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CELL PHONE DETECTION SYSTEM

Amar Sparsh Raj*, Anil Kumar, Karamjit Kaur
Department of Electronics and Communication Engineering,
Amity University Haryana, Gurugram, Haryana, India.

Abstract: This study aimed at building a cell phone detector circuit. This cell phone detector can detect a mobile phone that a person is carrying in the range of 1.5 meters and that is why this detector can be used to prevent a person to use the mobile phone in restricted places such as examination halls, cinema halls, etc. The application of this device can also be extended to prevent the use of mobile phone by a person to monitor the activities in various unauthorized or restricted places. This device is also capable of detecting the mobile phone even if the mobile phone is kept in silent mode. Alarm, which is a piezo buzzer, and the LED device that are attached in the detector are activated whenever the cell phone detector receives the radio frequency signals from an activated mobile phone. PCB is designed as small as possible so that it can fit in the compact size of the detector. All the capacitors used in the circuit of the detector have the length of 1 mm, a short telescopic antenna and a 12V battery are also used in this device and due to this reason, the detector becomes compact.

Keywords – Cell Phone, Alarm, LED, PCB, Radio-Frequency Signals

INTRODUCTION

Initially, there were two signal detection techniques. The first technique was found to be difficult as it used discrete signals and even though this technique, being affordable, required precise tuning and was also found to be inaccurate.[1] The second signal detection technique was also discussed. It was found that this second technique used a downstream converter, a controlled gas oscillator, and a band pass filter. It was also found that this technique is accurate. [2]

Cell phone can be defined as an electronic device which can make and receive calls.[3] Cell phones can provide a wide range of services apart from just making and receiving calls like Bluetooth, USB transfer, high resolution cameras, etc. and these types of cell phones are known as smart phones. A radio network which is spread over a large terrestrial area is known as cellular network. During continuous cell communication, the process of shifting of one cell frequency to another cell frequency is known as “Handover”. [5]

Mainly almost all the modern cell phones use three main technologies which are 2G, 3G, and 4G. [5] Different protocols for these technologies are: -

- FDMA
- TDMA
- CDMA
- GSM
- CDMA2000
- WCDMA
- TDSCMA

Previously, mobile phones were thought to be stationary and always in “power on” mode. Previous cell phone detection systems worked on this principle only. The only drawback was that whether these systems were able to detect a cell phone or not because these systems were capable of detecting shelf cell phones. Berkeley Varitronics Systems and Mobile Security Products are two most popular companies that produce an effective cell phone detector. Wolfhound Cell Phone Detector is produced by Berkeley Varitronics Systems company and Callbuster is produced by Mobile Security Products company. [4]

Wolfhound Cell Phone Detector is capable of detecting PCS, CDMA, GSM, and those cellular phones that emit radio frequency signals within a radius of 40 to 50 feet. The only drawback of this system is that it detects any random cell phone and not those which are in standby mode. [4]

Callbuster Cell Phone Detector covers the drawback of Wolfhound Cell Phone Detector as it can detect even those cell phones which are in standby mode. It is capable of detecting analog, digital, CDMA, TDMA, PCN and GSM mobile phones. [4]

Circuit Diagram of the Cell Phone Detector

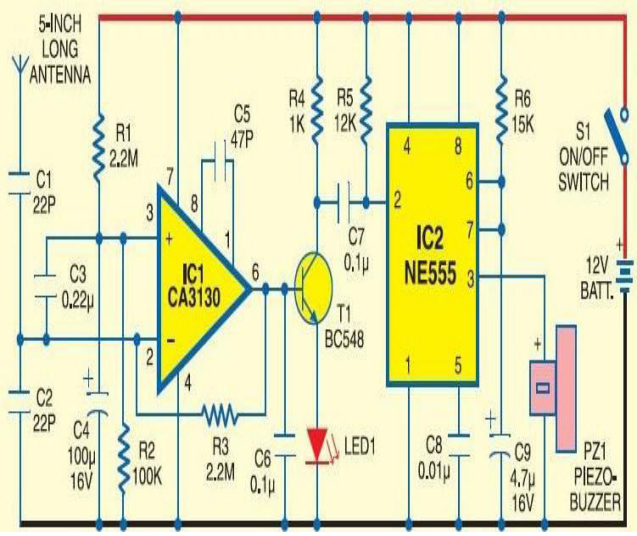

Figure 1.1 Circuit Diagram of the Cell Phone Detector

LED lights up temporarily whenever the power goes high. Through this circuit, messages and video transfers can be detected even though the cell phone is kept on silent mode. This cell phone detector circuit mainly used a voltage converter, a controlled voltage oscillator and a bandpass filter for detecting cell phones.[4]

PCB and Fabrication of PCB

Printed Circuit Board or PCB is a type of electrical circuit which is constructed when all the components and conductors are placed properly on a compact mechanical structure. When we laminate the insulating materials between layers of conductive materials, then we obtain the mechanical structure.[7]

PCB is mainly used to mechanically support the circuit and electrically connect the electronic and electrical components used in this circuit. PCB is also known as Printed Circuit Board. Wire-wrap and point-to-point connections are the best-known alternatives of PCBs.[9] Today, all the PCBs are made using four materials which are: -

- Lights
- Laminates
- B-base Fabrics
- Copper Foil

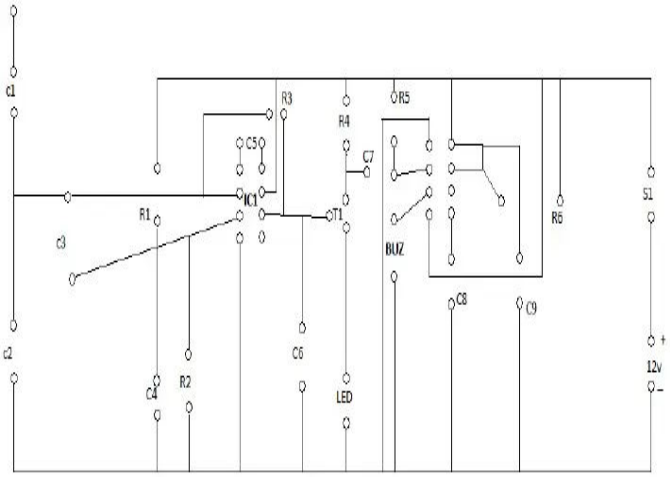

Figure 1.2 PCB Layout of Cell Phone Detector System

When we compress the filtered materials of resin under heat and pressure, then we obtain copper-clad laminates. When we select and create the copper-clad laminate, the next step is to clean it. This is done either by etching or adding resist. The next step which follows is screen printing. The process which involves transfer conductor pattern to the copper-clad laminates is known as screen printing.[7] The next step which follows is etching which is defined as a process to remove harmful chlorides present in the PCB. The second last after removing the harmful chlorides is drilling holes in the PCB.[6] This process is only used when the cost of the drilling tool is very high. After the process of drilling holes in the PCB is completed, all the components including the PCB are mounted to the circuit. The main advantage of mounting all the components is that there are no cracks in the components placed. [8]

Semiconductors

Semiconductors also play a role in this circuit. Semiconductors can be defined as those materials which have both the characteristics of conductors and insulators. The valance band present in the semiconductors has a medium gap which means that the gap is not small enough to let the electrons and holes to cross the band and conduct electricity and not large enough also that do not let the electrons and holes to cross the band and there is no conduction of electricity[10]. Properties or characteristics of these semiconductors can be changed by a process known as doping. Doping is a process of adding impurities in the semiconductor and the degree of impurity is directly proportional to the amount of impurities added and it also affects the amount of electricity which is conducted by the semiconductor.[12]

COMPONENTS USED

Six resistors and nine capacitors each of different values, two integrated circuits, one transistor, one LED, one antenna, one piezo buzzer, on and off switch and power supply are the following components that are used to design the circuit. [15]

Resistors can be defined as those electrical components which restrict the flow of electricity in any electrical circuit. In any electrical circuit, resistors can be connected either in series or in parallel. Resistance of a resistor can be measured by using the formula devised by Ohm, also known as Ohm's Law. Ohm's Law states that resistance in any circuit is directly proportional to the voltage applied in the circuit and inversely proportional to the current flowing in the circuit.[13] The formula for calculating resistance is

$$R = V/I \qquad (1.1)$$

Capacitors are those electrical devices that store energy whenever they are connected in a circuit. The amount of energy which a capacitor stores is known as capacitance. Capacitance of the capacitor changes due to three common reasons which are change in the size of the plates used in capacitors, changes in the distance between the plates, and changes in the nature of the dielectric component used.[14] The basic formula for calculating the capacitance of the capacitor is

$$C = Q/V \qquad (1.2)$$

Another formula for calculating the capacitance is

$$C = € \times (A/D) \qquad (1.3)$$

There are many types of capacitors available in the market but in this circuit, mainly two types of capacitors are used which are ceramic capacitors and electrolytic capacitors. Ceramic capacitors are those capacitors which are like the standard capacitor, but dielectric component is different.[19] Electrolytic capacitors are those capacitors which are polarized in nature and have metallic anode.[17]

Transistors are those semiconductor devices which have three terminals. Transistors are mainly used to convert one form of energy into electrical signals and are also used to amplify these electrical signals.[20] It can also be used to conduct and insulate electricity. Among the three terminals of the transistor, first terminal is known as the base, second terminal is known as collector and the third terminal is known as emitter. Transistors are available in market in various types among which the most common types of transistors are NPN transistor, PNP transistor, FETs and MOSFETs.[16]

LEDs are one of those semiconductor devices which are capable of emitting light in various colours like blue, green, yellow, etc. but the most common LED available in the market is is the red colour LED. These devices work on the principle of electroluminescence. LEDs provide several advantages like effectiveness, various bright colours, small size, cycling rates, etc. [18]

Piezo buzzers are very simple devices capable of producing various sounds and can also be used as alarms in various devices. Sound in the piezo buzzer is generated whenever the pressure wave developed in the crystal pushes

the diaphragm in a conical shape.[21] The piezo buzzer work on the principle of piezoelectricity which is defined as the collection of electrical charges whenever some mechanical pressure is applied.[22] The literal meaning of piezoelectricity is the production of electricity under pressure or stress. Piezoelectricity is produced in two ways either directly applying the mechanical energy to the piezoelectric crystal or by inverse piezoelectric method.[28]
Integrated circuit or IC is a single small chip which contains numerous electronic circuits. ICs are mainly semiconductor devices mostly made up of silicon.[22] ICs have better and faster performance due to the presence of tiny MOS transistors. ICs are most effective against discrete circuits due to their low cost and high performance. Two types of ICs are used in this cell phone detector circuit which are IC CA3120 and IC NE555. [24]

Conceptualization of the Cell Phone Detector

We can perform a bandpass test to check whether the circuit was operational at the frequency of 900MHz. In this bandpass test, the frequencies ranging from 600MHz to 1.2GHz were divided into various equal parts having same frequency of 100MHz. Amplitude which resulted from this test changed at all the frequencies.[30] We can also observe that this amplitude was critically lower at 900MHz frequency although it was also observed that the amplitude did got low at various places but not as low as it was observed at 900MHz frequency. [31]

As I examined this cell phone, we will find that the spectrum analyser was able to locate a cell phone using only the 500 MHz probe. Speaking of mobile phone, the analytical specialist came in at 832MHz. Frequency range for designing this cell phone also came within this range. Before assembling the circuit on the PCB, we can test it on the breadboard using the components, connecting wires, and a 9V battery.

The main purpose of designing the circuit is to catch the person who is using the cell phone in the restricted areas. This circuit is also useful for catching those persons who are making video and audio recordings either in a restricted area or in an illegal way. This circuit is also capable of detecting messages and texts that are sent from the cell phone.

Radio Frequency is emitted by cell phones at a wavelength of 30cms and frequency emitted by the cell phones ranges from 872MHz to 2170MHz. That is a typical high voltage signal with great power.[23] Mobile phones, when operational, emits sine waves as signals and these sine waves are capable enough to move in space. The base station receives the electronic beams which were emitted by the audio or video signals, and these audio and video signals were included in the sine wave emitted by the cell phone. The cellular systems are so called because the access points of these systems are divided into various cells.[26]

Standard LC circuits are used to find the low frequency radiation emitted by the bands used in the cell phones, which are modulated in accordance with frequency and amplitude. Carrier waves return the signals with the help of variable capacitor to the coil which is held by the circulation tank present in the circuit. The frequency waves, which are present in the microwave region, cannot be detected by these LC circuits. Therefore, in order to catch the radio frequency signals emitted by the cell phones, a capacitor is used which is capable of conserving even those signals which are coming from an external source and is capable of oscillating like an LC circuit. [25]

Result and Discussion

Basically, this circuit has its applicability anywhere to receive the signals from the mobile phones. As of today, the generation of advanced communication devices and mobile phones is the first requirement for this. But somehow there is a reason for the misuse of these devices. Therefore, we should give up this for our own safety. We may use a cell

phone detector or at our place of work, private halls, prisons, courtroom, and many other places where the cell phone is not allowed.

The only limitation to this circuit is its range which is between 1 metre and 1.5 metres. Thus, cell phones are only detected by this circuit only when it comes within the specified range. Next time we will increase the detector distance so we can see more than 100 meters of cells. In a nutshell, this is a small initiative towards avoiding the use of mobile phones in various restricted and unwanted places. This circuit can be used in various places like cinema halls, examination halls, theatres, restaurants, etc.

CONCLUSION

Thus, from the above discussion, it can be concluded that these cell phone detector circuits can be used in those places where the use of cell phones is strictly restricted. The main purpose of this circuit is to avoid the misuse of cell phones in important places such as examination halls, conference halls, etc. Range can be further increased in the future improvements of these circuits. It can also be concluded that mobile phone detection circuits have a better future ahead.

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