or strengths. Small GSM jammers are usually powered by batteries. Often, the batteries are even the same as cell phone batteries. Larger GSM jammers are electrically powered.

2.8 GSM JAMMER RANGE

GSM jammers typically have a range of between 50 and 80 feet. This means that they will only successfully jam cell phones that are within this range. As soon as the cell phone travels out of range, the signal will return and you can again use the phone. More sophisticated cell phone jammers might have larger ranges, typically associated with higher power (wattage) jammers.

2.9 RADIO FREQUENCY JAMMER USES

Some buildings, businesses, offices and churches are now beginning to utilize strong Radio Frequency jammer equipment that are mounted on a wall or a ceiling. These Radio Frequency jammers are generally housed in small metal boxes and are quite inconspicuous. Radio Frequency jammers like this can effectively make cell phone use impossible within the building. This is also of high importance in the provision of adequate security, by disrupting network signals required to detonate bombs and other explosives.

2.10 RADIO FREQUENCY JAMMER EVOLUTION

When cell phone Radio Frequency jammers first hit the market, consumers didn't have many options to choose from. The available units were typically brief cased sized or larger, and could be difficult to carry around. Today, however, you will find many more cell phone Radio Frequency jammer options available, including some units that are small enough to fit within the palm of your hand. One of the great aspects of having a small cell phone Radio frequency jammer is the fact that you can carry one with you wherever you go.

The questions below will justify the use of Radio Frequency jammers:

- Have you ever been caught in line at a fast food restaurant behind someone that won't turn off his cell phone and place his order?
- Have you ever been caught in your morning bus commute, being forced to listen to every detail of last night's escapades from one of the other commuters?
- Have you ever gone to see a film, only to be distracted by the narration into the cell phone by one of the other patrons?

Evidently, one will appreciate the thought of having a small cell phone Radio Frequency jammer that you can activate whenever you like.

When you use your personal Radio Frequency jammer, you will enjoy.

- Instant peace and silence.
- Faster processing in lines when you are behind a cell phone user
- The film with its original dialogue
- Perfect rest of mind and a reduction in risk of being exposed to bombs and other Radio Frequency controlled explosives

Although the range of a portable or pocket sized cellular phone Radio Frequency jammer is not as broad as larger fixed models, they are large enough to help you bring peace and quiet to your personal space.

2.11 SUMMARY

This chapter is about the previous and present work on this project. This chapter dwells on the difference in technology being used in the evolution of this device. This chapter has been written as a result of research using articles, books, magazines, websites and other methods. More information about the present work on Radio Frequency jammer will be explained in the next chapter.

CHAPTER THREE

METHODOLOGY

3.1 INTRODUCTION

This chapter explains in detail the methodology and components of this final year project report. Each part and component that has been selected has as its own purpose mostly focused on functionality and low cost. In this chapter also, the technical plan, analysis and also the specifications are being explained.

3.2 METHODOLOGY

To build this project: the system must be divided into two phases: the first phase as the jamming system and the second one is to control the jamming system to be an intelligent jamming system. These subsystems and stages are coming from different functions of each small component, so let's discuss the purpose of each stage by explaining the operation of the system.

The jamming system will produce the jamming signal by mixing the noise with intermediate frequency and then modulate into UHF (Ultra High Frequency) range for mobile communication system as single side band (SSB). The switching system will choose the mobile communication system to jam (GSM or DCS). Finally the signal must be amplified to be propagated.

3.2 System Block Diagram

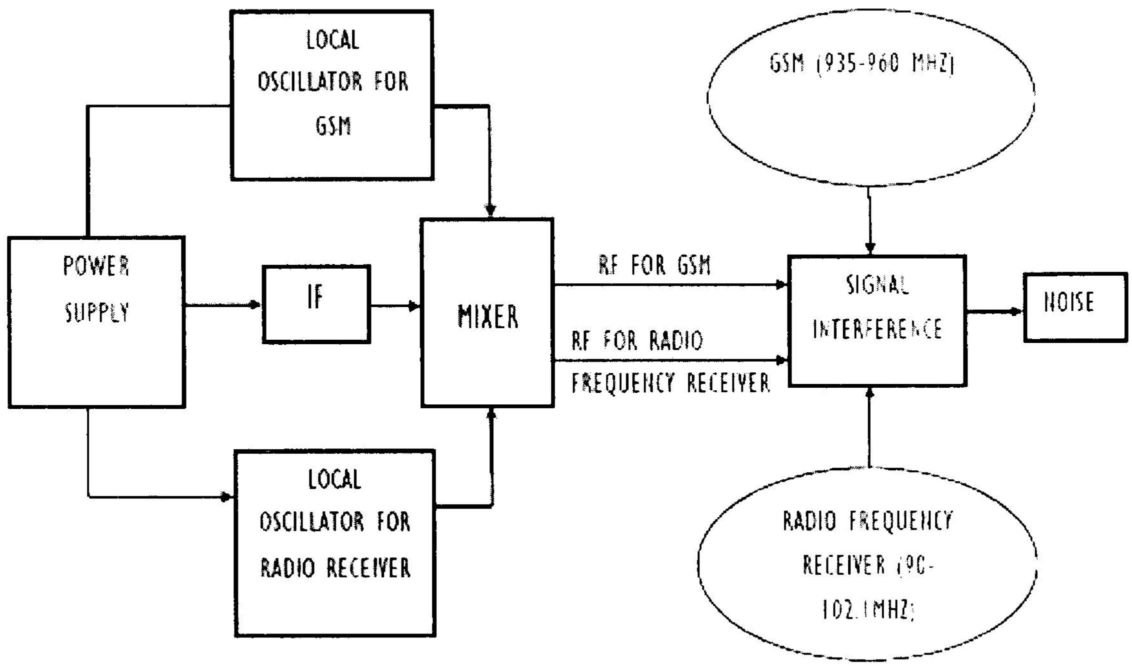

Fig 3.1: System Block Diagram

Fig 3.1 shows the systems block diagram where the power supply energizes the local oscillator for GSM and Radio receiver. The frequency generated by the local oscillator (s) then mix with the frequency at the IF section and this produces two RF. one for GSM and one for radio receiver. and thus jams the GSM/ radio receiver signal to produce noise.

3.3 DESIGN CALCULATIONS

3.3.1 POWER SECTION

Power calculations:

Here, we need to find the power that is needed to be transmitted to jam any cell phone within a distance of around 10 meters for DCS. From the above considerations, we can find the required output power from the device, as follows:

Using SNR = 9 dB and the maximum power signal for mobile receiver = -15 dBm, gives J = -24 dBm. But, our goal is to find the output power from the device, so when we add the free space loss to the amount of power at the mobile receiver we get our target: Output power = -24dBm+58dB = 34 dBm.

Calculation for the minimum power required to block the GSM-900 and DCS (Jr):

For GSM - 900 the minimum signal to noise ratio (SNR min = 9 dB) and maximum signal power (SMAX = - 15dBm).

Now

$$\mathbf{SNR} = \frac{S}{N} = \frac{S}{Jr'}, \quad \text{So}$$

$$\mathbf{Jr(dB) = -15 - 9 = -24dBm}$$

To cover area of 20 meter radius; the free. space power loss (FSPL) should be calculated as follow:

$$\mathbf{FSPL = 20Log\frac{4\pi R}{\lambda}}$$

Where: R and λ in meter

For 960MHz

$$\lambda = \frac{3 \times 10^8}{960 \times 10^6} = 0.3125m$$

Substituting in FSPL equation gives:

$$FSPL = 58dB$$

Then $Jr = -24 + 58 = 34dBm$

For DCS

SNR min = 9dB and S MAX = -23dBm

Repeating the calculations with f = 1880 gives

$$Jr = -32 + 63.9 = 31.9dBm$$

To meet this power we need amplifier

3.3.2 THE POWER SUPPLY

This is used to supply the other sections with the needed voltages. Any power supply consists of the following main parts:

Transformer: - is used to transform the 220VAC to other levels of voltages.

Rectification: - this part is to convert the AC voltage to a DC one. We have two methods for rectification:

- Half wave-rectification: the output voltage appears only during positive cycles of the input signal.
- Full wave –rectification: a rectified output voltage occurs during both the positive and negative cycles of the input signal.

The Filter: used to eliminate the fluctuations in the output of the full wave rectifier "eliminate the noise" so that a constant DC voltage is produced.

This filter is just a large capacitor used to minimize the ripple in the output. Regulator: this is used to provide a desired DC-voltage. Figure 2 shows the general parts of the power supply. Figure 2 Parts of the power supply. In This project I need 9volts and 5volts and I found that the 9volts Battery can serve as power supply and can provide all the voltages that I need in the jammer, so I bought one.

From figure 3.2, it shows that the device needs supply to operate the system. Figure 3.3 shows the circuit diagram and Figure 3.4 shows the PCB design for the power supply circuit. The operation of power supply is as shown below:

Fig 3.2: Power Supply Circuit Diagram

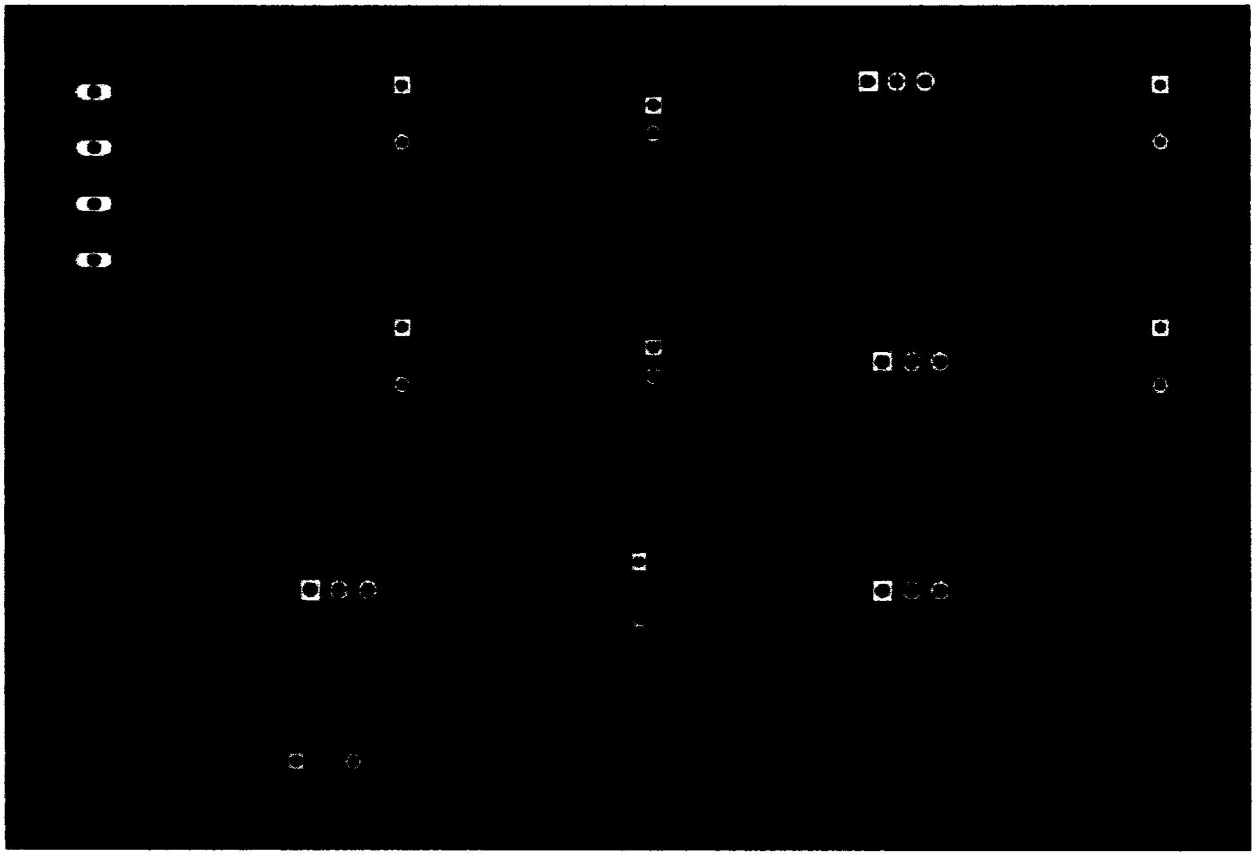

Fig 3.3: Power Supply PCB Design

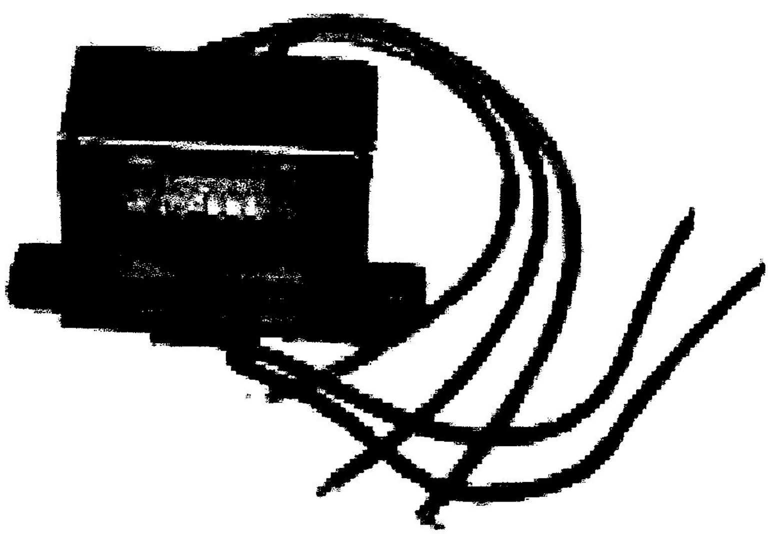

Fig 3.4: Transformer 9 Volts 21

Fig 3.5 shows the transformer which transforms 220V AC to other levels of voltage. Its functions are outlined below:

i. **Rectification**: Convert the AC voltage to DC voltage.

ii. **Filtering**: "Eliminate the noise" so that a constant DC voltage is produced. This filter is just a large capacitor used to minimize the ripple in the output.

iii. **Voltage Regulation:** It provides the desired DC voltage.

3.3.3 THE NOISE GENERATOR/OSCILLATOR UNIT

The noise generator unit is also known as the oscillator unit there are various types of Oscillators or signal generators for example; Hartley. Colpitt. Vactar.Franklin. Wein bridge and other types. But in this work the Hartley oscillator was used.

In electronics an LC circuit, also called a resonant circuit, tank circuit, or tuned circuit, consists of two electronic components connected together; an inductor, represented by the letter L, and a capacitor, represented by the letter C. The circuit can act as an electrical resonator, an electrical analogue of a tuning fork, storing energy oscillating at the circuit's resonant frequency.

LC circuits are used either for generating signals at a particular frequency, or picking out a signal at a particular frequency from a more complex signal. They are key components in many electronic devices, particularly radio equipment, used in circuits such as oscillators, filters, tuners and frequency mixer.

An LC circuit is an idealized model since it assumes there is no dissipation of energy due to resistance. Any practical implementation of an LC circuit will always include loss resulting from small but non-zero resistance within the components and connecting wires. The purpose of an LC circuit is usually to oscillate with minimal damping, so the resistance is made as low as possible. While no practical circuit is without losses, it is nonetheless instructive to study this ideal form of the circuit to gain understanding and physical intuition. For a circuit model incorporating resistance.

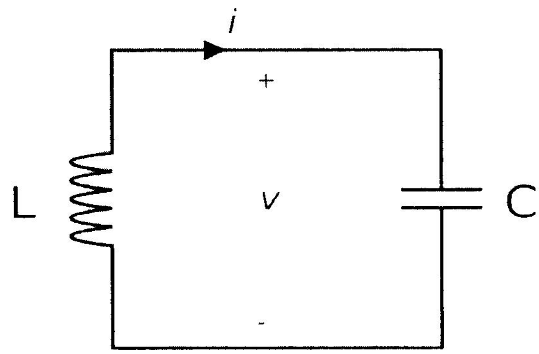

Fig. 3.5 LC Tuned Circuit

If a charged capacitor is connected across an inductor, charge will start to flow through the inductor, building up a magnetic field around it and reducing the voltage on the capacitor. Eventually all the charge on the capacitor will be gone and the voltage across it will reach zero. However, the current will continue, because inductors resist changes in current.

The energy to keep it flowing is extracted from the magnetic field, which will begin to decline. The current will begin to charge the capacitor with a voltage of opposite polarity to its original charge. When the magnetic field is completely dissipated the current will stop and the charge will again be stored in the capacitor, with the opposite polarity as before. Then the cycle will begin again, with the current flowing in the opposite direction through the inductor.

The charge flows back and forth between the plates of the capacitor, through the inductor. The energy oscillates back and forth between the capacitor and the inductor until (if not replenished by power from an external circuit) internal resistance makes the oscillations die out. Its action, known mathematically as a harmonic oscillator, is similar to a pendulum swinging back and forth, or water sloshing back and forth in a tank. For this reason the circuit is also called a tank circuit. The oscillation frequency is determined by the capacitance and inductance values. In typical tuned circuits in electronic equipment the oscillations are very fast, thousands to millions of times per second.

The resonance effect occurs when inductive and capacitive reactance is equal in magnitude. The frequency at which this equality holds for the particular circuit is called the resonant frequency where L is the inductance in Henry, and C is the capacitance in Farads. The angular frequency ω0, has units of radians per second.

The equivalent frequency in units of hertz is

$$f_0 = \frac{\omega_0}{2\pi} = \frac{1}{2\pi\sqrt{LC}}.$$

LC circuits are often used as filters; the L/C ratio is one of the factors that determine their "Q" and so selectivity. For a series resonant circuit with a given resistance, the higher the inductance and the lower the capacitance, the narrower the filter bandwidth. For a parallel resonant circuit the opposite applies. Positive feedback around the tuned circuit ("regeneration") can also increase selectivity.

Stagger tuning can provide an acceptably wide audio bandwidth, yet good selectivity. The most common application of tank circuits is tuning radio transmitters and receivers. For example, when we tune a radio to a particular station, the LC circuits are set at resonance for that particular carrier frequency.

The charge flows back and forth between the plates of the capacitor, through the inductor. The energy oscillates back and forth between the capacitor and the inductor until (if not replenished by power from an external circuit) internal resistance makes the oscillations die out. Its action, known mathematically as a harmonic oscillator, is similar to a pendulum swinging back and forth, or water sloshing back and forth in a tank. For this reason the circuit is also called a tank circuit. The oscillation frequency is determined by the capacitance and inductance values. In typical tuned circuits in electronic equipment the oscillations are very fast, thousands to millions of times per second.

$$\omega_0 = \frac{1}{\sqrt{LC}}$$

Fig 2: LC Tuned Circuit If a charged capacitor is connected across an inductor, charge will start to flow through the inductor, building up a magnetic field around it and reducing the voltage on the capacitor. Eventually all the charge on the capacitor will be gone and the voltage across it will reach zero. However, the current will continue, because inductors resist changes in current. The energy to keep it flowing is extracted from the magnetic field, which will begin to decline. The current will begin to charge the capacitor with a voltage of opposite polarity to its original charge. When the magnetic field is completely dissipated the current will stop and the charge will again be stored in the capacitor, with the opposite polarity as before. Then the cycle will begin again, with the current flowing in the opposite direction through the inductor. The charge flows back and forth between the plates of the capacitor, through the inductor. The energy oscillates back and forth between the capacitor and the inductor until (if not replenished by power from an external circuit) internal resistance makes the oscillations die out. Its action, known mathematically as a harmonic oscillator, is similar to a pendulum swinging back and forth, or water sloshing back and forth in a tank. For this reason the circuit is also called a tank circuit. The oscillation frequency is determined by the capacitance and inductance values. In typical tuned circuits in electronic equipment the oscillations are very fast, thousands to millions of times per second.

The resonance effect occurs when inductive and capacitive reactance are equal in magnitude. The frequency at which this equality holds for the particular circuit is called the resonant frequency.

Where L is the inductance in Henry, and C is the capacitance in Farads. The angular frequency $\omega 0$, has units of radians per second. The equivalent frequency in units of hertz is LC circuits are often used as filters; the L/C ratio is one of the factors that determines their "Q" and so selectivity. For a series resonant circuit with a given resistance, the higher the inductance and the lower the capacitance, the narrower the filter bandwidth. For a parallel resonant circuit the opposite applies. Positive feedback around the tuned circuit ("regeneration") can also increase selectivity. Stagger tuning can provide an acceptably wide audio bandwidth, yet good selectivity. The most common application of tank circuits is tuning radio transmitters and receivers. For example, when we tune a radio to a particular station, the LC circuits are set at resonance for that particular carrier frequency. It's The charge flows back and forth between the plates of the capacitor, through the inductor. The energy oscillates back and forth between the capacitor and the inductor until (if not replenished by power from an external circuit) internal resistance makes the oscillations die out. action, known mathematically as a harmonic oscillator, is similar to a pendulum swinging back and forth, or water sloshing back and forth in a tank. For this reason the circuit is also called a tank circuit. The oscillation frequency is determined by the capacitance and inductance values. In typical tuned circuits in electronic equipment the oscillations are very fast, thousands to millions of times per second.

In Fig 3.2, the system flow chart shows that when the power is ON, the supply will go into triangular wave generator and noise generator. The two signals will be mixed in the mixer so that the signal will be a noise. Then the signal will be transferred to the clamper for achieving the desired voltage to VCO. Then the signal will then go through the VCO at the RF section after being amplified, and will then interfere with the mobile signal. This system flow chart can be seen as being applied to both GSM and radio frequency receiver, with considerable difference in operating frequency.

3.3.4 INTERMEDIATE FREQUENCY SECTION (IF)

Intermediate Frequency section is the section where the signal is produce to the Radio Frequency section (RF). IF section is the frequency tuning section which processes the triangular wave mixed with noise signal to sweep the Voltage Controlled Oscillator (VCO). The IF section consists of four main parts which are:

a) Triangular Wave Generator: To tune the VCO in the RF section.

b) Noise Generator: To generate output noise.

c) Mixer: To mix the triangular signal with the noise signal.

d) Clamper: To reduce the desired voltage for VCO. 22

3.3.4.1 TRIANGULAR WAVE GENERATOR

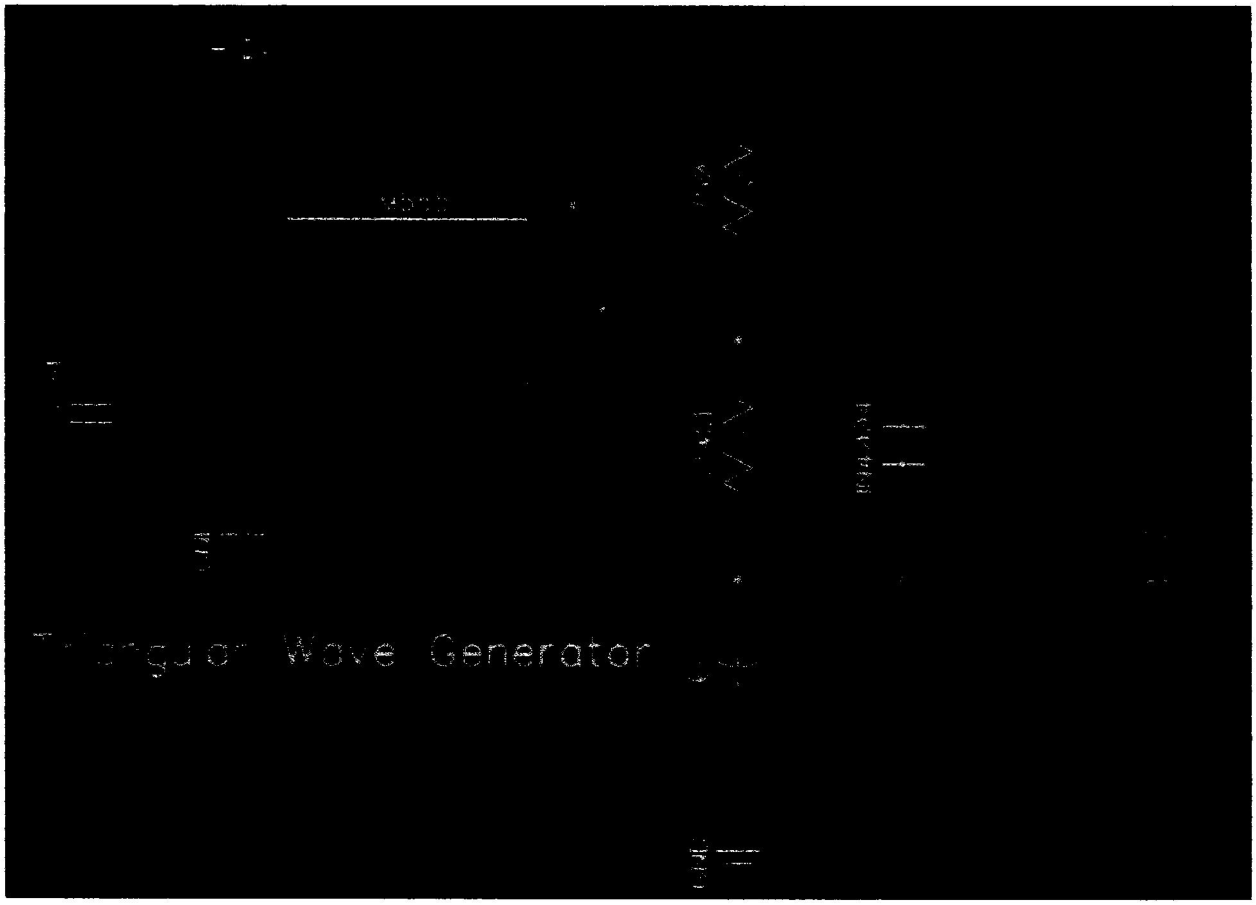

Fig 3.6: Triangular Wave Generator Circuit Diagram

Fig 3.6 is the Triangular Wave Generator Circuit Diagram. Triangular wave generator is used to sweep the tuning frequency to the Voltage Controlled Oscillator (VCO). It will sweep the desired frequency range to cover the downlink frequency which is 935 to 960 MHz where this is the frequency range that needed to block the transmission for GSM. 555 timer IC was used and operates in a stable mode to generate the sweeping signal to the VCO. The output frequency for triangular wave generator is 110 kHz.

3.3.4.2 NOISE GENERATOR

Fig 3.7: Noise Generator Circuit Diagram

Figure 3.7 is the circuit diagram of the Noise Generator. Without noise, the output of the VCO is just an un-modulated sweeping RF carrier. Due to this, it is required to mix the triangular signal and noise (Frequency Modulated (FM) modulating the RF carrier with noise). To generate the noise signal, zener diode be used in reverse mode. This is because; operating in the reverse mode will cause avalanche effect. Avalanche effect in this stage means it will create a wide band noise. Then the noise will be amplified. There are two stages where the noise will be amplified which is using NPN transistor as common emitter and then using LM386 IC which is audio amplifier.

3.3.4.3 MIXER

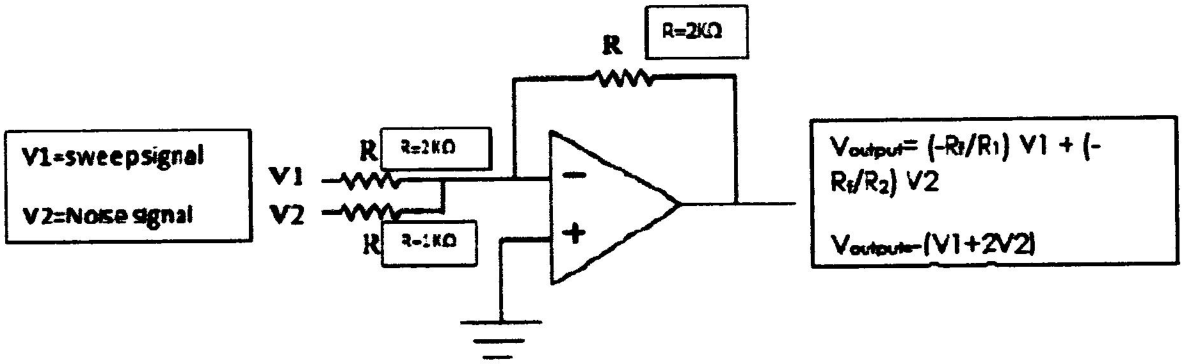

Fig 3.8: Op-Amp Summer Circuit Diagram

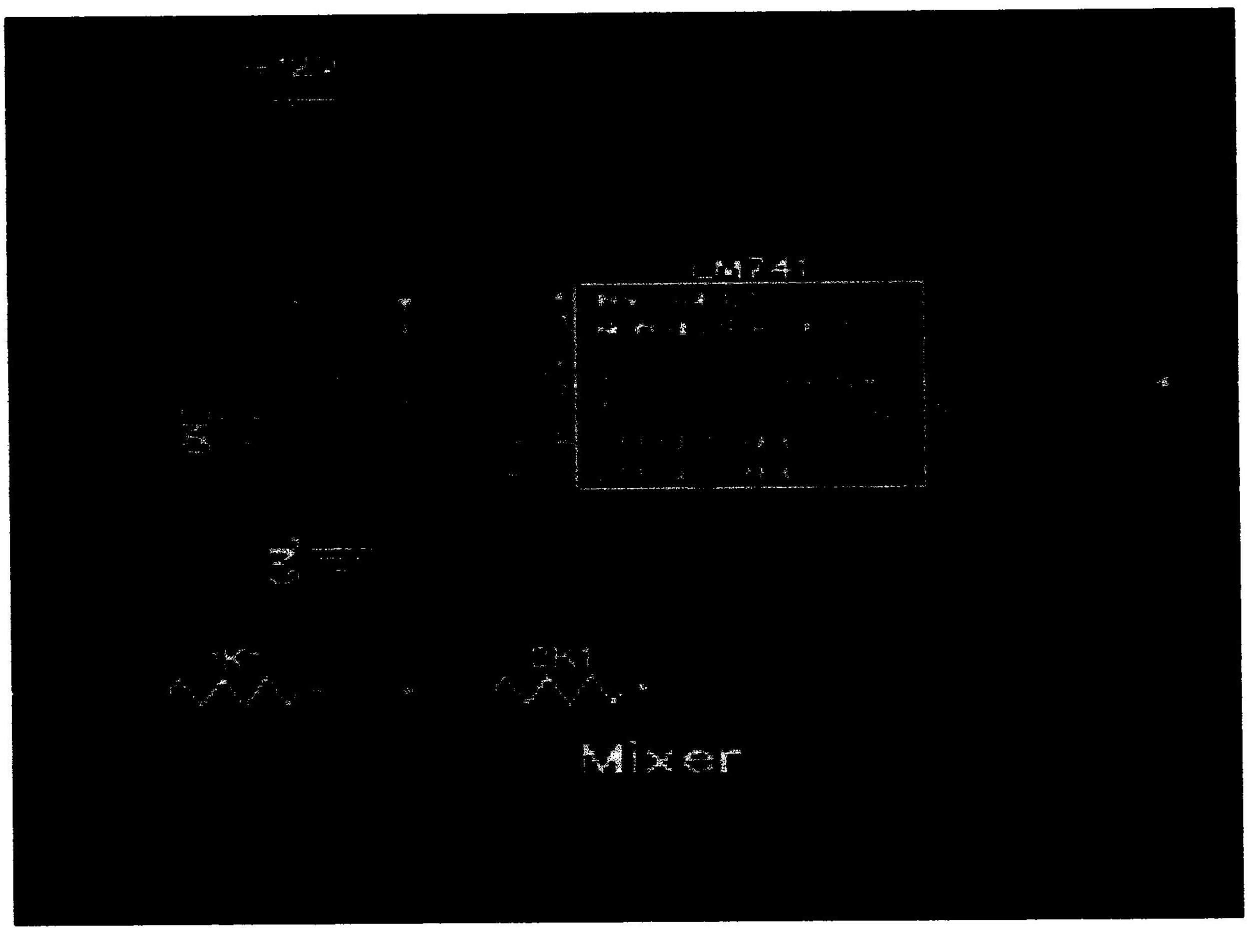

Fig 3.9: Mixer Circuit Diagram

Fig 3.8 illustrates the Op-amp pins and the calculation. Fig 3.9 is the Mixer Circuit Diagram. In this case, the mixer is just an amplifier which operates as a summer. The triangular signal and noise will add together in the mixer before entering the VCO. To achieve this target, LM741 was used.

3.3.4.4 CLAMPER

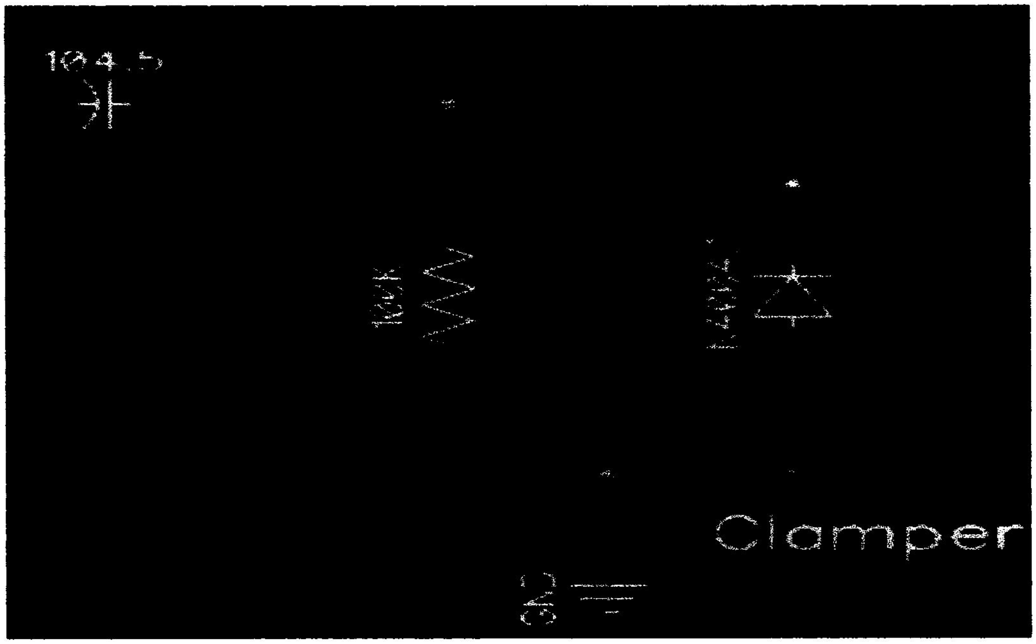

Fig 3.10: Clamper Circuit Diagram

Clamper is a circuit where capacitor is connected in series with resistor and diode. The circuit is been shown in Fig 3.10. The input of VCO must be bounded from 0 to 3.5 V. This is the reason why clamper being used. The clamper being used to achieve the desire voltage been needed for VCO.

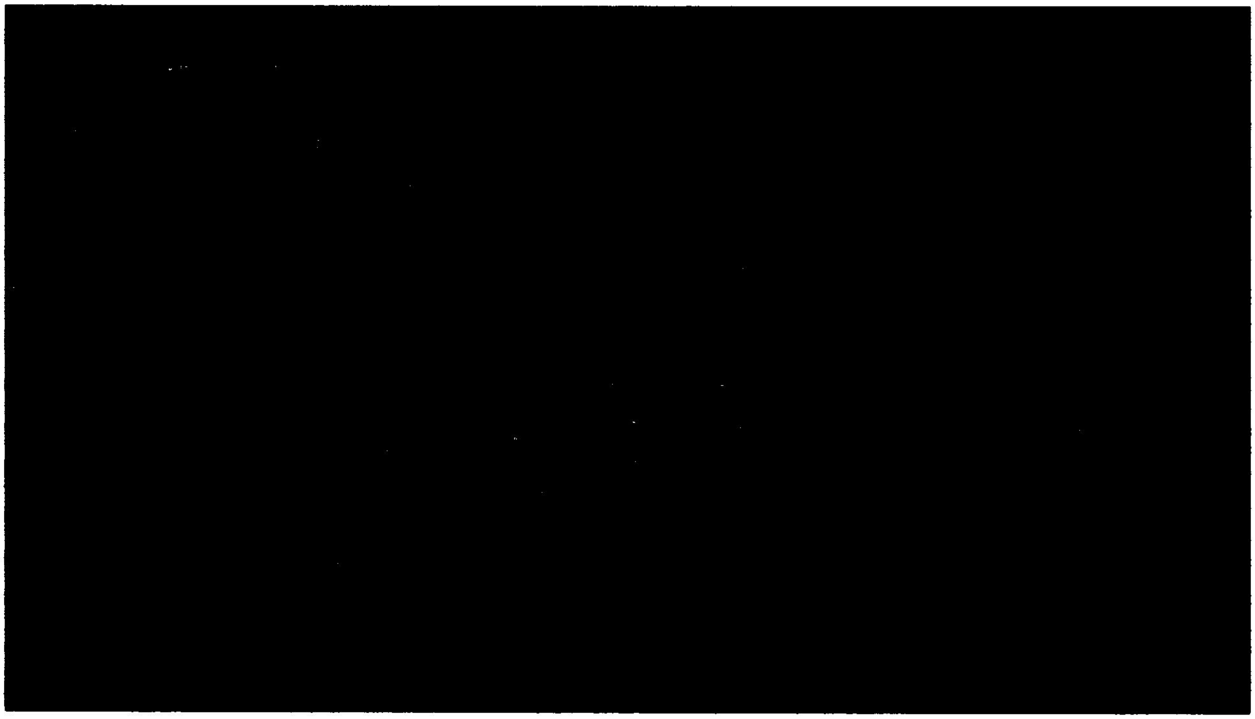

Fig 3.11: IF Circuit Diagram

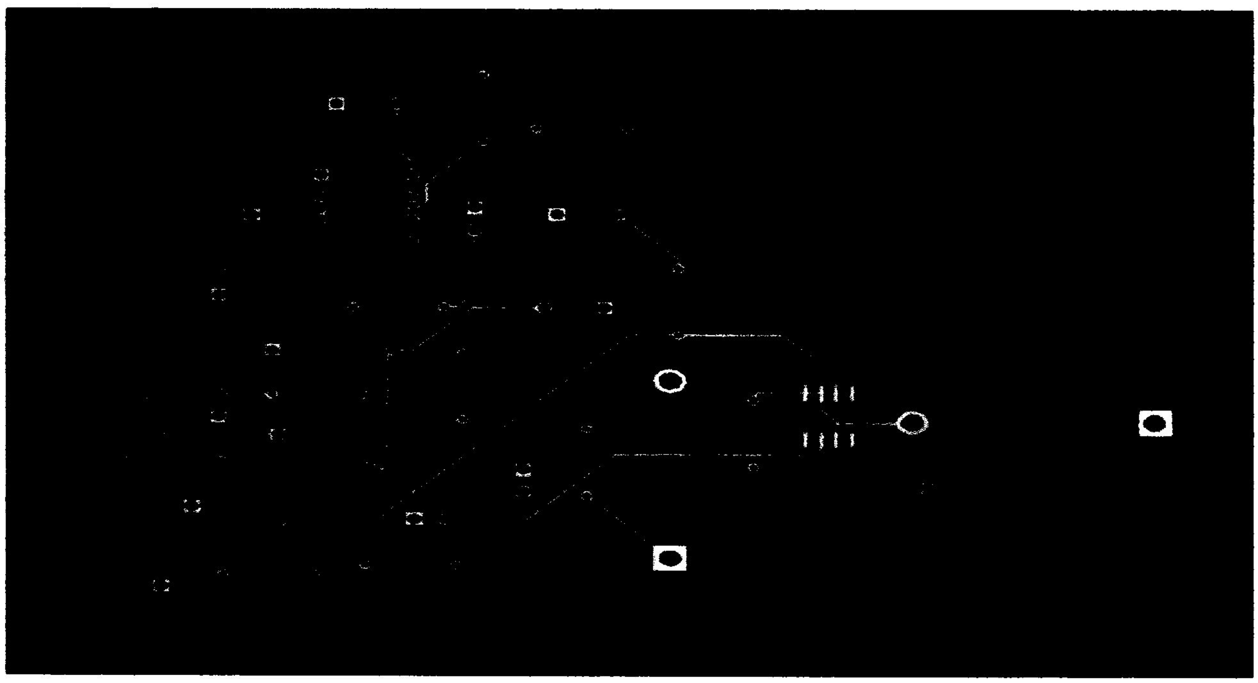

Fig 3.12: IF PCB Design

Fig 3.11 and Fig 3.12 is the Intermediate Frequency (IF) circuit diagram and the PCB design. The circuit has been constructed after merging the Triangular Wave Generator, Noise Generator, Mixer and Clamper Circuit.

3.3.5 RADIO FREQUENCY SECTION (RF)

Radio Frequency section is the most important part in this device where the output of this section will interface with the transmission of mobile signal. This section contains three parts which is: Voltage Controlled Oscillator, Power Amplifier and Antenna.

3.3.5.1 VOLTAGE CONTROLLED OSCILLATOR (VCO)

Fig 3.13: Voltage Controlled Oscillator

The most important part in this section is Voltage Controlled Oscillator. The reason it is important because Voltage Controlled Oscillator will generate the RF signal which will block the mobile signal transmission. The output of the Voltage Controlled Oscillator has a frequency which is proportionally with the input voltage. In this case, we can change the output frequency by changing the input voltage. There are three criteria to select a Voltage Controlled Oscillator:

a) Cover the bands that needed.

b) Low cost.

c) Run at low power consumption.

After some period of researching of the component, finally I found out that CVCO55CL is the suitable component for blocking the frequency range 935 to 960 MHz. Fig 3.13 shows the Voltage Controlled Oscillator image. The output power is up to 8dBm. The reason this component been selected because of these reasons:

a) Surface mount can reduce the size of product.

b) Large output power which can reduce the amplification stages.

c) Having the same value of power supply which is 5V.

d) Having same noise properties.

3.3.5.2 POWER AMPLIFIER

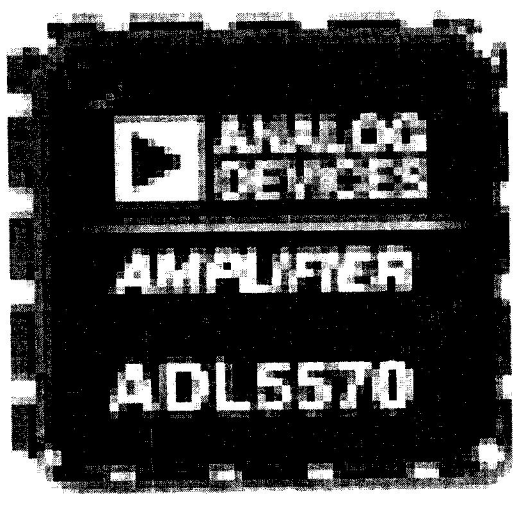

Fig 3.14: Power Amplifier

The power amplifier been used in this device is ADL5570 as shown in Fig 3.14. This power amplifier specification is suitable to be used in telecommunications devices. Therefore the specifications for the device are as follows:

a) Fixed gain of 29dBm.

b) Operate from 2.3GHz to 2.4GHz.

c) Power out 25dBm.

3.3.5.3 ANTENNA

Fig 3.15: Antenna

Antenna is a device which transmits a signal around it. So, in this case the antenna must be selected due to the project's objectives. The criterion is as follows:

a) Monopole antenna.

b) Input impedance 50Ω.

c) VSWR < 2 (Voltage Standing Wave Ratio).

d) Frequency 850 MHz to 1 GHz.

e) Range covered in 1meters.

This criterion is being chosen because the antenna must transmit the same frequency as the mobile signal frequency. The Image of the Antenna is being shown in Fig 3.15. When the ratio between the antenna frequency and the mobile signal frequency is 1:1, the mobile signal frequency will be blocked.

3.3.6 SUMMARY

This chapter explains the methods and the functionality of all the components that are used in the construction of this project. Development of Radio Frequency Jammer has three main parts which is Power Supply, Intermediate Frequency section and Radio Frequency section. The device operates when the power supply gives ± 12V to IF and RF section. The triangular wave regulator will regulate the triangular waveform as an input to RF section. The triangular wave and the noise signal will be mixed in the mixer for the RF so that it will transmit the desired noise frequency. The mixture of the signal then will be transferred to clamper so that the clamper will give the desired voltage range between 0 to 3.5V for Voltage Controlled Oscillator. Then the signal will be amplified at power amplifier at RF section and then transmitted as a high noise frequency range 935 to 960 MHz.

This criterion is been chosen because the antenna must transmit at the same frequency as the mobile signal frequency. Image of the Antenna is shown in Fig 3.15. When the ratio between the antenna frequency and the mobile signal frequency is 1:1, the mobile signal frequency will be blocked.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF RESULT

4.1 INTRODUCTION

This chapter explains the results of the project and the analysis throughout this project. It gives a detailed insight on the analysis and output of the project.

4.2 RESULT PRESENTATION

The Radio Frequency jammer has been tested against three mobile phone networks and against radio frequency receivers. The circuit has been constructed on a Vero board.

It was observed that the Transistor used in the project cannot function with reasonable gain above 800MHz the gain drops drastically thereby hindering the oscillations. The circuit's works very well from 300MHz to 750MHz, at this frequency it jams the Commercial TV stations from about 8 to 10 meters, and jams mobile phone frequency gradually from about 3 to 5 meters.

The jammer has been designed into three sections which are; power supply, IF section and RF section. The reason why the jammer was designed into three parts is because it gets easy when doing troubleshooting.

Since 5dBm output powers from the VCO do not achieve the desired output power of the GSM jammer, an amplifier with a suitable gain must be added to increase the VCO output to 34dBm. The PF08109B has high gain of 35 dB. As datasheets illustrated that this IC is designed to work on dual band GSM & DCS, the first design of the circuit is using only one power amplifier IC. Upon testing, the jammer didn't work properly. It was concluded that amplifier IC does not work at the two bands simultaneously. Such a fact was not indicated in the datasheets. This result was really a big shock, but easily solved by changing the whole RF design.

4.4 ANALYSIS

Mobile Detector for Smart Mobile Phone jammer was successfully used to jam three mobile operators. Which are MTN, ETISALAT and GLOBACOM. When the jammer is ON it will jam the mobile phones in that range that are using 2G GSM networks. This jammer did not function in 3G mobile phone because 3G use high frequency which is 2100MHz frequency while 2G only cover 815MHz to 925MHz.

The results show that this project functioned as intended. This testing is to see the duration of time taken by the jammer to jam the GSM phone between the operators. The testing has been done using three major mobile operators in Nigeria which are MTN, ETISALAT and GLOBACOM.

Based on the result and testing of the Mobile Jammer, the objective of this project has been achieved. The Mobile Detector Phone Jammer successfully jammed all the three operators but the radius of the range did not get as expected in the designed.

Results been obtained when the Development of Radio Frequency/GSM Signal Jammer was "ON", the mobile phone transmission signal will show "NO NETWORK" .

4.4.1 OUTPUT ON MOBILE NETWORK WITH RADIO FREQUENCY/GSM JAMMER "OFF".

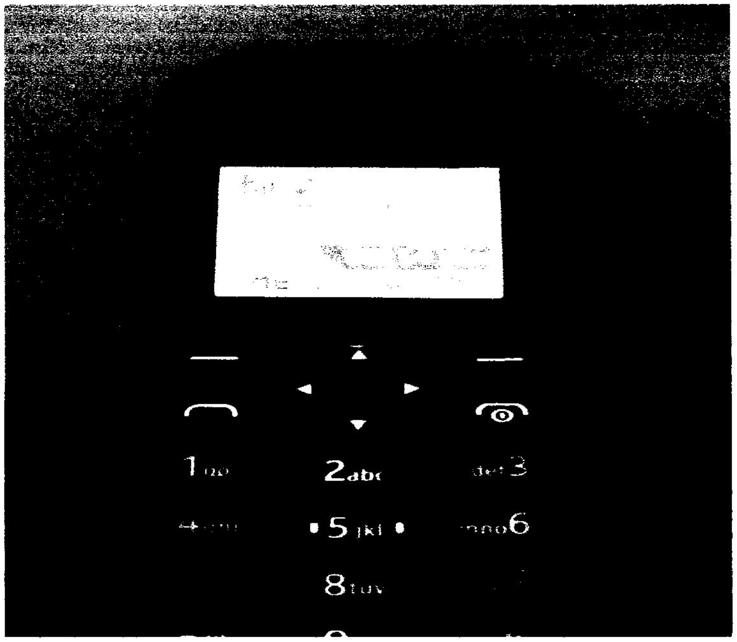

Fig 4.1: MTN Operator with Network Coverage

Fig 4.2: Etisalat Operator with Network Coverage

Fig 4.3: Globacom Operator with network coverage 38

4.3.2 Output on mobile network with Radio Frequency/GSM Jammer "ON"

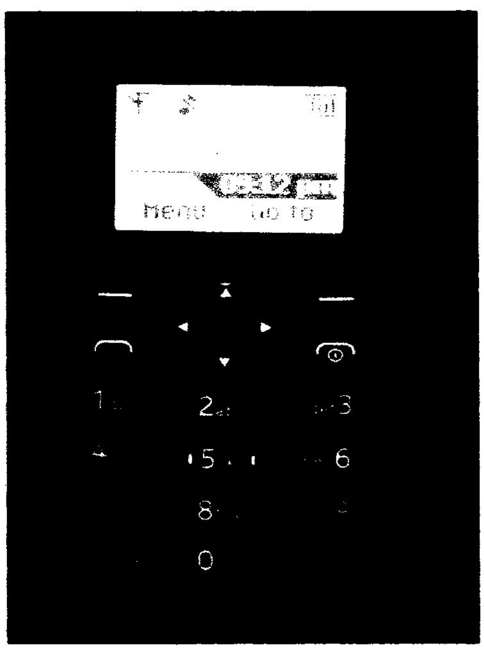

Fig 4.4: MTN Operator with No Network Coverage

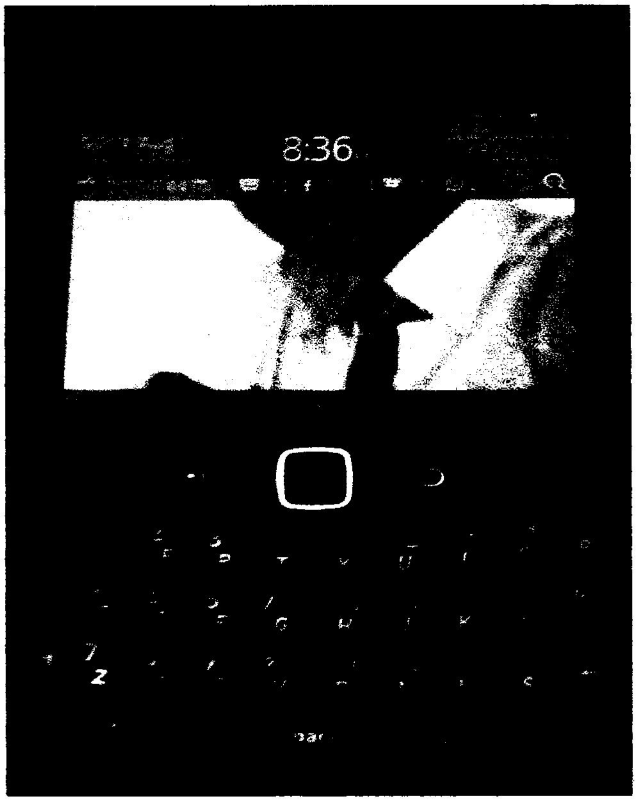

Fig 4.5: Etisalat Operator with No Network Coverage

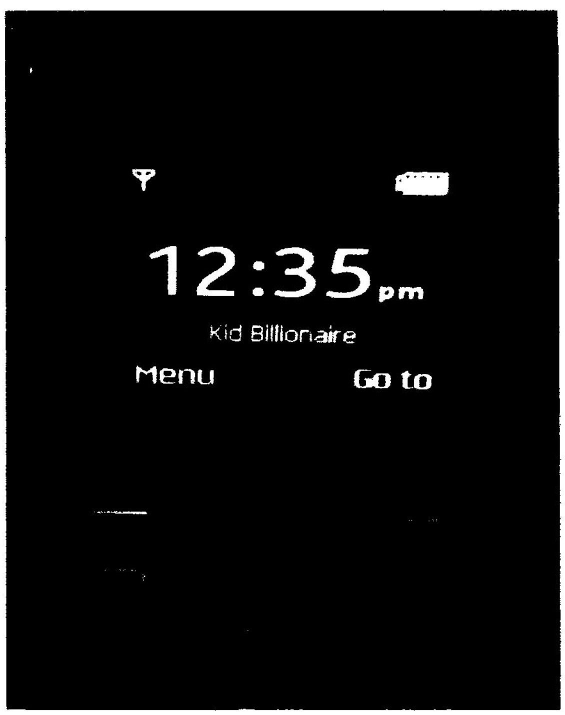

Fig 4.6: Globacom Operator with No Network Coverage

4.4 SYSTEM TESTING AND INTEGRATION

4.4.1 SYSTEM TESTING

After the construction and implementation phase, the system built has to be tested for Durability, Efficiency, and Effectiveness and also ascertain if there is need to modify this construction. The system was first assembled using a breadboard. All components were properly inserted into the breadboard from whence some tests were carried out at various stages. To ensure proper functioning of components' expected data, the components were tested using a digital multi meter (DMM). Resistors were tested to ensure that they were within the tolerance value. Faulty resistors were discarded .The 78LS05 voltage regulator was also tested. the resulting output was 5.02v which is just a deviation of 0.02v from the expected result of 5.00v.The LEDs were tested to ensure that they were all working properly.

4.4.2 TEST PLAN AND TEST DATA

This chapter entails an overall system testing of the integrated design of the voltage measurement device. The testing and integration is done to ensure that the design is functioning properly as expected thereby enabling one or even intended users for which the project was targeted for, appreciate its implementation and the approaches used in the construction and integration of the various modules of the project.

However, this involves checks made to ensure that all the various units and subsystems function adequately. Also there has to be a good interface existing between the input/output unit subsystems. When the totality of the modules was integrated together, the system was created and all modules and sections responded to as specified in the design through the power supply delivering into the system designed.

4.4.3 COMPONENT TEST

Similar components like resistors were packed together. Other components includes capacitor, preset switches, transformer, diodes (rectifier) LED, transistor, voltage regulator etc.

Reference was made to resistor color code data sheet to ascertain the expected values of resistors used. Each resistor was tested and the value read and recorded. The collector, base and emitter junctions were tested in the following order. The collector, emitter and base pins were gotten from the data analysis on power transistor.

Table 4.1 Test for Transistor

	Black probe	**Red probe**
1st test on pins	Collector	Base
2nd test on pins	Emitter	Base

4.4.4 SYSTEM FINAL TESTING

After construction of the device, it was taken to the electronics laboratory for testing, this was necessary because the device had to be tested with a varying input supply voltage, this was to enable us to determine the system's ability to provide protection to the equipment connected to it. The system was powered and operated upon using several possibilities. They include plugging and unplugging the mains and noting the output responses of the system hardware. The system delays and allows output alongside the corresponding LED in the seven segments.

The actual testing is not just to block the transmission signal but to check the duration of the time taken by the device to block the transmission between these three operators MTN, ETISALAT and GLOBACOM. From the testing, the time taken for the device to block the transmission between these three operators was totally different. The duration of the time taken for the device to block the transmission is shown in table 4.2 below:

Table 4.2: Duration Time Taken to Block the Transmission

OPERATORS	MTN	ETISALAT	GLOBACOM
DURATION (SECONDS)	**55**	**37**	**87**

The power of the operator at the mobile phone is different which makes the duration time taken to block the transmission also different. ETISALAT operator has the closest power to the device which makes it to be blocked faster than others.

4.5 EXPERIMENTED RESULT VS ACTUAL RESULT

Table 4.3 Experimented Values VS Actual Values

COMPONENTS	EXPERIMENTED VALUE	ACTUAL VALUE	UNIT	TOLERANCE
Capacitor	10 10 30	10.20 10.15 29.82	μf μf μf	
Transistor	R_{be} 520 R_{be} 510	550 548	Ω Ω	
Transformer Voltage	**12Vac at 240Vac Input**	**13.2 at 210**	**Volt** **Volt**	
Regulator	**5.00**	**5.20**	**Volt**	

Packaging of Radio Frequency/GSM jammer is as shown below

Fig 4.7: The Circuit without the Amplifier

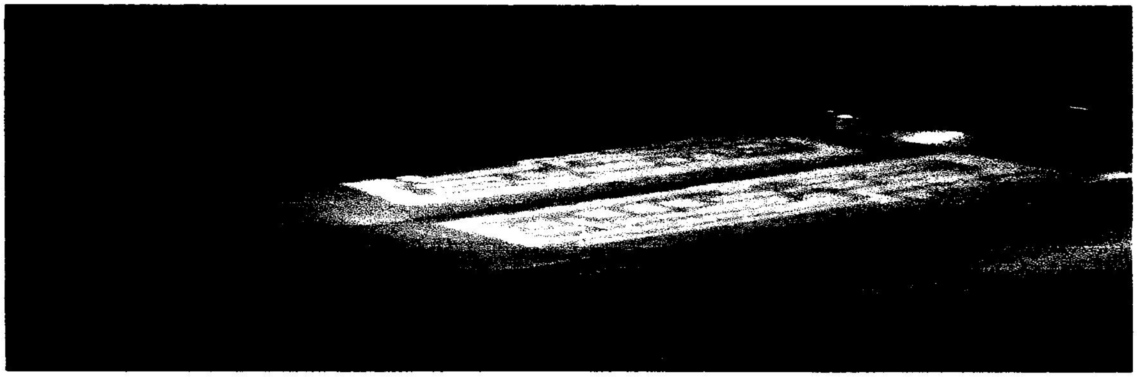

Fig 4.8: The Etching Process with Hydrochloric and Peroxide

Fig 4.9: The Bread boarding stage (experimenting)

The Circuit with Two Stage Amplifiers

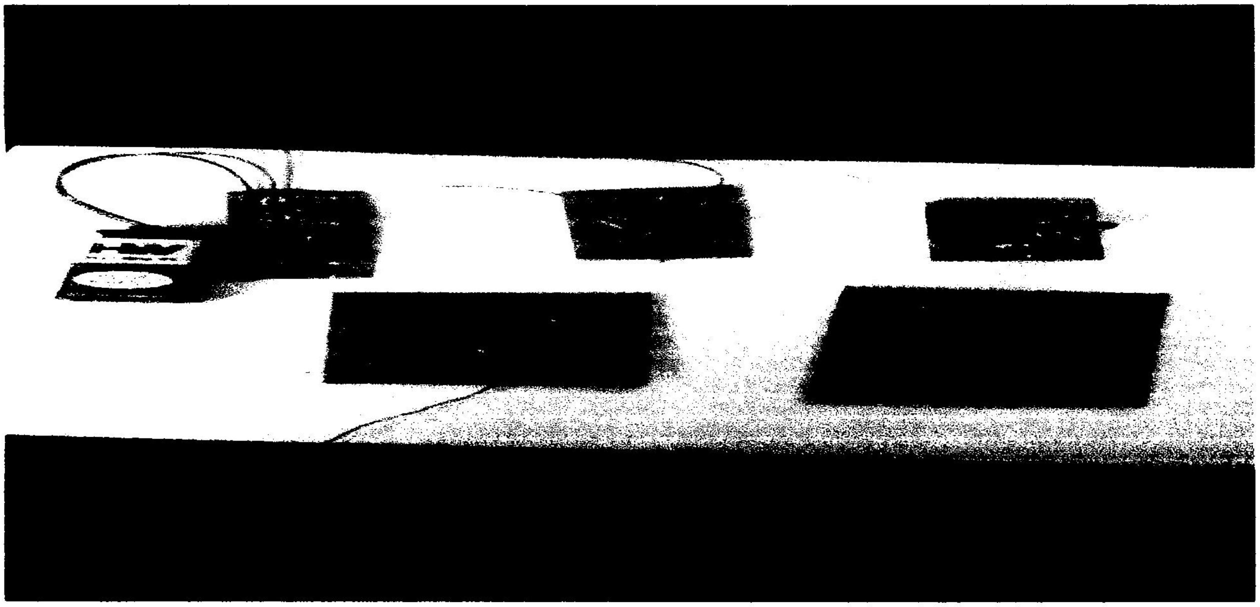

Fig 4.10: Five Others Built That Couldn't Reach 900 MHz

4.6 SUMMARY

Based on the result and analysis, The Project was able to jam the commercial broadcasting TV networks which cover from 300 to 800 MHz, with the right Transistor I will be able to achieve the 900MHz to 1800MHz.

Although the device can operate as expected, but the radius of the antenna did not meet the expectation. The radius should be more than obtained result which is 4 meter.

CHAPTER FIVE

SUMMARY OF ACHIEVEMENT, PROJECT LIMITATION, RECOMMENDATION AND CONCLUSION

5.1 SUMMARY OF ACHIEVEMENT

With a little more stress of soldering the components together, I was able to assemble the components according the paper design. At the end, I was able to produce a functional circuit that is well fit in its place.

I was able to make it work using my own specifications. It was not so easy getting to identify the entire components after I took them to my hostel, all mixed up in a container. Sorting them was a great problem. This problem I had is common to majority of engineering student. This is due to the fact that we do not engage in practical more often. I thereby suggest that a good mix of academic activity will be made up of theory and practice. This should be drafted by those that design the school curriculum to assist the student in the technical aspect of their academics.

5.2 PROJECT LIMITATION

1. Wireless signal jammer is an illegal device to be used in Nigeria as the frequency that is been used by the operators are legally given by the National Communication Commission (NCC).
2. The components are hard to find and expensive.
3. The radius covered by the device is too small.
4. Lack of Rf oscilloscope
5. Lack of military grade components
6. Cost of the materials involved
7. Power supply failure was an annoying set back

8. Lack of Rf testing equipment's. Like inductance and capacitance meters
9. This above made the circuit building expensive and time consuming

5.3 RECOMMENDATIONS AND CONCLUSION

From the challenges i encounter while working on this project I will advise anybody trying to embark on this project should study the working principles of Rf circuits and their characteristics, secondly the task of building a circuit that you can visualize it working mode makes inevitable to use rf oscilloscope which is relatively expensive.

In conclusion though the work was tasking, expensive and time consuming it was added advantage for me. because i was able to go beyond the walls of the classroom into a field many people run away from high frequency electronics. The project was able to jam the commercial broadcasting TV network which covers from 300 to 800 MHz; with the right transistor i will be able to achieve the 900 MHz to 1800 MHz.

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APPENDIX A

List of Components

1. Transistor = 2SC3355
2. MMIC = RF amplifier
3. Resistors = 10k,560R,47k,100R,220R,3.3K
4. Capacitors = 1pf,2pf,100nf,1nf,8pf,22nf, variable capacitor (2-10pf)
5. Inductor = 2nH,10nH, 20uH,
6. Antenna = 16cm copper wire
7. PCB board
8. Patteress for casing
9. Switch
10. Battery clip for 9volts battery
11. Soldering Iron
12. Solder Lead
13. Razor blade

APPENDIX B

Bill of Engineering Measurement and Evaluation

S/ N	NAME OF ITEM	QUANTITY	UNIT PRICE (₦)	AMOUNT(₦)
1	Vero Board	1	150	150
2	Connecting Wire (inches)	12	10	120
3	One way Power Switch	1	30	30
4	30 Amp Fuse	1	30	30
5	30 Amps wall Plug	1	50	50
6	Soldering Lead (inches)	12	20	240
7	Soldering Iron	1	800	800
8	LED	1	10	10
9	230V/ 60V Transformer	1	300	300
10	12V D.C battery	1	120	120
11	IN9004 diode	1	50	50
12	IN4004 diode	4	50	200
13	750Ω resistor	6	30	180
14	100Ω resistor	5	30	150
15	1KΩ resistor	3	30	90
16	2KΩ resistor	3	30	90
17	22KΩ resistor	3	30	90
18	100KΩ resistor	3	30	90
19	12μF Capacitor	2	40	80
20	103μF Capacitor	5	40	200
21	104μF Capacitor	6	40	240
22	134μF Capacitor	3	40	120
23	220μF Capacitor	3	40	120
24	1000μF Capacitor	4	40	160
25	LM555 IC	2	80	160
26	LM741 IC	2	150	300
27	LM386 IC	1	150	

28	LM7805 IC	1	150	150
29	LM117 IC	1	150	150
30	LM7812 IC	1	150	150
31	LM7912 IC	1	150	150
32	CVC055CL Voltage	1	600	150
	Controlled Oscillator			600
33	Crystal Oscillator	2	400	
34	850MHz -1 GHz monopole	1	1200	800
	antenna			1,200
35	Radio receiver antenna	1	150	
36	3×2.5mm wire (inches)	10	30	150
37	Casing	1	4,000	300
38	Painting &Fabrication	1	3000	4,000
39	Miscellaneous Expenses	1	5000	3000
	(Transportation & burnt			5000
	components)			
			TOTAL AMOUNT (₦)	20,120.00