

ON THE PHYSICS OF GSM JAMMER AND ITS APPLICATION IN LECTURE THEATERS

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ABSTRACT

The design and construction of a dual-band mobile-phone jammer was thoughtfully carried out to sense phone network signals and to automatically activate it so as to de-activate the incoming or outgoing phone network signals. This jammer was designed to work at GSM 900MHz and GSM 1800MHz simultaneously and thus jams the four well-known network carriers in Nigeria (MTN, GLO, Etisalat and Zain.) as applied to lecture halls. It is evident from the results that the designed GSM jammer disabled mobile cell phone carriers.

KEYWORDS: designed GSM jammer disabled mobile cell phone carriers.

INTRODUCTION

The use of mobile phone is at the increase and globally appreciated as it makes the world a global village. In spite of its advantages, mobile phones are sometimes misused especially in the lecture halls, worship centres, movies theatres, concerts, shopping malls, all suffer from the spread of cell phones because not all phone users know when to stop talking. These are serious distractions. In this article a cell phone jammer is designed for use in Federal university of technology Minna to control and reduce the distractions in some specific places especially in lecture halls where the use of cell phone is undesirable. A mobile phone (GSM) jammer is an instrument used to prevent cellular phones from receiving signals from base stations. When used the jammer effectively disables cellular phones. These devices can be used in practically any location, but are found primarily in places where a phone call would be practically disruptive because silence is expected. These were originally developed for law enforcement and the military to interrupt communications by criminals and terrorists. (Scourias, 1997) Some were also designed to foil the use of certain remotely detonated explosives (Jisrawi, 2006). The civilian applications were apparent, so over time many companies originally contracted to design jammers for government used 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. As with other radio jamming, the cell phone jammers block cell phone use by sending out radio waves along the same frequencies that cellular phone use (Adediran, 2004). This causes enough interference

with the communication between cell phones and towers to render the phones unusable. The jamming becomes successful when the mobile phone is disabled from making or receiving calls and other smart phone activities (sending or receiving text messages and receiving internet services). Cell phones use one band to send signal to the base station (upward signal) and another band to receive signal from the base station (downward signal). Mobile phone can be disabled via interrupting any of these signals. Because the distance to the base station is larger than the distance to mobile phone that needs to be blocked, it needs less energy to block signal from base station to phone (Zanger 2002). The signal from the transmitter is always far away from the receivers in the jammer's area, this makes the signal from the transmitter to be very small in that area. The jammer, on the other hand, has a "large" signal in that area because it is so close to the receivers and therefore becomes more effective to disable signal between the transmitter (tower) and the receiver (mobile phone) [Scourias, 1997].

THEORY

As with other radio jamming, the cell phone jammers block cell phone use by sending out radio waves along the same frequencies that cellular phone use. This causes enough interference with the communication between cell phones and towers to render the phones unusable. The mobile phone jammer works on the concept of blocking mobile phones and unable to communicate to the base station thus prevents mobile phone from receiving or establishing any call.

It transmits signals on the frequency which mobile phone uses. This way mobile phone jammer creates disturbance (Noise) for the mobile phones. Mobile phone uses different frequencies for listening and talking. The Jammer blocks any one of this frequency by transmitting relatively high power signals (noise) on the same frequency which the mobile phone operates. When these two frequencies meet they cancel out each other. [Bueche, 1986]. Because of this high power signal (noise) transmission of the jammer, a mobile phone cannot identify the signal from the base station and then

it keeps searching for signal and so it can be seen on the mobile phones display screen "no network coverage" or "searching for network" or "no service".

There are two (2) types of signals, one is mobile phone to base station and another is base station to mobile phone. Jammer generally tries to disturb base station to mobile phone signal because base station are far away from the mobile phone, the signal coming from them that reaches the mobile phone is of low power. So it is easier for the jammer to disturb base station to mobile phone signal. Superposition can be defined as when two or more separate disturbance arrives at a point simultaneously the resultant disturbance is the vector sum of the individual disturbance [Bueche, 1986]. The vector sum may either be Constructive Interference i.e. all the disturbance are summed up to form a larger disturbance (frequency) or Destructive Interference i.e. the disturbance cancels out each other. The general rule of power for a transmitter getting to a receiver (the magnitude of electromagnetic signal) is that the signal strength is going to be the inverse square of the distance from that transmitter [Scourias, 1997]. That means that if you have "x" amount of signal at a given spot from a

transmitter and then double the distance from the transmitter, the signal will be

$$X = \frac{1}{d^2} \quad (1)$$

Where

X, is the amount of signal

d, is the distance from the transmitter i.e. from the base station

Doubling the distance by two it becomes,

$$\frac{1}{2d^2} \text{ or } \frac{1}{2^2} \text{ or } \frac{1}{4}^{\text{th}} \quad (2)$$

Showing the amount had before. Double the distance again and you have down to $\frac{1}{16}^{\text{th}}$ the original amount of

signal.

MATERIALS AND METHODS

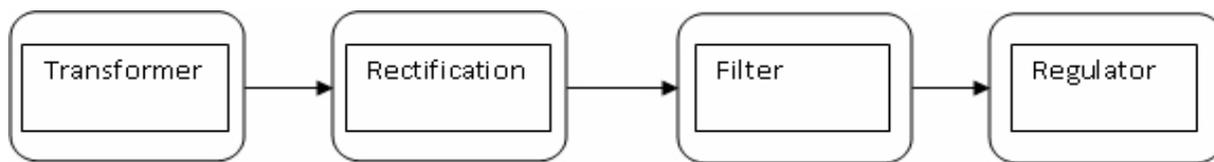
Table 1. list of materials used for the construction of the Jammer

S/N	COMPONENTS NAME	QUANTITY NEEDED	SPECIFICATION
1	Battery	1	12V/7AMP
2	Switch	2	250V/AAC
3	Capacitor1	12	10nF
4	Capacitor2l	7	470Pf
5	Capacitor3	10	20pF
6	Capacitor4	12	1nF
7	Capacitor5	8	100nF
8	Capacitor6	12	47pF
9	Capacitor7	2	2pF-30pF (variable)
10	Capacitor8	11	25pF
11	Inductor	20	30μH
12	Inductor	8	50μH
13	Inductor	15	20μH
14	Inductor	12	10μH
15	Inductor	10	2μF
16	Transistor	6	BC337
17	Transistor	6	BFW30
18	Resistor	12	10KΩ
19	Resistor	12	47KΩ
20	Resistor	12	22KΩ
21	Diode	8	1N4007
22	Regulator	1	LM7812
23	LED	6	12V

Experimental set-up



Fig (1) Circuit Block diagram of Power Source .and Jammer



Fig(2) shows the general parts of the power supply.

The power module supplies the other sections with the needed voltages. The power supply consists of the following main parts:

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

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

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

(iii) 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.

(iv) Regulator: this is used to provide a desired DC-voltage.

In our project we needed a 12 volts power supply and we found a 12 volt, 7amp DC battery so we bought one while we design a 12 volt regulated AC source to charge the DC battery

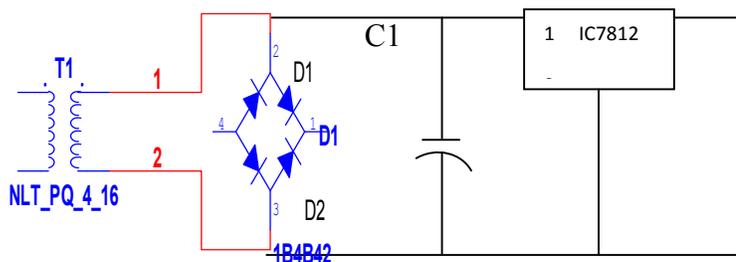


Fig (3) Bridge rectifiers

Jammer

Noise frequency is being generated at a very high

frequency so as to interfere with the mobile phone signal. This section consist of six (6) sub modules as listed below

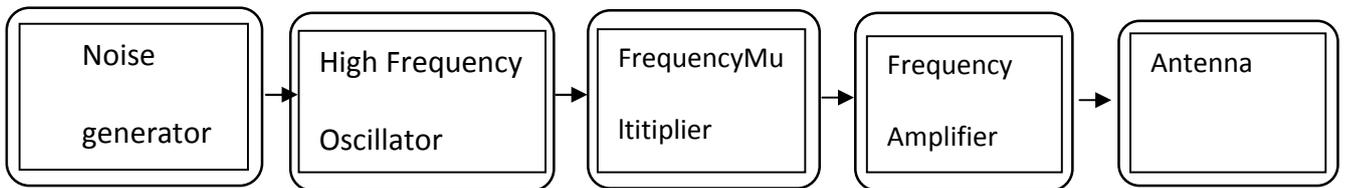


Fig (4) circuit block diagram for the Jammer section.

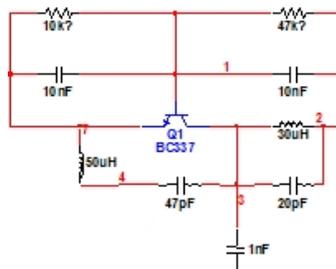


Fig (5) Noise generator

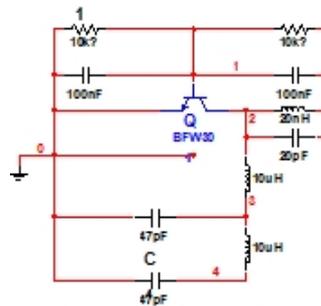


Fig (6) High frequency oscillator

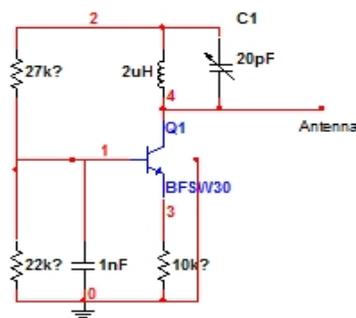


Fig (7) Frequency amplifier/multiplier

(i) The Noise Generator:

The noise generator is an oscillator made to generate high frequency up to 4MHz to interfere with the mobile signal.

(ii) RF Oscillator (High frequency oscillator)

The high frequency is an oscillator which generates frequency within the bandwidth of 200MHz to 700MHz with the help of the LC circuit which is parallel to each other. The transistor Bfw30 having a frequency response of 1-1.7GHz, possess the potential to amplify the high frequency.

(iii) Frequency Multiplier.

The frequency multiplier is a device in the system that increases the number of the frequency. The frequency generated in this circuit is about 650MHz but when it gets to the frequency multiplier section, the frequency is amplified to twice its initial value .i.e ($650 \times 2 = 1300$) MHz or 1.3GHz. Therefore, this enables the frequency of the signal jammer to interfere with that of the mobile phone.

(iv) Frequency amplifier

Frequency amplifier is a common base amplifier which has low impedance and has high output impedance, in which the collector is connected to the tank circuit which also forms the circuit load. The output impedance is as high as $50K\Omega$, the amplifier can respond to frequency from a very low value to a high value of 1.3GHz.

(v) Antenna

A proper antenna is necessary to transmit the jamming signal. In order to have optimal power transfer, the antenna system must be matched to the transmission system and the antenna must be Omni directional. In this project, we used $1/4$ wavelength cooper wire antennas, so that the antenna can match the system

Methodology.

The components were arranged on Vero board (according to the design specification), soldered and encased to give a good finishing . The 220/240 AC main (PHCN) was stepped down using a 12volts step down transformer and then rectified to 12volts direct current (DC) power supply using a full bridge rectifier system. The ripples associated with the 12volts DC was taken

care of using a smoothing capacitor. The DC supply is further regulated to a constant DC of 12volts supply with the use of a regulating IC (LM7812). This regulated power source is used to charge the DC battery.

The 12volts DC was fed into the sensor section. The sensor section consists of 555timer, resistors, capacitors and a transistor (C3355). The transistor functions as a gate when the sensor senses a signal; it opens the gate to activate the jammer.

When the jamming section is activated, the 12 volts DC is fed into the noise generator. The noise generator consists of resistors, capacitors and a transistor (BC337) which are used to generate noise signal (destructive wave) at a very high frequency. The 12volts DC was also fed into the RF Oscillator circuit (High Frequency Oscillator) section which consists of resistors, capacitors, inductors and a transistor (BFW30). This section is used to generate an oscillation within the bandwidth of 200MHz to 700MHz with the help of the RC circuit which is connected in parallel to each other. The transistor BFW30 having a frequency response of 1-1.7GHz, therefore posses the potential to amplifier the high frequency signal.

Now the two signals generated .i.e. noise generated signal and the high frequency oscillator signals are then summed up (mixed). Hence the two signals are modulated to yield a frequency close to the frequency modulation (FM) signal. The FM signal is then fed to the frequency multiplier section which multipliers the frequency by twice its initial value. The multiplied frequency is then fed to the frequency amplifier section which consists of resistors, capacitors, inductor, transistor (BFW30) and a variable capacitor used to amplifier the signal which is then sent to the antenna which transmits the signals at $1/4^{\text{th}}$ of its wavelength. The construction was first carried out by building the proto-type of the design on a breadboard. Basically, the process was aimed at correcting errors; so that unsuitable design or components can easily be changed for better performance. The arrangement on the breadboard allowed for the detection of components to be changed (replaced) and also give room for the calculation to be made to obtain the desired frequency for the construction.

Careful planning of the circuit layout on the board by use of matrix simplifies wiring, minimized errors and ease troubleshooting. Overall circuit layout was made parallel so as to conform to orderly schematic diagram of the circuit. All

transistors and integrated circuit used were positioned on the basis of their pins configuration for logical signal flows and this makes it easy to keep track of pin number during wiring and

troubleshooting. The continuity on the Vero board was cut with the aid of precision screw driver as desired. The device was packed into a small plastic casing.

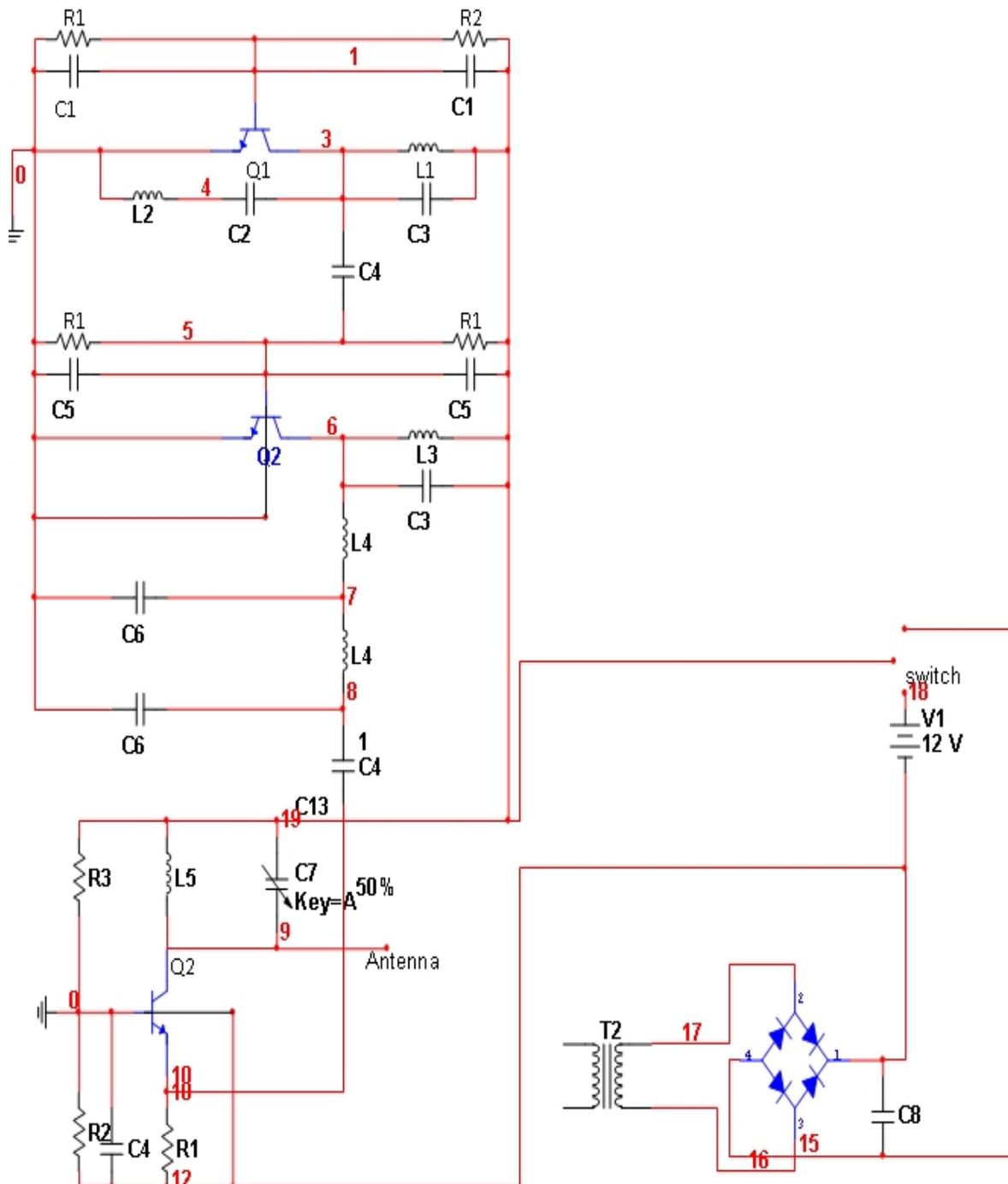
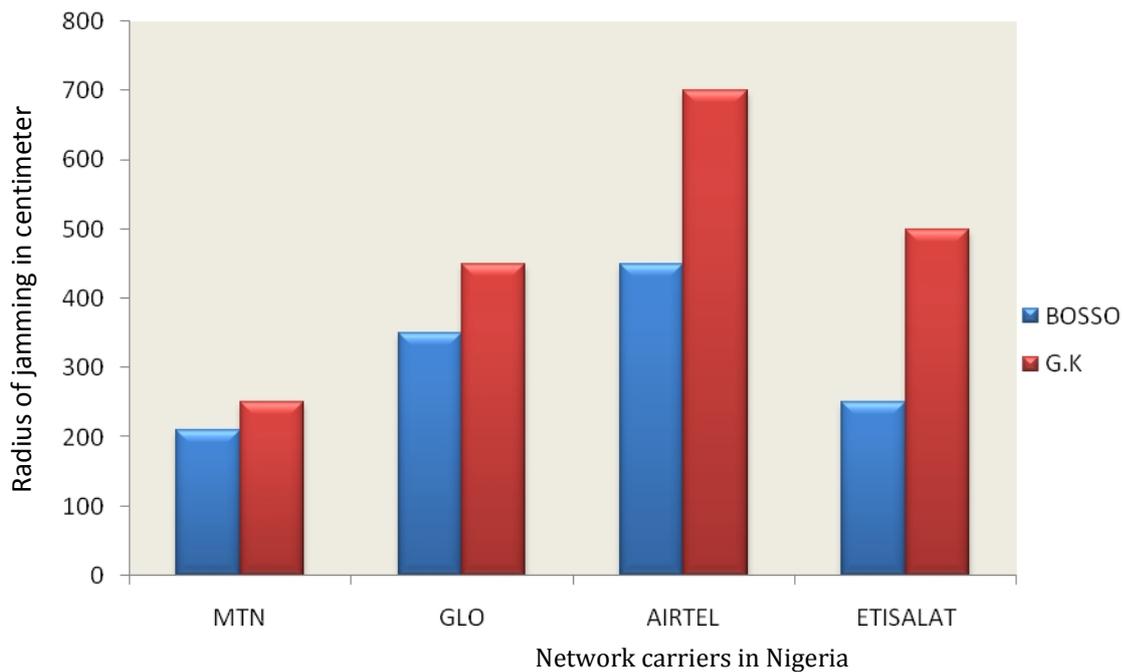


Fig (8) Circuit diagram for mobile phone signal jammer

RESULTS AND DISCUSSION

Network Name	Distance of signal jamming in Bosso campus (cm)	Distance of signal jamming in Gidan Kwano campus(cm)
MTN	210	350
GLO	350	450
AIRTEL	450	700
ETISALAT	250	500

Table (2) showing jamming distance for various networks



Fig(9) Bar chart showing the jamming strength for various network in Bosso and Gidan Kwano Campus

 Red indicates jamming radius at Gidan Kwano Campus.

 Blue indicates jamming radius at Bosso Campus.

TEST.

When the jammer was switched ON, we observed that between 30 to 50secs the network bar on the mobile phone within the radius of the jammer was swapped OFF (disappeared) as shown in figures (11b, 12b, 13b and 14b) below. While the jamming device was still ON, we tried calling the mobile phones in figure (11b, 12b, 13b and 14b) with another mobile phone from outside the jamming area. It was observed that the mobile phones in figure (11b, 12b, 13b and 14b) were connected, and the network service providers

were responding that the user is not reachable. We further tested the effectiveness of the jamming device by trying to call other mobile phones outside the jamming area with the mobile phones in figure (11b, 12b, 13b and 14b). We also observed that the mobile phones of figure (11b, 12b, 13b and 14b) showed out of network coverage. This implies that the signal has been jammed which can be resets manually as shown in the figures below. It can be clearly seen that the signal was "ON" when the jammer was "OFF", the signal disappeared when the jammer was "ON".

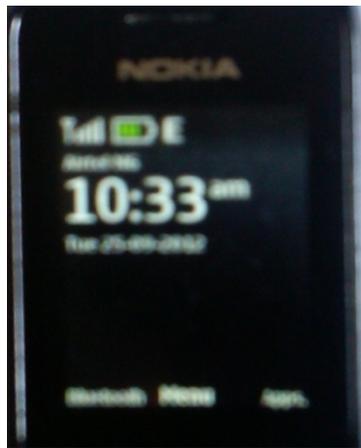
Fig (11a) Jammer OFF (MTN)



(11b) Jammer ON (MTN)



Fig (12a) Jammer OFF (Airtel)



(12b) Jammer ON (Airtel)



Fig (13a) Jammer OFF (GLO)



(13b) Jammer ON (GLO)

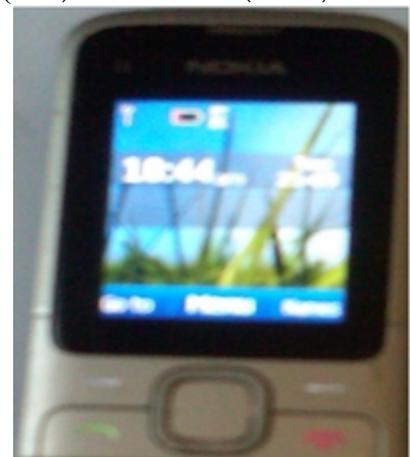
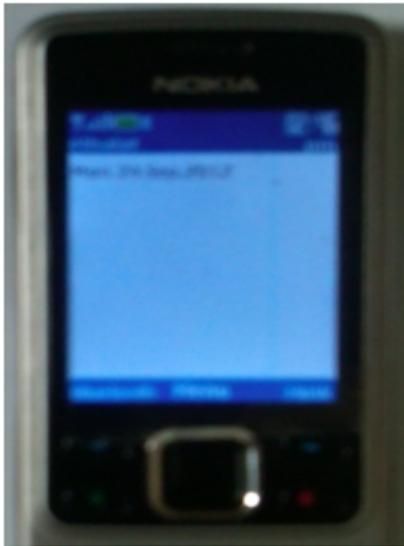
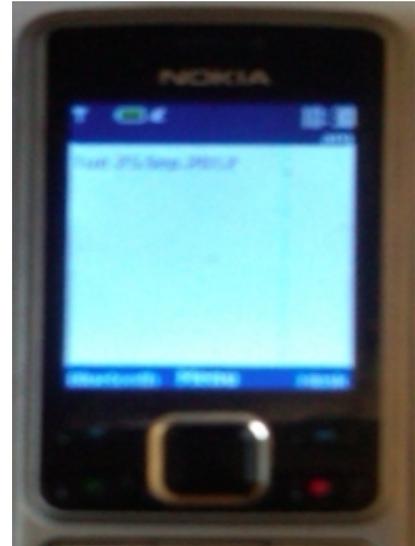


Fig (14a) Jammer OFF (etisalat)



(14b) Jammer ON (etisalat)



DISCUSSION

The bar chart in figure (10) above shows the jamming strength of both Bosso and Gidan Kwano Campuses of Federal University of Technology Minna, Niger State, Nigeria. It is obvious from table (2) above that MTN has the lowest radius of jamming in Bosso. This is because of the fact that the base station (mask) is located at Bus park right inside the campus which is about 15 meter away from where the device was tested. In Gidan Kwano the radius of jamming covers a wider range this is because the base station (mask) is far away from the location where the device is tested. This implies the jammer is more effective in Gidan Kwano campus than in Bosso campus for MTN network as seen in the bar chart in figure (10) above. It is evident in table (2) above that the jamming radius for GLO is higher in Gidan Kwano Campus than in Bosso Campus. This is due to the fact that the base station (mask) for GLO in Bosso Campus is about 2km away from reference point while in Gidan Kwano the base station is about 4km away from reference point. This shows why the jammer was more effective in Gidan Kwano Campus than in Bosso when used in jamming GLO network.

The same reason applies to Airtel which has the highest radius of jamming in both Bosso and Gidan Kwano Campus as can be clearly seen in the bar chart above when compared with other networks. This is because the nearest base station (mask) is 4km away in Bosso Campus from reference point. While in Gidan Kwano the base station (mask) is about 5km away from reference point. This accounts for the wider range of

jamming for Airtel network in both Bosso and Gidan Kwano Campuses.

As for ETISALAT, the nearest base station (mask) is averagely 1.3km away from our reference point in Bosso campus. This is the reason ETISALAT was the second network with the lowest radius of jamming in Bosso Campus. While in Gidan Kwano Campus the nearest base station (mask) is about 3km away from where the jammer was tested this shows why the jammer was more effective in Gidan Kwano as can be clearly seen in the bar chart in figure (10) above.

It is evident from the bar chart that the closer the mobile phone is to the base station, the more the decrease in the jamming distance and vice versa as clearly seen in table (2) above. This is due to the fact that Radio wave frequency (EM wave) tends to zero as it moves away from the source that produces it. The jamming distance for various networks varies from place to place this explains why the differences in radii of jamming for MTN, GLO, Airtel and Etisalat. Another factor that is responsible for the variation in jamming distance is that network service providers transmit at different frequencies [Flood, 1997]. The effect of the jamming is explained as it affects signals as follows fig (11a) above. It can be clearly seen that the mobile phone signal bar was fully ON when the jammer was OFF, and in fig (11b) it is evident that the signal bar of the mobile phone disappeared when the jammer was ON for MTN. The same was observed for Airtel in fig (12a) and fig (12b), GLO in fig (13a) and fig (13b) and ETISALAT in fig (14a) and fig (14b) respectively. These show the effectiveness of the jammer; it

wipes the network bar on the screen of the mobile phones.

CONCLUSION

It is evident from the results that the designed GSM jammer disabled mobile cell phone carriers, MTN, GLO, AIRTEL, and ETISALAT from receiving signals in lecture theatres. The designed device works in dual bands. It jams both the GSM 900 and GSM 1800 bands. The device can also be applied to places where phone calls are restricted.

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