DESIGN AND CONSTRUCTION OF MOBILE PHONE DETECTOR

BY

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(EE/06/0594)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING, SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY MODIBBO ADAMA UNIVERSITY OF TECHNOLOGY YOLA

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A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING, SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY MODIBBO ADAMA UNIVERSITY OF TECHNOLOGY YOLA, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF BARCHELOR OF ENGINEERING

DECEMBER 2012

DECLARATION

I hereby declare that this project was written by me and it is a record of my own research work. It has not been presented before in any previous application for a bachelor's degree. References made to published literature have been duly acknowledged.

.... Date....................................

OLOYO, LAWAL OLAJIDE

(Student)

The above declaration is confirmed

.... Date.....................................

Dr S.Y MUSA

(Supervisor)

CERTIFICATION

This project entitled “**DESIGN AND CONSTRUCTION OF STANDBY / OFFLINE MOBILE PHONE DETECTOR**” by; **Oloyo, Lawal. Olajide (EE/06/0594)** meets the regulations governing the award of bachelor’s degree of the federal university of technology, Yola, and is approved for its contribution to knowledge and literary presentation.

.... Date.......................................

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(Supervisor)

.... Date..

Engr. I. M. Visa

(HOD)

.... Date..

Prof E.E OMIZEGBA

(External Examiner)

DEDICATION

This project report is dedicated to Engr and Mrs. O.F Shittu

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ABSTRACT

The design and construction of mobile cell phone detector is presented in this report. This handy mobile transmission detector is capable of sensing the presences of mobile cell phones from a distance of one and half meters. So it can be used to prevent use of mobile phones in examination halls, banks, airports, etc. It is realized by assembling the circuit on a general purpose PCB as compact as possible and enclosed in a small box. The moment the devices detects RF transmission signal from mobile phone, it starts sounding a beep alarm and the LED blinks. After construction the device was tested and found to be working satisfactory.

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CHAPTER ONE: INTRODUCTION

1.0 BACKGROUND

Mobile phones (or cell phones, smartphones, etc.) have become an integral part of our daily lives. Many people find it very difficult to imagine life without the possibility of making a quick call from wherever they might be (or, better said, as long as they are within the specific area covered by their mobile operator). Furthermore, most mobile phones are capable of providing a whole range of extra-functions, from the capability of taking photos and shooting video clips to music playback, internet browsing, recordings, data messages and a lot more. Since the discovery of the solid state electronics, the research in the area of electrical out fits which operates on the detection of transmitted signals, has received an unknown growth with other security discoveries. In view of the high level of criminal and illegal activities, there is need for better security alerting system. The engineering field has made various effects to help teaming populace to be more conscious about themselves and their environments.

1.1 STATEMENT OF PROBLEM

Cellular phones, and other mobile phones, are convenient, but sometimes their use creates very serious problems.The use of mobile phone constitutes the following.

- Health and safety concerns**:** Due to electromagnetic interference (EMI) from cell phones, nearby sensitive electronic equipment can malfunction. Important patient-care equipment fails to perform properly, putting patient at risk.
- Power plant equipment malfunctions, causing power failure.
- Privacy and security concerns: Obtaining confidential information becomes much easier.

- Unlawful activities: Such as examination mal practices and other illegal activities.

1.2 OBJECTIVES

The objective of this study is to design and construct a cell phone detector which would be able to sound an alarm of the presence of a mobile cell phone, in areas where the use of mobile phone is prohibited. The phone can be activated, standby or offline mode.

1.3 SIGNIFICANCE

Before the advent of modern communication system, man made use of crude method of sending messages to their neighbors. Today man has been able to design circuits, which can transmit or receive information in the form of voice, video and data messages and recording. Hence the main significance of this study is to channel this technology towards alertness of the security and surveillance system at areas where uses of mobile cell phone are prohibited such as Banks, Prisons, Security Services Firms, Examination rooms, Detention Facilities, Police Departments, Gaming Facilities and other places where the use of mobile phones can be a threat to security.

1.4 SCOPE OF STUDY

With mobile phones getting smaller, they are increasingly being use in areas where they may compromise security. This is also becoming the preferred medium for bugs and other surveillance devices. To combats these problems, this project have developed the mobile phone detector which is design to sweep varying areas, by detecting activities from mobile phone transceivers. The scope of this research is thus to:

1. Design a circuit that will detect mobile phones usage at standby or offline mode.
2. To design and constructs a mobile phone detector that can detects analog and digital transmission in the continuous frequency range of 400MHz to 2000MHz.
3. To constructs a detector with a sensitivity control that can be adjusted to accommodate coverage areas typically extending from 2 to 30 meters outwards from the units.
4. Design a system that is capable of enforcing cell phone restrictions, protect private information and also help stop criminal activities.
5. A design that is cost effectives both in production and maintenance.

CHAPTER TWO: LITERATURE REVIEW

2.0 INTRODUCTION

The introduction in the 1990s of mobile phones using the digital Global System for Mobile Communications (GSM) with bandwidths of 900 and 1800 megahertz and the subsequent introduction of the Universal Mobile Telecommunications System (UMTS) have led to widespread use of this technology and to a substantial increase in the number of mobile phone base stations (MPBS) all over the world. This development has raised public concerns and substantial controversy about the potential effects on the use of mobile phones at certain places or prohibited arena of this technology [1].

2.1 MOBILE PHONE TECHNOLOGY

Mobile phone technology is rapidly changing. Features like Bluetooth, USB, high resolution cameras, microphones, Internet, 802.11 wirelesses, and memory cards are added every year. Also, the communication technology a cellular phone uses such as CDMA, GSM, 3G, and 4G are rapidly changing [1].

2.1.1 MOBILE PHONE FEATURES

Bluetooth is a secure wireless protocol that operates at 2.4 GHz. The protocol uses a master slave structure and is very similar to having a wireless USB port on your cellular phone. Devices like a printer, keyboard, mouse, audio device, and storage device can be connected wirelessly. This feature is mainly used for hands-free devices but can also be used for file transfer of pictures, music, and other data. Universal serial bus (USB) is a way for cellular phones to connect to a computer for data transfer. This feature is very similar to Bluetooth for a cellular phone with the exception of using a cable. On today's cellular phones this feature is mainly used for charging the battery or programming by the manufacturer. It can also be used to transfer pictures, music, and other data. Cameras on cellular phones are a very popular feature that was added in the last 10 years. In recent years, high resolution cameras have become a standard feature. Most mobile phones will come with at least a 2 mega pixel camera and the more expensive phones can be as much as 8 mega pixels. Microphones have been featured on cellular phones since they first came out. In the last 10 years the microphones have become dual purpose; now there are programs on the phone that record voice to file such as a simple voice recorder or as part of a video.

Almost every available cellular phone today has a connection to the Internet. This allows users to transfer files and data wherever they are. Mobile phones can send emails, text messages, picture text messages, video text messages, and upload data to the Internet.

Some cellular phones come with 802.11 wireless built in and allows the phone to connect to any nearby wireless networks. This provides an alternate connection method to the Internet and saves money if you're on a limited data plan. Also, connecting with 802.11 is most likely going to provide better throughput than using the cellular phone network. Since cameras and music have become popular features on cellular phones, manufacturers have started adding memory card slots. These memory cards provide expanded memory and allow more pictures to be taken or music files to be stored. Most memory cards can plug directly into the computer for easy data transfer. All these features make cellular phones today very versatile. They can connect with almost any storage medium or computer. In the years to come, mobile phones will continue to gain more and more features [2].

2.1.2 MOBILE PHONE COMMUNICATION STANDARDS

Currently the three main technologies used by cellular phone providers are 2G, 3G, and 4G. Each generation of technology uses a different transmission protocol. The transmission protocols dictate how a cellular phone communicates with the tower. Some examples are: frequency division multiple access (FDMA), time division multiple access (TDMA), code division multiple access (CDMA), global system for mobile communications (GSM), CDMA2000, wideband code division multiple access (WCDMA), and time-division synchronous code-division multiple access (TD-SCDMA). All of these protocols typically operate in the 824 - 894 MHz band in the United States. Some protocols, such as GSM (depending on the provider) will use the 1800 - 2000 MHz band [1, 2].

2.2 REVIEW OF MOBILE PHONE DETECTOR

Since cellular phone detection is a more recent problem, there are only a few articles that have already researched this area. Two important articles published between 2009 and 2011 respectively provide good analysis. The first article, "Detecting and Locating Cell Phones in Correctional Facilities," was written by EVI Technology, LLC. The second article,

"Cell Phone Detection Techniques," was written by a Contractor hired by the U.S. Department of Energy (DOE) [1, 2, 3]

This article details the growing problem with cellular phones in correctional facilities and lays out the constraints used to develop their solution. According to the research, cellular phones in a correctional facility are used to operate criminal enterprises, threaten witnesses, harass victims, plan uprisings, and undermine security. Their problem is monitoring, controlling, and locating cellular phones in a correctional facility [2].

EVI's possible solutions include physical search, non-linear junction detectors, signal jamming, shielding, network provider location based screening, RF detection, and their custom proprietary solution. They rule out all solutions but their own custom solution that uses a system of networked sensors that are controlled by a central computer. EVI uses proprietary software that determines the cell phone's location and detects any RF emissions. The location of detected cellular devices is displayed on a facility map [3].

This solution was developed for detecting cellular phones in a prison. It relies on the cellular phone remaining stationary which, in prison facilities makes sense since movement is limited. EVI's detection system finds mobile phones after they have already been in the facility for at least 30 minutes or if someone is making a phone call. EVI doesn't provide any details on the signal detection technique used since it is all proprietary. Also, there are no reviews or articles stating that this system works as advertised.

This study examines detecting cellular phones when a person is entering a secure facility or mobile phone restricted area. The detection technique studied requires measuring a cell phone's electromagnetic properties and determining an identifiable signature. Measuring the RF spectrum around 240 - 400 MHz (outside the cellular phone band) shows the most potential [3]. The DOE Contractor recommends developing a cellular phone detector by measuring the RF spectrum. Spurious emissions from cellular phones are monitored and recorded when the phone is in standby or transmitting.

Using this method has some advantages:

• No external signal required for detecting the phone

• The band of frequencies is limited by the FCC and is likely to be used by most manufacturers

• System could potentially detect more than cellular phones

• This method should work on future generations of cellular phones

• System could potentially detect cellular phones even when they are off

The authors lay out a proposed path forward for determining if this technique is possible and perform some preliminary testing of their own. They also provide an alternative path that would detect cellular phones based off of their RF reflecting material in the cellular phone filters on all phones. Cellular phones could then be detected whether they are on or off [3, 4].

This research article also mentioned an evaluation that was conducted in 2003 on the available commercial cellular phone detectors. Bechtel-Nevada and Sandia National Labs found that none of the detectors at the time were effective when the phone was off or in standby mode .

CHAPTER THREE: DESIGN AND CONSTRUCTION PROCEDURE

3.0 INTRODUCTION

In this chapter an attempt was made to outline detailed theoretical analysis and procedures to arrive at the circuit component.

3.1 WORKING OF MOBILE DETECTOR

This is simply the description and concepts involve in the working of the mobile cell phone detector.

3.1.1 DESCRIPTION

An ordinary RF detector using tuned LC circuits 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 phone detector. Here the circuit uses a 0.22µF disk capacitor (C_3) to capture the RF signals from the mobile phone [4]. The lead length of the capacitor is fixed as 18 mm with a spacing of 8 mm between the leads to get the desired frequency. The disk capacitor along with the leads acts as a small gigahertz loop antenna to collect the RF signals from the mobile phone.

Op-amp IC CA3130 (IC1) is used in the circuit as a current-to-voltage converter with capacitor C_3 connected between its inverting and non-inverting inputs. It is a CMOS version using gate-protected p-channel MOSFET transistors in the input to provide very high input impedance, very low input current and very high speed of performance. The output CMOS transistor is capable of swinging the output voltage to within 10 mV of either supply voltage terminal.

Capacitor C_3 in conjunction with the lead inductance acts as a transmission line that intercepts the signals from the mobile phone. This capacitor creates a field, stores energy and transfers the stored energy in the form of minute current to the inputs of IC1. This will upset the balanced input of IC1 and convert the current into the corresponding output voltage.
Capacitor C_4 along with high-value resistor R_1 keeps the non-inverting input stable for easy swing of the output to high state. Resistor R_2 provides the discharge path for capacitor C_4. Feedback resistor R_3 makes the inverting input high when the output becomes high. Capacitor C_5 (47pF) is connected across 'strobe' (pin 0 and 'null' inputs (pin 1) of IC1 for phase compensation and gain control to optimize the frequency response.

When the mobile phone signal is detected by C_3, the output of IC1 becomes high and low alternately according to the frequency of the signal as indicated by LED1. This triggers monostable timer IC2 through capacitor C_7. Capacitor C_6 maintains the base bias of transistor T1 for fast switching action. The low-value timing components R_6 and C_9 produce very short time delay to avoid audio nuisance.

3.1.2 CONCEPT

Mobile phone uses RF with a wavelength of 30cm at 872 to 2170 MHz that is the signal is high frequency with huge energy. Mobile phone at active, standby or offline state transmits signal in the form of sine wave which passes through the space [5]. 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 [5].

When a GSM (Global System of Mobile communication) digital phone is transmitting, the signal is time shared with 7 other users [5]. 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 250 milli watts of continuous power. Each handset with in 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 traveling. This will cause severe battery drain. So in long journeys, battery will flat with in a few hours [5].

(AM) Radio uses frequencies between 180 kHz and 1.6 MHz. FM radio uses 88 to 180 MHz. TV uses 470 to 854 MHz [6]. Waves at higher frequencies but within the RF region are called Micro waves. Mobile phone uses high frequency RF wave in the micro wave region carrying huge amount of electromagnetic energy. That is why burning sensation develops in the ear if the mobile is used for a long period [7]. Just like a micro wave oven, mobile phone is 'cooking' the tissues in the ear. RF radiation from the phone causes oscillation of polar molecules like water in the tissues. This generates heat through friction just like the principle of microwave oven. 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 [7].

Below is the block diagram of standby/ Offline mobile phone detector for further illustrations.

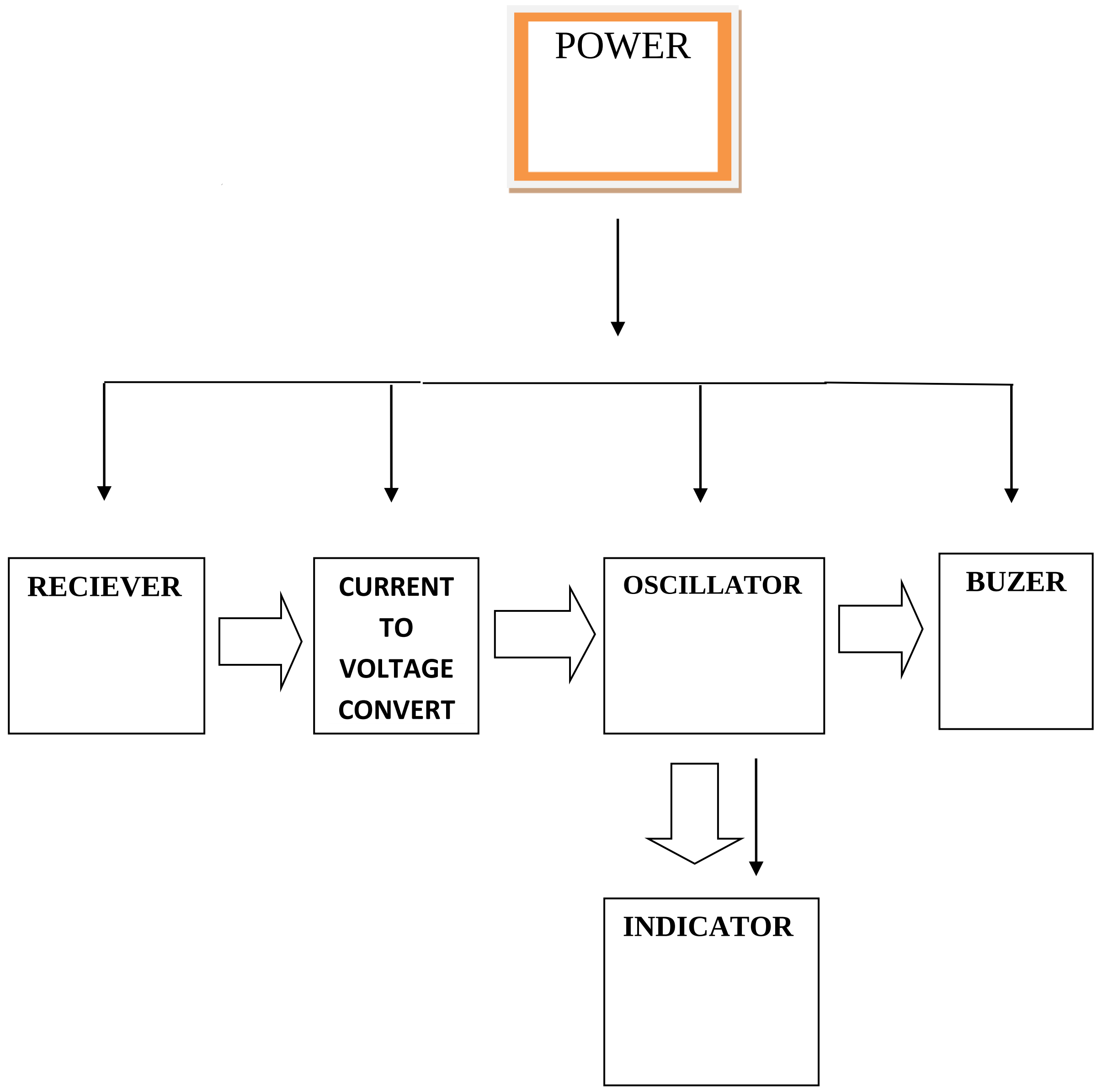
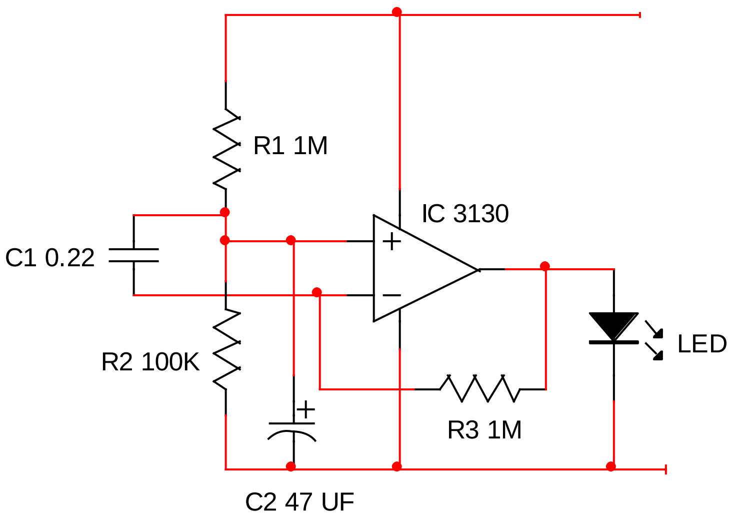


Fig 1 the block diagram of mobile phone detector

3.2 DESIGN OF THE CURRENT TO VOLTAGE CONVERTER UNIT

This unit consists of two resistors connected at non inverting input of the op-amp. They are used to form voltage divider at the input of the op-amp. The unit also consists of another resistor (feedback resistor) connected between the inverting input and output of the op-amp. The output of the op-amp is fed into the resistor driver via a capacitor of the value 100nf. A simple current to voltage converter is simply a resistor as a passive component. An input current passing through the resistor generates a voltage in proportion with the magnitude of the current. Ac model of resonance and current to voltage converter circuit at very high frequencies in the order of gigahertz, C_5 becomes an excellent conductor, thus grounding the resistors R3 and R1.



IC1 is designed as a differential amplifier non inverting input is connected to the potential divider R1, R2. Capacitor C2 keeps the non-inverting input signal stable for easy swing to + or – R_3 is the feedback resistor

Fig 2 Current to voltage converter

IC1 functions as a current to voltage converter, since it converts the tiny current released by the 0.22 capacitor as output voltage.

At power on output go high and LED lights for a short period. This is because + input gets more voltage than the – input. After a few seconds, output goes low because the output current passes to the – input through R2. Meanwhile, capacitor C1 also charges. So that both the inputs gets almost equal voltage and the output remains low. 0.22 capacitor (no other capacitor can be substituted) remains fully charged in the standby state.

When the high frequency radiation from the mobile phone is sensed by the circuit, 0.22 capacitor discharges its stored current to the + input of IC1 and its output goes high momentarily. (In the standby state, output of the differential amplifier is low since both inputs get equal voltage of 0.5 volts or more). Any increase in voltage at + input will change the output state to high.

3.2.1 HOW THE CIRCUIT WORKS?

Ordinary LC (Coil-Capacitor) circuits are used to detect low frequency radiation in the AM and FM bands. The tuned tank circuit having a coil and a variable capacitor retrieve the signal from the carrier wave. But such LC circuits cannot detect high frequency waves near the microwave region. Hence in the circuit, a capacitor is used to detect RF from mobile phone considering that, a capacitor can store energy even from an outside source and oscillate like LC circuit.

High value resistor R_1 = 2.2M (recommended in the datasheet to keep the non-inverting input stable foe easy swing of the output high state)

R_2 = 100K (recommended in the datasheet to provide discharge parts for C_4)

R_3 = 2.2M (recommended in the datasheet as feedback resistor to make the inverting input high when the output becomes high)

3.3 DESIGN OF THE OSCILLATOR UNIT

Normally IC1 is off. So IC2 will be also off. When the power is switched on, as stated above, IC1 will give a high output and T1 conducts to trigger LED and Buzzer .This is a good indication for the working of the circuit.

This section contains the transistor and its switching mode with monostable timer IC2. Low value resistors (R_4, R_5 of value rating 1K and 12K respectively as recommended in the datasheet) are used which maintain the base bias of the transistor T1(BC548) for fast switching action through capacitor C_7 and C_6 respectively.

R_6 =15K (as recommended in the datasheet) and C_9 acts as a low timing component produce very short time delay to avoid audio nuisance.

$T_{high}=1.1RC$

For this circuit, the duration of the output high state is given as

$T_{high}=1.1 \times 15K\Omega \times 10\mu F$

$T_{high} = 1.1 \times 15 \times 10^{3} \times 10 \times 10^{-6}$

T_{high}= 0.165secs

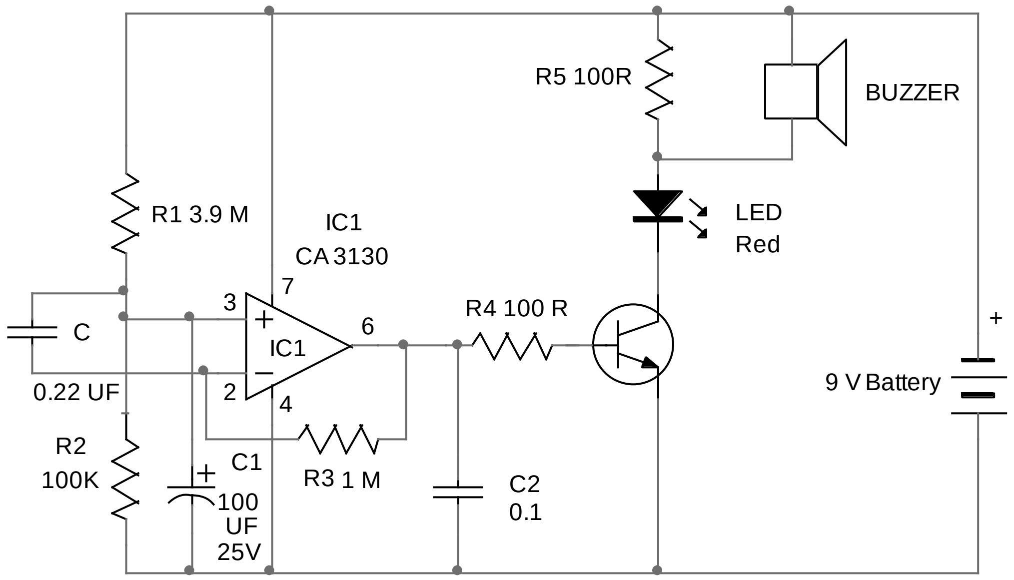


Fig 3 Signal detector circuit

3.3.1 REACTANCE ANALYSIS

In calculating the reactance of the L-C combination, C5 is in series with C,, the effective capacitance is given as C.

The reactance of the parallel combination X will be

$1 / X_P = 1 / Xc + I / X_L + 1/Z_{in}$

Xc= reactance of capacitor

X_L= reactance of inductor

Cs = Continuous line capacitor

Xp = Reactance of parallel combination

$l/X_P = (1/j\omega Cs)^{-1} + (j\omega Lx) + Z_{in}$

$= j\omega Cs + 1 / j\ \omega Lx + 1/\ Z_{in}$

$= (-\omega^2\ Z_{in}LxCs + Z_{in} + j\ \omega Lx) / j\omega Z_{in}Lx$

$l/X_P = (-\ j\omega^2\ Z_{in}LxCs +/ jZ_{in} + \omega Lx) / {-\omega} Z_{in}L_x$

$X_p = -\omega\ Z_{in}\ Lx\ /\ (-\omega^2\ Z_{in}LxCs + Z_{in} + j\ \omega Lx)$

At resonance, the imaginary part of the impedance is zero. Thus,

$-j\omega^2\ Z_{in}LxCs + jZ_{in} = 0$

$-\omega^2 LxCs + 1 = 0$

$\omega^2 = 1/LxCs$

Since $\omega = 2\pi f$

$F = 1/2\pi\ \sqrt{\ LxCs}$

at resonance,

$Xp = \omega Z_{in}Lx\ /\ \omega Lx$

$Zp = Z_{in}$ (approx)

Also

$Z_{out} = Z_{in} + R_5$

the transfer equation is given as

$VIN = V_{out}\ (Zin\ /\ Zin + R_5)$

since the input impedance of the op amp (CA3130) is very high (1.5 TΩ

from the datasheet). The voltage gain A_v is approximately 1.

Using the frequency of 1800MHz, the relative permittivity of the Vero board is assumed to be $\varepsilon_r = 2$, then $\varepsilon = \varepsilon_r\varepsilon_0$

$\varepsilon_0 = 8.85 \times 10^{-12}$F/m, $\varepsilon = 2 \times 8.85 \times 10^{-12}$F/m $= 1.77 \times 10^{-11}$

$\mu_0 = 4\pi \times 10^{-7}$ H/m

The parameter of capacitor C4 are selected as D = 0.8cm, l = 1.8cm, the radius of the leads are measured with micrometer screw gauge to be r = 0.029cm

The line capacitance is calculated as

$C_x = \pi \times 1.77 \times 10^{-11}$

$C_x = 0.0302pF$

The line inductance is calculated as

$Lx = 4\pi \times 10^{-7} \times 1.8 \times 10^{-2} \times \log_e (0.8 / 0.029)$

$Lx = 23.9nH$

Since $Cx \ll C_4$ the resultant value of the series combination of Cx and C4 is approximately Cx thus Cs = Cx = 0.0302pF

The resonance frequency is given as f, which is illustrated thus

$f = ½ \pi \sqrt{} 23.9 \times 10^{-9} \times 0.0302 \times 10^{-12}$

$f = 1.87 \times 10^{9}$

f = 1.87 GHz

3.3.2 SEARCH COIL

The number of turns of the search coil is chosen as 130 turns, with a diameter of 5.8mm and a length of 9mm. the inductance of the coil is given as

$L = \mu N^2 A/I$

$L = (4\pi \times 10^{-7} \times 130^2 \times \pi \times 5.8 \times 10^{-3})$

$L = 62.34\mu H$

3.4 CIRCUIT DIAGRAM

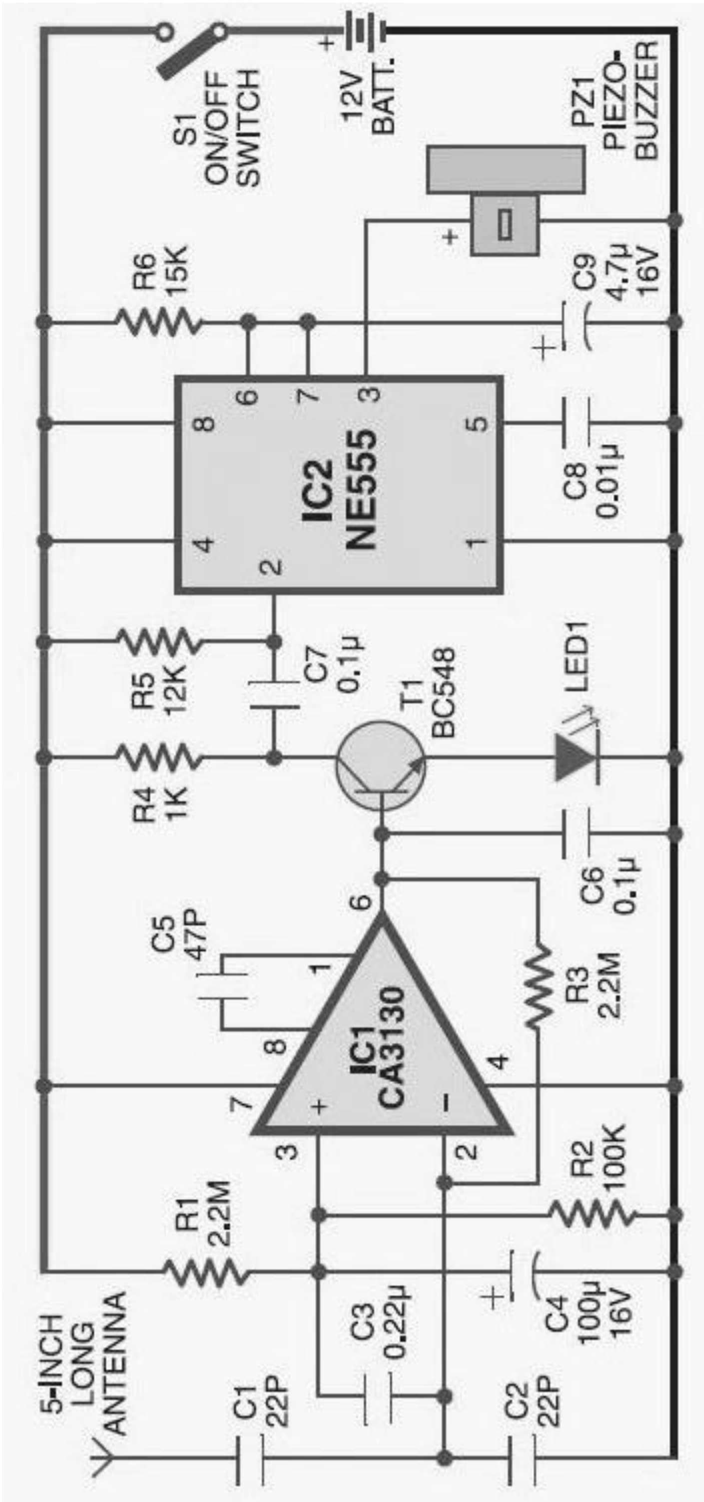


Fig 4 Circuit diagram

3.5 USE OF CAPACITOR

A capacitor has two electrodes separated by a ‘dielectric’ like paper, mica etc. The non-polarized disc capacitor is used to pass AC and not DC. Capacitor can store energy and pass AC signals during discharge. 0.22capacitor is selected because it is a low value one and has large surface area to accept energy from the mobile radiation. To detect the signal, the sensor part should be like an aerial. So the capacitor is arranged as a mini loop aerial (similar to the dipole antenna used in TV) [8]. In short with this arrangement, the capacitor works like an air core coil with ability to oscillate and discharge current.

3.5.1 HOW THE CAPACITOR SENSES RF?

One lead of the capacitor gets DC from the positive rail and the other lead goes to the negative input of IC1. So the capacitor gets energy for storage. This energy is applied to the inputs of IC1 so that the inputs of IC are almost balanced with 1.4 volts. In this state output is zero. But at any time IC can give a high output if a small current is induced to its inputs. There a natural electromagnetic field around the capacitor caused by the 50Hz from electrical wiring. When the mobile phone radiates high energy pulsations, capacitor oscillates and release energy in the inputs of IC. This oscillation is indicated by the flashing of the LED and beeping of Buzzer. In short, capacitor carries energy and is in an electromagnetic field. So a slight change in field caused by the RF from phone will disturb the field and forces the capacitor to release energy.

3.6 PIN CONFIGURATION OF IC1 (ICCA 3130)

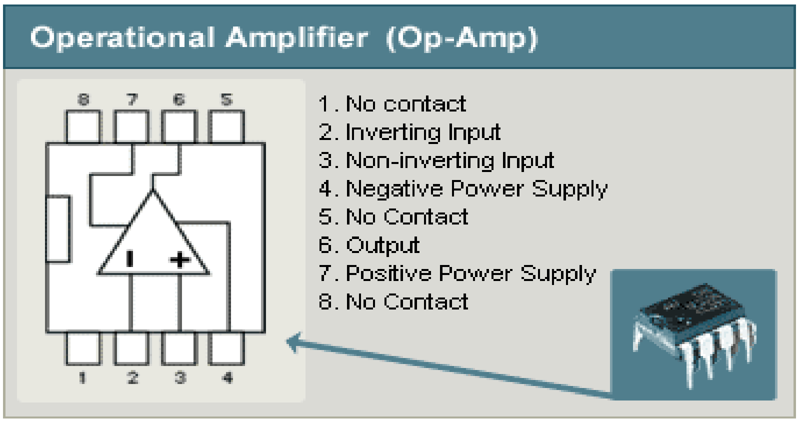


Plate 1 The ICCA 3130 pin configuration

3.6.1 HOW ICCA 3130 WORKS?

This IC is a 15 MHz BiMOS Operational amplifier with MOSFET inputs and bipolar output. The inputs contain MOSFET transistors to provide very high input impedance and very low input current as low as 10pA. It has high speed of performance and suitable for low input current applications.

CA3130A and CA3130 are op amps that combine the advantage of both CMOS and bipolar transistors. Gate-protected P-Channel MOSFET (PMOS) transistors are used in the input circuit to provide very-high-input impedance, very-low-input current and exceptional speed performance. The use of PMOS transistors in the input stage results in common-mode input-voltage capability down to0.5V below the negative-supply terminal, an important attribute in single-supply applications.

A CMOS transistor-pair, capable of swinging the output voltage to within 10mV of either supply-voltage terminal (at very high values of load impedance), is employed as the output circuit.

The CA3130 Series circuits operate at supply voltages ranging from 5V to 16V, (2.5V to 8V). They can be phase compensated with a single external capacitor, and have terminals for adjustment of offset voltage for applications requiring offset-null capability. Terminal provisions are also made to permit strobing of the output stage. The CA3130A offers superior input characteristics over those of the CA3130.

3.6.2 ROLE OF IC CA 3130

FEATURES

• MOSFET Input Stage Provides:

- Very High ZI = 1.5 T

- Very Low current . . . . . . =5pA at 15V Operation

• Ideal for Single-Supply Applications

• Common-Mode Input-Voltage Range Includes Negative Supply Rail; Input Terminals can be Swung 0.5VBelow Negative Supply Rail

• CMOS Output Stage Permits Signal Swing to Either (or both) Supply Rails

APPLICATIONS

• Ground-Referenced Single Supply Amplifiers

• Fast Sample-Hold Amplifiers

• Long-Duration Timers/ Mono stables

• High-Input-Impedance Comparators (Ideal Interface with Digital CMOS)

• High-Input-Impedance Wideband Amplifiers

• Voltage Followers (e.g. Follower for Single-Supply D/A Converter)

• Voltage Regulators (Permits Control of Output Voltage Down to 0V)

• Peak Detectors

• Single-Supply Full-Wave Precision Rectifiers

• Photo-Diode Sensor Amplifiers

3.7 IC NE 555TIMER

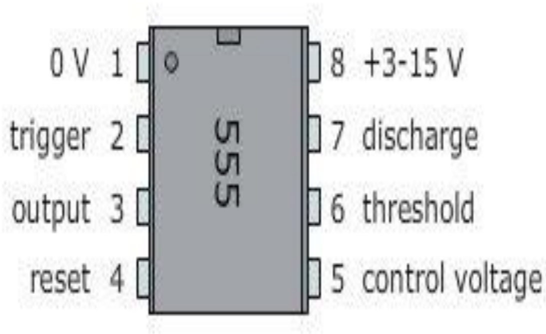


Plate 2 IC NE 555Timer pin configuration

The NE555 IC is a highly stable controller capable of producing accurate timing pulses. With a monostable operation, the time delay is controlled by one external resistor and one capacitor. With an astable operation, the frequency and duty cycle are accurately controlled by two external resistors and one capacitor.

3.7.1 DETAILS OF PIN IC NE 555 TIMER

1. Ground, is the input pin of the source of the negative DC voltage
2. trigger, negative input from the lower comparators (comparator B) that maintain oscillation capacitor voltage in the lowest 1 / 3 Vcc and set RS flip-flop
3. Output, the output pin of the IC 555.
4. Reset, the pin that serves to reset the latch inside the IC to be influential to reset the IC work. This pin is connected to a PNP-type transistor gate, so the transistor

will be active if given a logic low. Normally this pin is connected directly to Vcc to prevent reset

5. Control voltage, this pin serves to regulate the stability of the reference voltage negative input (comparator A). This pin can be left hanging, but to ensure the stability of the reference comparator A, usually associated with a capacitor of about 10nF to berorde pin ground
6. threshold, this pin is connected to the positive input (comparator A) which will reset the RS flip-flop when the voltage on the capacitor from exceeding 2 / 3 Vc
7. Discharge, this pin is connected to an open collector transistor Q1 is connected to ground emitter. Switching transistor serves to clamp the corresponding node to ground on the timing of certain
8. Vcc, pin it to receive a DC voltage supply. Usually will work optimally if given a 5-15V. The current supply can be seen in the datasheet, which is about 10-15mA.

3.7.2 ROLES OF IC2 IC NE 555 TIMER

FEATURES

- High Current Drive Capability (200mA)
- Adjustable Duty Cycle
- Temperature Stability of 0.005%/□C
- Timing from Sec to Hours
- Turn off Time Less than 2Sec

APPLICATIONS

• Precision Timing

• Pulse Generation

• Time Delay Generation

• Sequential Timing

3.8 PIEZO BUZZER

A buzzer or beeper is a signaling device, usually electronic, typically used in automobiles, household appliances such as microwave ovens, or game shows. It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a preset time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound. Nowadays, it is more popular to use a ceramic-based piezoelectric sounder which makes a high-pitched tone. Usually these were hooked up to "driver" circuits which varied the pitch of the sound or pulsed, the sound on and off. The word "buzzer" comes from the rasping noise that buzzers made when they were electromechanical devices, operated from stepped-down AC line voltage at 50 or 60 cycles. Other sounds commonly used to indicate that a button has been pressed are a ring or a beep.

Plate 3 Piezo Buzzer

WORKING CIRCUITS ON VERO BOARD

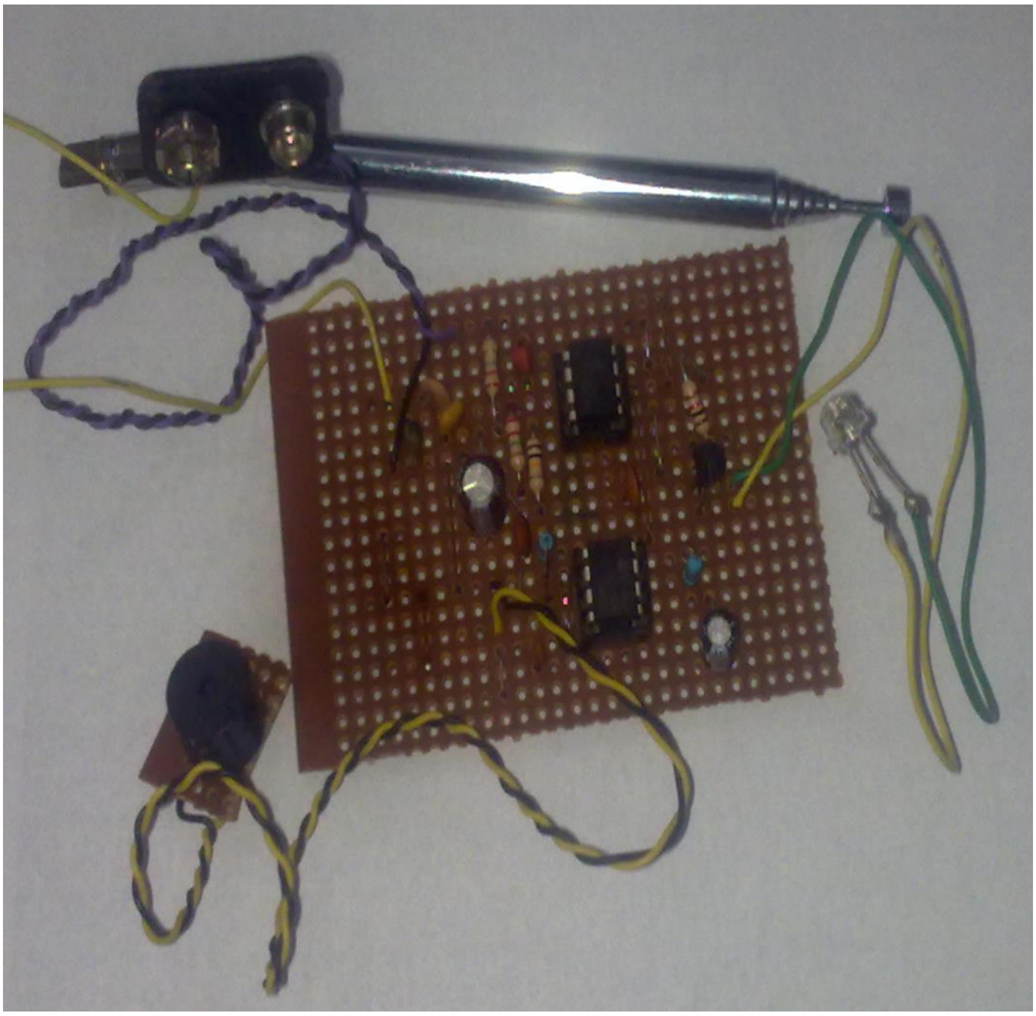


Plate 4 Snapshot of the circuit

CHAPTER FOUR: PERFORMANCE AND COST EVALUATION

4.0 INTRODUCTION

This chapter reveals the tests carried out on the project work and the performance /results obtained. It also provides a list of the components used and the cost of producing a unit of the device.

4.1 TESTING/PERFORMANCE

Prior to the final coupling of the mobile phone detector, assembling of the component on the Vero board, its performance evaluation was carried out according to design specification. Testing of individual component separately, separate sub units were carried out before assembling and performance evaluation was monitored on each sub units and the entire system on and after assemblage. The packaging was also considered.

4.2 THE TESTING OF THE CIRCUIT.

The testing of the circuit follow a modular pattern with each functional block being tested and for any block that was not working properly, the fault was check and corrected appropriately.

4.2.1 TESTING THE POWER SUPPLY UNIT.

The digital multimeter was the tool that was used for testing the power supply unit. Power OFF test was carried out to check for continuity power ON test was carried out to check for the input voltage level at the ICs. These units were functioning properly when tested.

4.2.2 TESTING THE AMPLIFIER STAGES.

The amplifier stage which consists of the search coil, antenna, three capacitors, two resistors and a transistor connected in common emitter, collector feedback configuration. It was tested for the output voltage level, using the multimeter. The circuit was trouble shot for both shot circuit and open circuit faults.

4.2.3 TESTING OF THE ENTIRE CIRCUIT.

The entire circuit was tested for short circuit and open circuit faults that could result in the nearest future. All fault were corrected, some component had to be replaced and firmly soldered.

4.3 CONSTRUCTION OF CASING.

Plate 5 The casing

A plastic casing was used for housing the device, it also provide a space for housing the power supply.

4.4 COST EVALUATION OF THE COMPONENTS

The cost implication of the project the construction component list is tabulated in the table below.

S/NO.	**COMPONENT**	**QUANTITY**	**RATE (₦)**	**AMOUNT(₦)**
1.	Resistors (KΩ)	4	10	40
2.	Resistor (MΩ)	2	15	30
3.	Vero board	1	200	200
4.	Transistor (BC548)	1	200	200
5.	Capacitor (Polarized)	3	50	150
6.	Capacitor (Non Polarized)	6	30	180
7.	Op-Amp (CA3130)	1	1500	1500
8.	Antenna	1	150	150
9.	555 (Timer)	1	50	50
10.	Battery (Transistor)	1	300	300
11.	Led (Red color)	1	100	100

12.	Buzzer (Pie-zo)	1	150	150
13.	Power switch	1	40	50
14.	Casing		650	650
	TOTAL			3750

Table 1: Component costing

CHAPTER FIVE: CONCLUSIONS

5.0 SUMMARY

This project work attempts to proffer a lasting solution to the long lingered problems of mobile phone usages at unauthorized places.

Information surfed from the internet and relevant books form the sources of data used to achieve the desired goal.

Components selected were assembled on a Vero-board in accordance with schematic diagram. The assembly was tested with relevant instrument before the final packaging and casing. Tested results reveal that:

The voltage measured at some strategic points was approximately tending to the value obtained from calculations.

This can be justified with fact that,

i. No conducting material is perfect.
ii. Same components of some values do not measure perfectly the same when tested with multimeter.
iii. Joints made with soldering lead introduce capacitive effects especially if not properly soldered.

5.1 CONCLUSIONS

The purpose of this work is to design and construct a mobile cell phone detector which would be able to sound alarm of the presence of a mobile cell phone, in areas where the use of mobile phone is prohibited. The findings aforementioned indicate that the project was successful. This proves beyond reasonable doubt that the system is more reliable because of the ease with which the mobile phone detector picks up RF transmission. Despite the prevalent advantages accompanying this system, it should not be accepted as a perfect and flawless product.

5.2 RECOMMENDATIONS

For further study, modification and improvement, the researcher recommends:

i. Trying to increase the detecting range of mobile phone detector to few more meters, for observing wide range of area
ii. .A printed circuit board should be used instead of the vero board.

iii. A crystal oscillator can be used for further work for better stability and optimum performance.

iv. The University should provide a modality for ensuring that components necessary for any design are readily available and found in the laboratories.

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