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Implementation of GSM Detection System with Remote Jamming Capabilities

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***Abstract*—** *Implementing an integration of cell phone detection, visual and SMS alerts, with remote jamming capabilities using a microcontroller as the central control hub is necessary following the imminent security risk factors associated with the unrestricted use of GSM phones in some areas. This work improved the restriction methods already employed by security experts in prohibiting the excesses of phone usage. The system performs continuous scan for GSM signals, sends information to a designated phone line upon detection of any signal within the allocated spectrum for MTN, GLO, 9Mobile and Airtel mobile (example in Nigeria) telecommunications network service providers. A jammer circuit is also integrated into the system to disable use of mobile phones within prohibited range. The jammer circuit can be activated remotely via SMS from a designated mobile phone. All the sequence of events is displayed on an LCD for effective monitoring. The ATmega328 is employed as the central hub of the system because it is a low-power, high performance AVR RISC-based microcontroller with adequate minimum requirement for the system execution. With carefully prepared instructions in C programming language the Microcontroller Unit is able to handle multiple events at the same time thereby controlling LCD displays, SMS messages and jamming unit of the system. The execution the circuit was successful in all of the proposed areas of deployment. Testing showed that all the GSM service networks were successfully detected and jammed within the radius of coverage specified in the design objective. The remote jamming was also implemented to add flexibility to the device. Hence, the jamming unit of the system can be activated from any location within the coverage of mobile telecommunication services. Deploying this system will eliminate the need for human presence in every location where phone use is prohibited*.

***Keywords*—** *AVR RISC-base microcontroller, ATmega328, remote jamming.*

I. INTRODUCTION

Following the spate of growing technology and increased use of mobile phones for varying degree of applications, there has been a focus in recent years on issues relating to the use of mobile phones in restricted, prohibited and unauthorized areas. Mobile phones can be intrusive and can as well serve as a source of distraction for areas where silence is needed. Recently, GSM phones have been used by terrorists to trigger or detonate explosives. The signal can cause problems in hospitals, by interfering with delicate instruments or equipment. There have also been issues concerning the use of mobile phones constituting high hazard risk in filling stations and refineries (amta.org.au). Following these growing concerns for wrong use of mobile phones, it has become pertinent to employ the use of technology in curbing the problem because they can be easily smuggled into unauthorized locations without being detected. Some effects of the phone hazards are: disturbance from ringtones and vibrations, security challenges of spying in unauthorized locations, distraction and exam malpractice [1, 2, 3]. For these reasons, phones are mostly prohibited in churches, mosques, conference rooms, library, examination halls, lecture halls, prisons, banks' treasury/loading bay, law courts etc. This paper aimed at implementing a microcontroller system of cell phone detector with SMS as well as LCD alert and remote jamming capability in order to detect and curb the use of phones in some unpermitted areas. The design specifications of the system shall cover the following: Perform continuous scan for cellular phone activity within the radius of 1m-10m coverage and detect unauthorized phone usage within range; Provide visual alert by sending signals to LCD indicating each step of activity taking place within the system; send SMS alert to a designated phone number to activate remote jamming and finally disable GSM signals for Digital and Analog Cellular phones within a radius coverage of 5m to 20m.

II. LITERATURE REVIEWS

The mobile phone signal detector was developed by [1], with the objective of designing a sensor that can be used to detect mobile phones in active mode that are communicating. Here a detector circuit was designed to sniff an RF signal ranging from 860MHz to 965MHz within a diameter of 1.5m. When a mobile phone is detected, the buzzer will sound and the LED starts blinking to generate and alert whereas [4] designed and simulated an intelligent mobile detection system that could sense a GSM communication within 1.5m radius and then activate a signal jamming device to disable the mobile network within 5-10meters of the device location. The detecting frequency is between 1820MHz to 1865MHz and jamming frequency is within 900MHz to 1800MHz. The device however had no way of discriminating between two phones within the same frequency. But, [2] worked on implementing a pocket sized mobile phone detector. The design consists of four stages which are the sensor stage, the power supply stage, the Op-amp stage and the response stage. The circuit is powered by a 9V DC battery. When the antenna receives a wireless signal, the Op-amp LM358AN amplifies the received signal which in turn triggers the buzzer and makes the LED to flicker. The device detects active phones within the range of 1.5m radius.

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[5] in his work presented a method for creating, sensing and decrypting a GSM signal using software defined radio and commodity hardware. The project was based on software designed by GNU Free software where GSM packets were transmitted and received over the air. Within the same process, their arrival time is being detected. Based on the information received by the software radio, software analysis of multiple receivers is performed to locate an emitter. The M.Sc. thesis examined the feasibility of implementing a system for locating an emitter of a GSM signal using the time-difference-of-arrival (TDOA) method with software radio and Universal Software Radio Peripheral (USRP).

The design and implementation of a line follower robot was performed by [6]. His work was directed at implementing a mobile machine that can detect and follow a predefined line drawn on the floor (the line can either be a black line drawn on a white surface or a high contrast color). The device incorporates Light Dependent Resistor (LDR) sensors installed under the robot. Here a tuned LC mobile phone detector was used to perceive a GSM communication device from a distance of 1.5m. The robot is designed to stop whenever an active communication is detected.

[7] designed a GSM signal detector with Audio Visual alert indication using Programmable System on Chip (PSoC) mixed signal array. Here, the design incorporates a path follower robot, GSM transmission detector, land mine detector and gas leakage detector as well. The sensors in this design to spot the GSM frequency is connected to the PSoC. When the detector senses these signals, the device generates an alarm and a message indicating "mobile phone detected" is displayed on an LCD screen.

[8] in his paper presented a unique way of detecting explosives in a populated area by the use of mobile phones. He proposed an idea to design and integrate a small cognitive radio sensor into the mobile phone that adapts to a changing environment by analyzing the Radio Frequency in the surrounding area then controlling the spectrum use correctly. The design has the capability of sensing and locating explosives within a specified area. It can as well inform the law enforcement agency of police of the position of the booby trap through a GSM service provider.

[9] developed a Dual Band Mobile Jammer for GSM 900 and GSM 1800. This is an instrument used for preventing cellular phones from receiving signals from base stations. It implements the Denial of Service technique by transmitting noise on the same frequencies of the two bands GSM 900MH, and GSM 1.8GHz. When used, it effectively disables network from cellular phones. The jamming device operates by broadcasting RF signal in the frequency range reserved for cell phones which interfaces with cell phone signals, resulting in "no network available" display on the cell phone screen. The major drawback of this technology is the inability of users to make calls especially in cases of emergency [2]. Also, the use of mobile jammer is illegal in many countries including the USA, even when confined in restricted areas [1].

[10] designed and constructed a dual-band mobile-phone jammer to de-activate the incoming or outgoing phone network signals in examination halls. The jammer was designed to works at GSM 900MHz and GSM 1800MHz simultaneously and thus disables 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.

[11] designed a Cellular Signals Jamming System in 2G And 3G. The design was aimed at implementing a high range, low cost jammer hence, proposed Max2235 as a RF amplifier which provides approximately same range at low cost and less complexity. Max2235 is a low voltage, silicon RF power amplifier designed for use in the 900MHz frequency band. It is capable to provide+32.5dBm output power. For transmitting the generated RF Signal he used a λ/4 wave monopole GSM SMA Antenna, which can operate up to 2.4GHz. It was integrated into a set of components which include such sections as the noise generator (TLO72CP), Mixer Colpitts Oscillator, RF section MAX303 and Power amplifier.

[12] designed a Mobile Signal Jammer Using Arduino. The project is specially designed for Jamming GSM Signals. The Arduino Uno is a microcontroller system based on the ATmega328p. It has 14 digital input/output pins, 6 analog inputs, a 16MHz ceramic resonator, a USB connection, a power jack, and a reset button. DS1307 Real time clock chip is used to set the schedule.

III. Design and Analysis

Methodology

The methodology entailed simulating and implementing each stage of the system before combining the circuits to obtain a wholesome of the system.

A. Operation of block diagram components

Figures 1 and 2 show the block diagram and flow chart of the cell phone detection system with remote jamming capabilities using SMS. The RF sensors block senses the phone signal, and then signals are sends to the microcontroller. Once the microcontroller receives the signal from the RF sensor, it sends signals to the LCD display to alert users in the operation room of phone use activity. The microcontroller also sends an SMS to authorized personnel via GSM module connected to the microcontroller to respond accordingly, either to activate the jammer or reset the system if necessary.

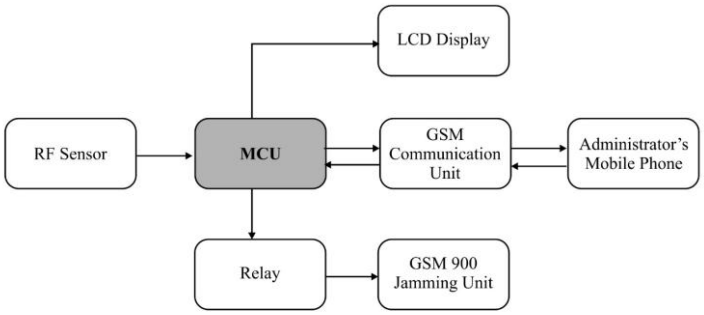

Figure 1: Block diagram GSM phone detector with remote jamming capabilities

B Operation of cell phone detector with remote jamming capabilities

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The system is powered on and the microcontroller begins to scan for a digital input from the input pin. The LCD indicates that a continuous scan process for phone use activity had begun. Whenever an active GSM phone is in operation within range, an input signal of a digital "HIGH" value is passed to the microcontroller. A series of event is triggered on the programmed AVR microcontroller. A display showing "PHONE DETECTED" will be shown on the LCD indicating that a phone used activity had been observed. At the same time, the GSM modem is activated and an "Active phone within restricted zone, send JAMM to stop or RSET to reset the system" message is sent to a preprogrammed phone number which is in custody of the security personnel. The microcontroller then waits for a response from the designated phone number.

The output pin to the relay only goes "HIGH" if a "JAMM" message is received from the designated phone number or manually jammed by the security personnel. However, a "RSET" message will reset the system, thereby allowing the detection circuit to continue its operation. A jam switch is also incorporated in the system to manually activate jamming from the control room.

IV. Implementation, Testing and Results

4.1 Design Using Proteus

Each sections of the circuit were built on Proteus 8 Professional in line with the positions of the components as presented in the block diagram. Stage by stage simulations were carried out to observe its workability, after which a complete circuit simulation was performed to access the overall workability of the complete circuit. After ascertaining that the program was working precisely at the software stage, the hardware was implemented.

4.2 Programming the ATmega328p

The AVR microprocessor used was programmed using the Arduino Integrated Development Environment (IDE) Version 1.6.9. The codes were written in C language and compiled in the same using same Arduino IDE.

This process was however repeated several times after each series of tests to ensure that the program worked perfectly as expected. Figure 3 shows the compilation process of the ATmega328p.

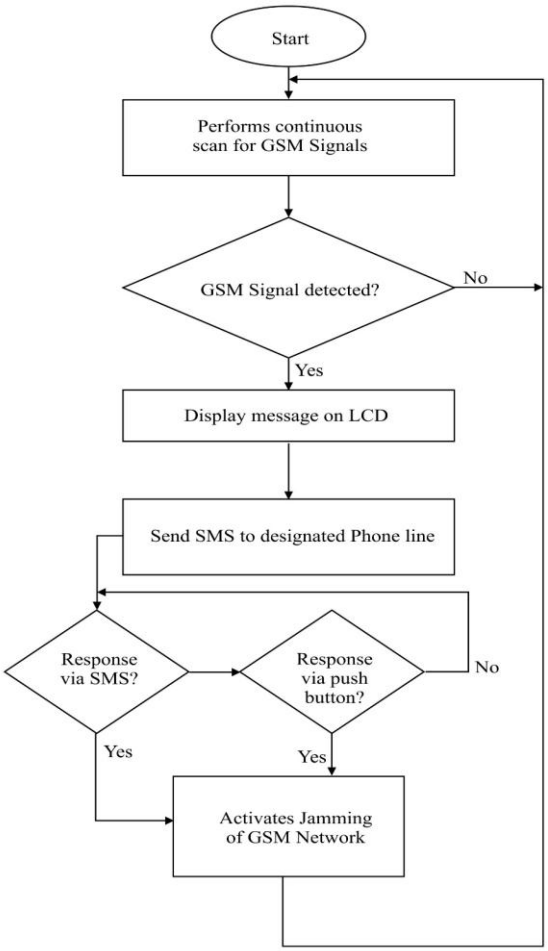

Figure 2: Flow chart for the GSM detection system with remote jamming

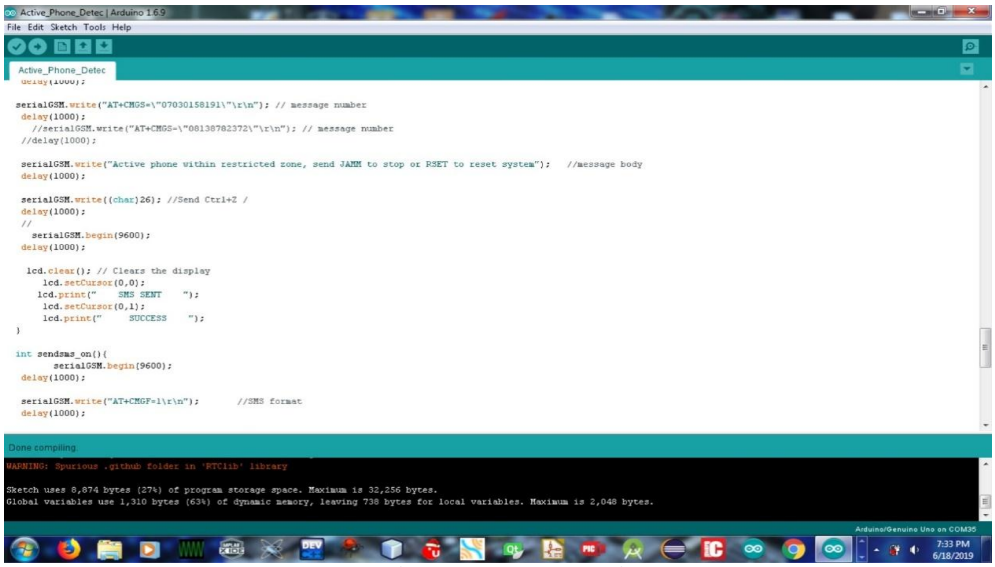

Figure 3: Successful Compilation process of ATmega328p.

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V. CONSTRUCTION

Initial placements of items were done on the breadboard for test before being transferred to the Vero board for final construction. The vero board used is a continuous one. Cutting the Vero board for discontinuity where necessary was also done to prevent short-circuiting of different components. The various units were constructed separately and tested individually before linking them for further tests.

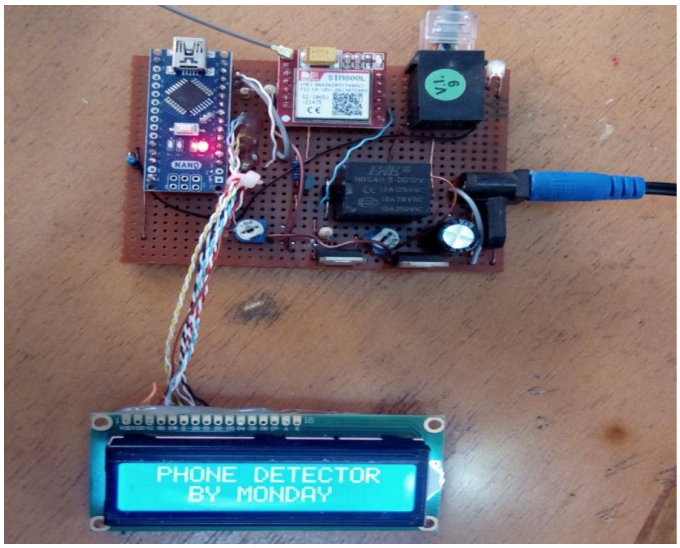

Figure 4: Initialization of phone detector with remote jamming system

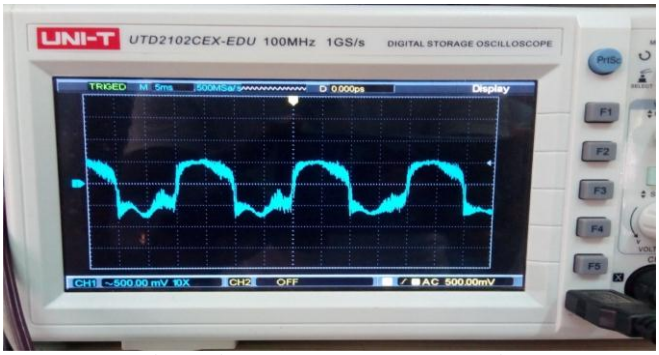

Figure 5: Waveforms of detector circuit when scanning for GSM signals.

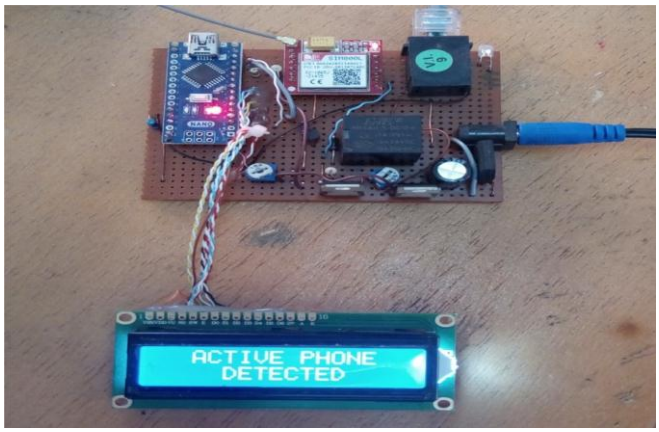

Figure 6: LCD display when GSM signal is detected

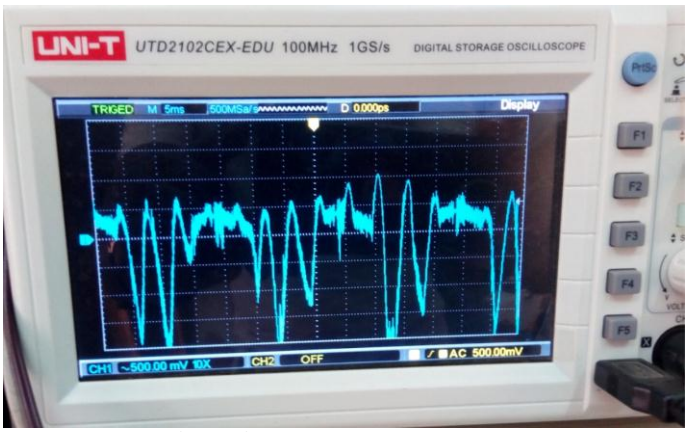

Figure 7: Waveforms of detector circuit when GSM signal is detected

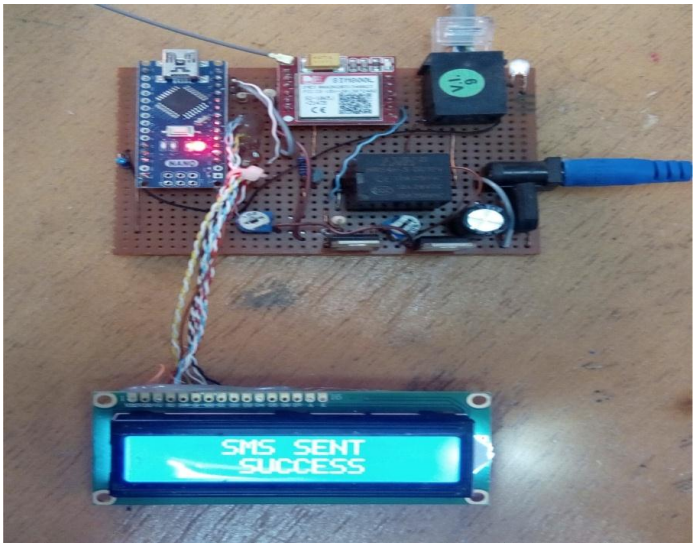

Figure 8: LCD display when a SMS is sent


Figure 9: LCD display when alert is received by the preprogrammed phone and a JAMM code sent

IC sockets were used to make unproblematic replacement of ICs in case of any failure. Flaws such as dry-joints, partial contacts and short-circuiting of components were also removed in the process.

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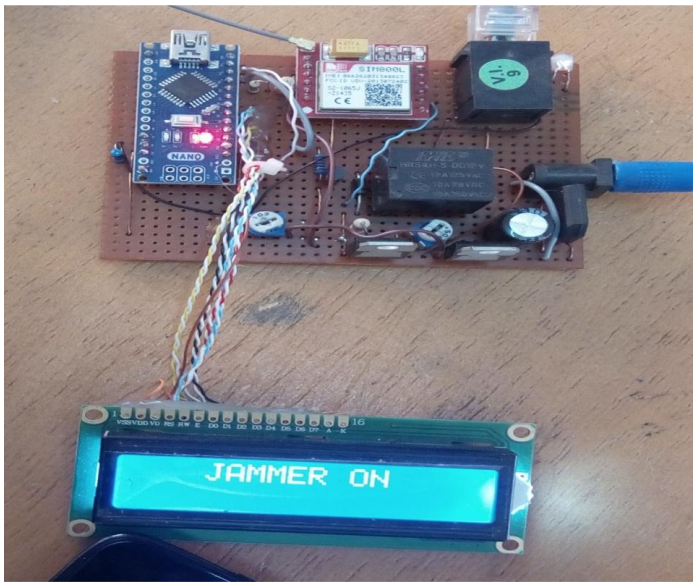

Figure 10: LCD display when Jammer is active

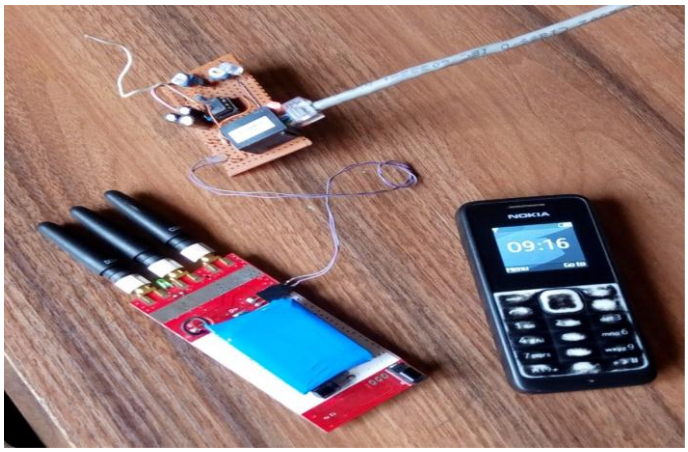

Figure 11: Active phone being jammed

VI. CONCLUSION

Development of a Microcontroller system of signal detector with LED, SMS alert and remote Jamming capability for Security Applications can be deemed as successful following the fact that it had achieved the main objectives targeted. The device which is designed to work mainly in GSM900 band has the capability of detecting all active mobile phones using the four main services in Nigeria. The networks detected include MTN, GLOBACOM, Airtel, and 9mobile. Following the adjusted schematics, SMS transmission and response was successfully achieved. Response time depends largely on availability of SMS service. The major drawback of the implementation is that the radius covered by the jammer circuit is too small and this is due to power supply variation with load current.

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