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AN INTELLIGENT POWER CABLE VANDALISM MONITORING SYSTEM WITH MOTION SENSOR AND TEXT MESSAGE ALERT SYSTEM.

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ABSTRACT

It is an open secret that the transmission lines belonging to power generation, transmission and distribution companies are vandalized by cable thieves. The activities of these vandals are felt by the companies, the economy and society at large. Having a stable power supply is the desire of any government, people and company. This can only be achieved if the installed cables carrying power from the generating stations to the final consumer is not interrupted`/tampered with by cable thieves. Hence the need to monitor/secure the power transmission lines against the activities of cable vandals, along the vandal prone points or remote areas. This research work will tend to achieve this, by the use of an electronics device that is intelligent; that is, it can monitor and report the presence of an individual or persons within the vicinity of the transmission lines by sensing the motion of the vandals, using a PIR sensor, then sends text message to pre-defined numbers and sounding an alarm, if a person attempts to climb the pole at an exact location at any point in time. The alarm is necessary to notify people around and the text message also informs the relevant persons for prompt action. This is important since the network of power cables passes through remote areas as they carry electricity from the power generating stations to the final consumer. This is essential since any security mechanism that is put in place will not function properly if they cannot tell when and where a vandal operates. Thereby making this system very vital in handling the menace of vandalism, that is plaguing the power sector.

1.0 INTRODUCTION

Power transmission and distribution companies do suffer lot of loses as a result of the activities of vandals; who interrupt the network of transmission or distribution cables with a view of stealing the conductors. Which attendant effect is felt by the companies, the economy and society at large. Hence, one begins to look out for ways to electronically monitor the destruction prone points of the transmission or distribution cable, with a view of re-

porting same to the relevant authorities for quick response. This research work will tend to assist both power distribution and transmission companies by designing a system that can detect power line disruption, with the help of motion sensors and a GSM sim800 module that can alert the service provider and other security infrastructure by text message, when someone attempts to climb the poles at a particular location. This system will also function whether there is power or not on the line. The system will also have an alarm that will sound, this will notify the people around especially communities that these cables passed through, that an intruder is at that point.

This is important since the network of power cables passes through remote areas as they carry electricity from the power generating stations to local communities or from substations to the final consumer at remote points, making them vulnerable to cable thieves.

Objectives of the Research are to:

[1] Develop a system that can monitor and report electronically the presence of an individual.

[2] Monitor the presence of an individual using a motion sensor.

[3] Use a microcontroller to read the output of the sensor and determine the use of the signal.

[4] Send pre-installed message Using sim 800 module, when asked to do so by the microcontroller

Adewale, (2014) defined vandalism as a wanton or deliberate destruction of public or private property resulting from vengeance in the case of dissatisfaction against an authority, or an attitude of abysmal disregard and ignorance in the proper use and handling of public and private properties. Thisday Newspaper on their editorial on Vandalism And The Power Sector, (2016) stated that the menace of electricity equipment vandals persists because of the existence of a “market” for the stolen items. It was further noted that these stolen equipment surprisingly turn up for supply by contractors in the sector.Bayo, (2016)said that ignorance is what drives the vandalism of power cables. Similarly the scrap value of power cables makes them target for vandals.

some methods of reducing vandalism includes; the control of physical access and the reduction of the scrap values of copper and aluminum as suggested by Tador (n,d) and the use of electronics means.

Skarbek, (2013) Did a research on the structural health monitoring of overhead power transmission Lines and

reported that Structural Health Monitoring (SHM). The author of this paper did a thorough review related to structural health monitoring of overhead power transmission lines and their supporting structures. Based on this devices existing in the field which were presented and discussed, he introduced fibre sensors as a tool for electric power line monitoring system. Remarking that to measure strains induced by icing, temperature or current loads, the use of distributed sensing networks with Fibre Bragg Grating (FBG) sensors otherwise referred to as Brillouin sensors be employed. From the data obtained through the use of the said sensors, it is possible to compute various useful safety factors.

Asiimwe, Adella, Mwikirize, & Okou, (2014) in theirpaper presents a customized surveillance system to counter vandalism of transmission lines, the system that they designed was able to detect power line vandalism along transmission network. The system that was developed by the researcher was based on the Raspberry Pi platform and seismic sensor, an infra-red enable camera that can view objects even at nights, and a GPRS (General Packet Radio Service) modem made by Huawei.

See, Carr, & Collier, (2008) also confirmed that due to the incessant destruction of electricity equipment by vandals, which is a problem bedeviling developing countries, that electric utility companies are finding it increasingly necessary to better monitor, analyze and control their distribution systems with a view to reducing or possible eliminating this challenge. See et al, (2008)further suggested thatSCADA employed, since it has reached almost universal usage by transmission and distribution utilities of all sizes and makes it possible to monitor and control generators, transmission lines, substations, distribution lines, and in-line equipment and devices.`

2.0 MATERIALS AND METHOD

The system that was developed in this research work, was done using HC-SR501 motion sensor that is used to monitor the motion of an intruder that attempt to climb up the network providers pole, an Arduinonano board designed with the ATMega328 microcontroller that is employed to process the signals in our circuit, a buzzer that sounds when the intruder comes within sensing range and a sim800 module that send text message to pre-coded number

when detection is made.

The complete circuit diagram is shown in figure 1

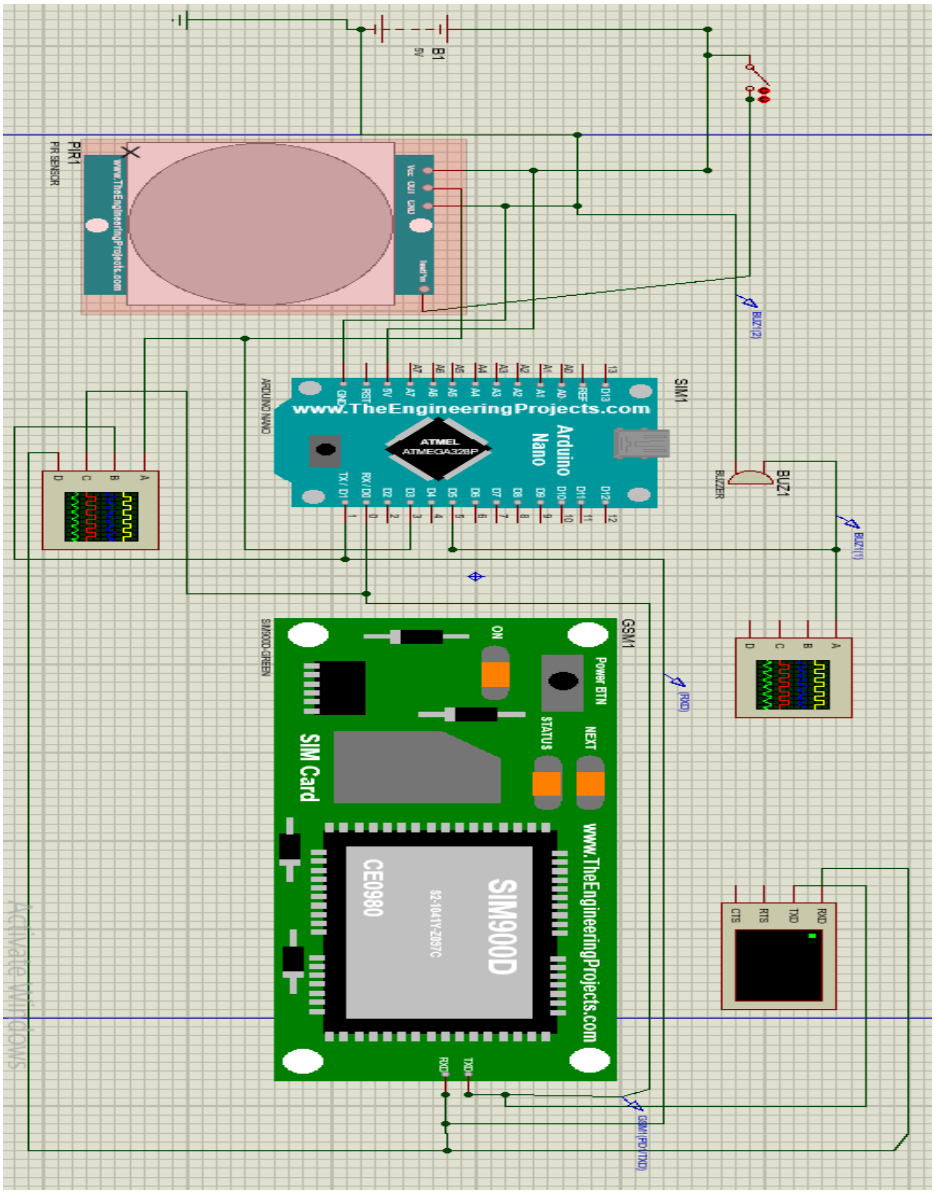

Figure1: Complete Circuit Diagram with Scope and Virtual Terminal

The said circuit is broadly divided into three sections namely, the sensing section made up of the motion sensor which is used to convert human movement into a signal that the controller can use (Bodurin, 2017), signal manipulation/ conditioning section made up of the Arduinonano and the output section made up of the buzzer and sim800 as can be seen in figure 2.

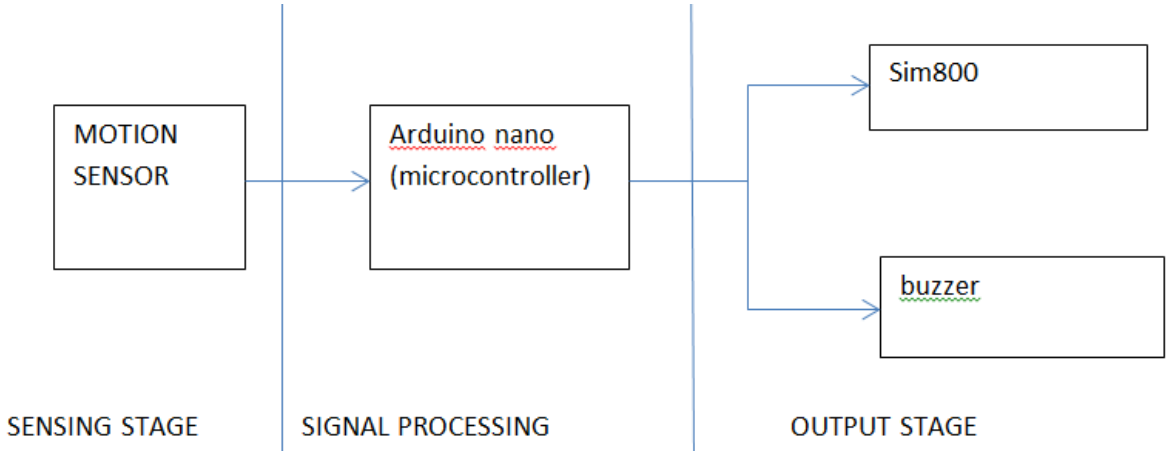

Figure 2: System Block Diagram

The system developed in this work is designed with each component connected on a PCB board. The flowchart used in developing the software program that controls the device is given in figure 3. The PCB layout was initially designed on Proteus 8.6 professional environment. This layout is then printed out on photo paper using a laser printer. The printed track lines are transferred from the glossy paper to the board through the application of heat. This heat is applied consistently for 30minutes for optimal result. The PCB board is etched manually by immersing the copper clad board in ferric chloride solution and for 10minutes. The board is then rinsed, dried and component holes drilled. Each component is carefully placed and soldered accordingly.

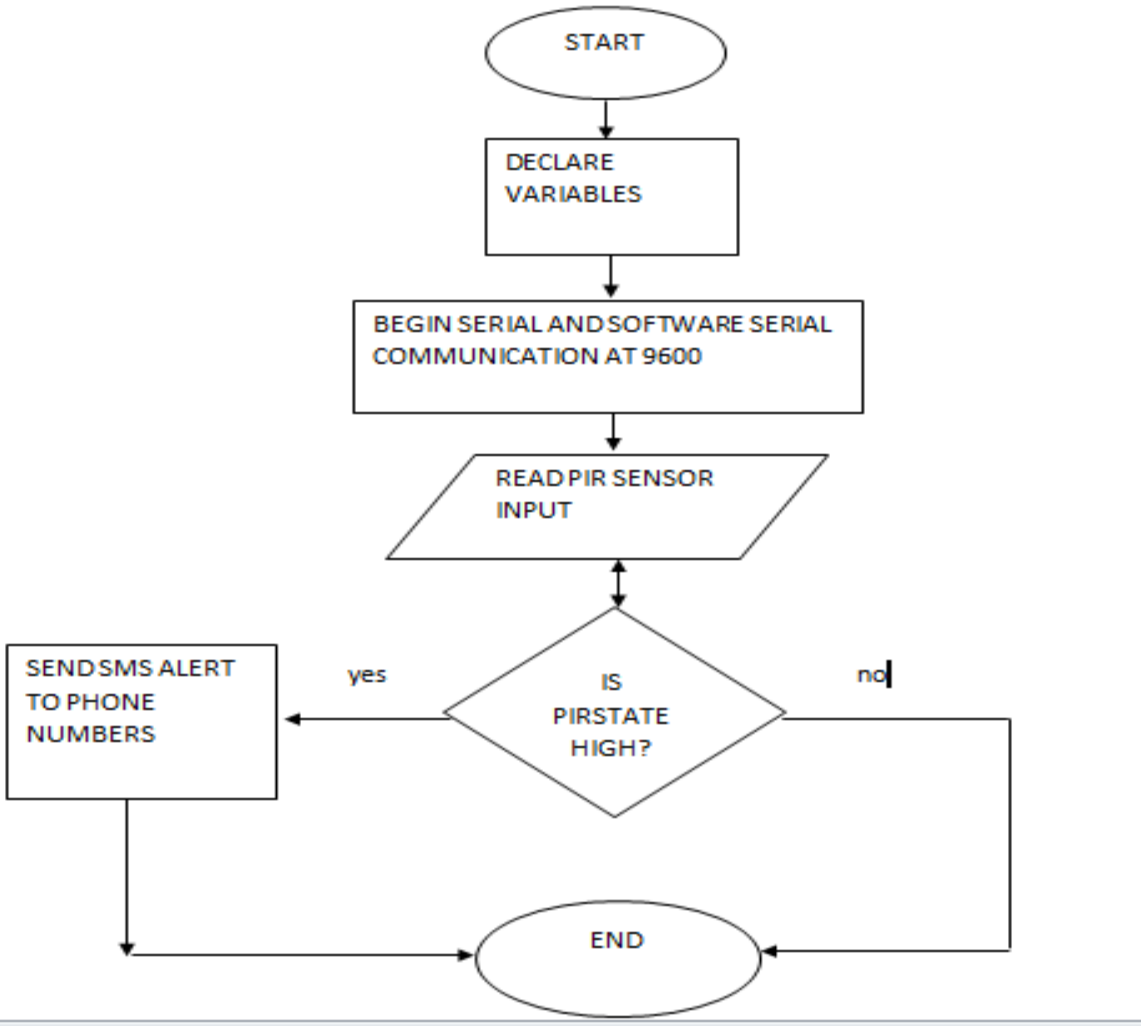

Figure 3: Chart of software development

3.0 RESULT AND DISCUSSION

I. Performance Evaluation of the Motion Sensor

Once motion is detected within the sensing range of the PIR sensor, the Rx (received signal) of the microcontroller changes from one to zero immediately, it takes about 70ms for the PIR to change state from zero to one, it is at this point that the system starts loading setup files with both the signal state of the signal received by the microcontroller and the transmitted signal changing state to one, as can be seen in figure 4.

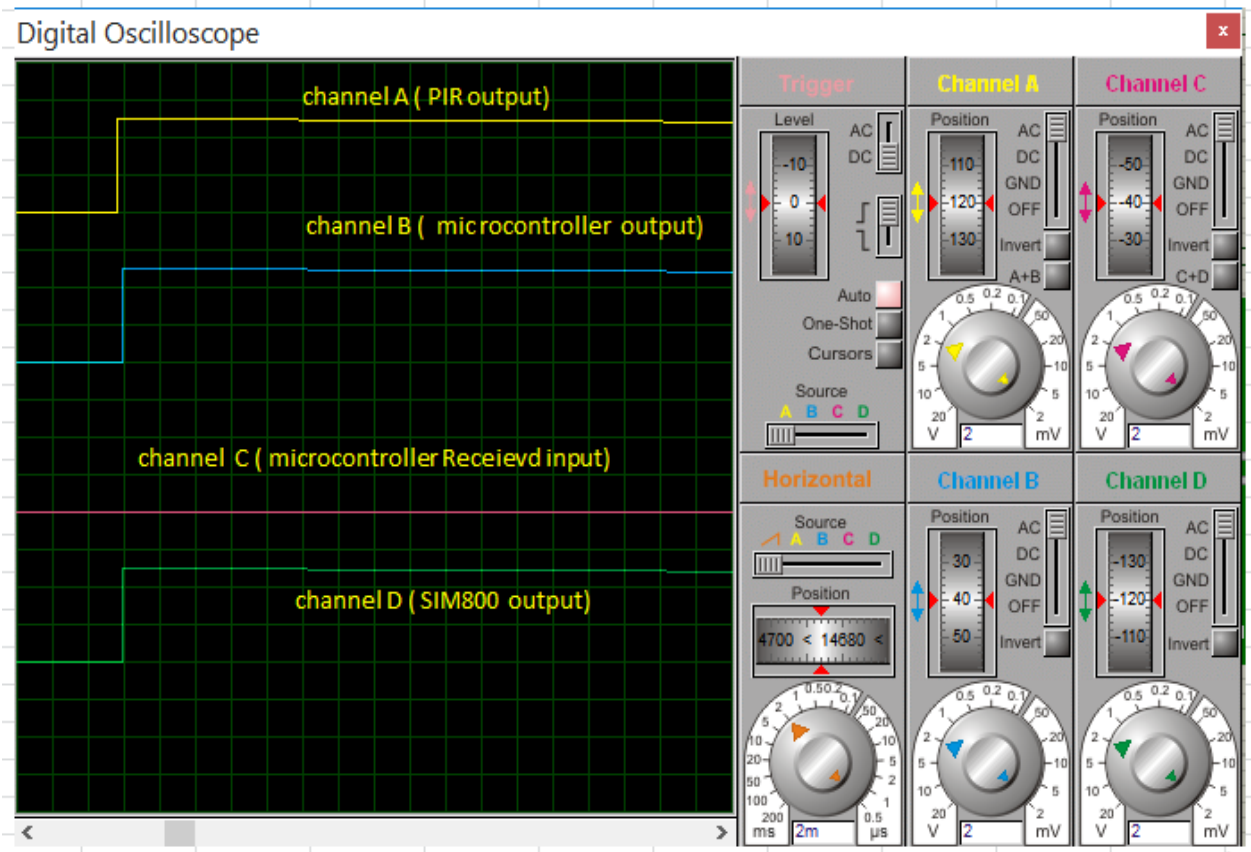

Figure 4: Graph of Motion Sensor Reaction to Motion Detected

When there is no motion (nobody within the sensing range), the PIR is in-active state, with its output pin having no output. This can be seen in figure 4 with the output signals from the PIR (yellow lines), the microcontroller (green lines) and that to the virtual terminal (blue lines) remaining at zero. It is only the microcontroller received signal (pink lines) that drops from 1 to zero, indicating that our micro controller has been powered on, shown in figure 5.

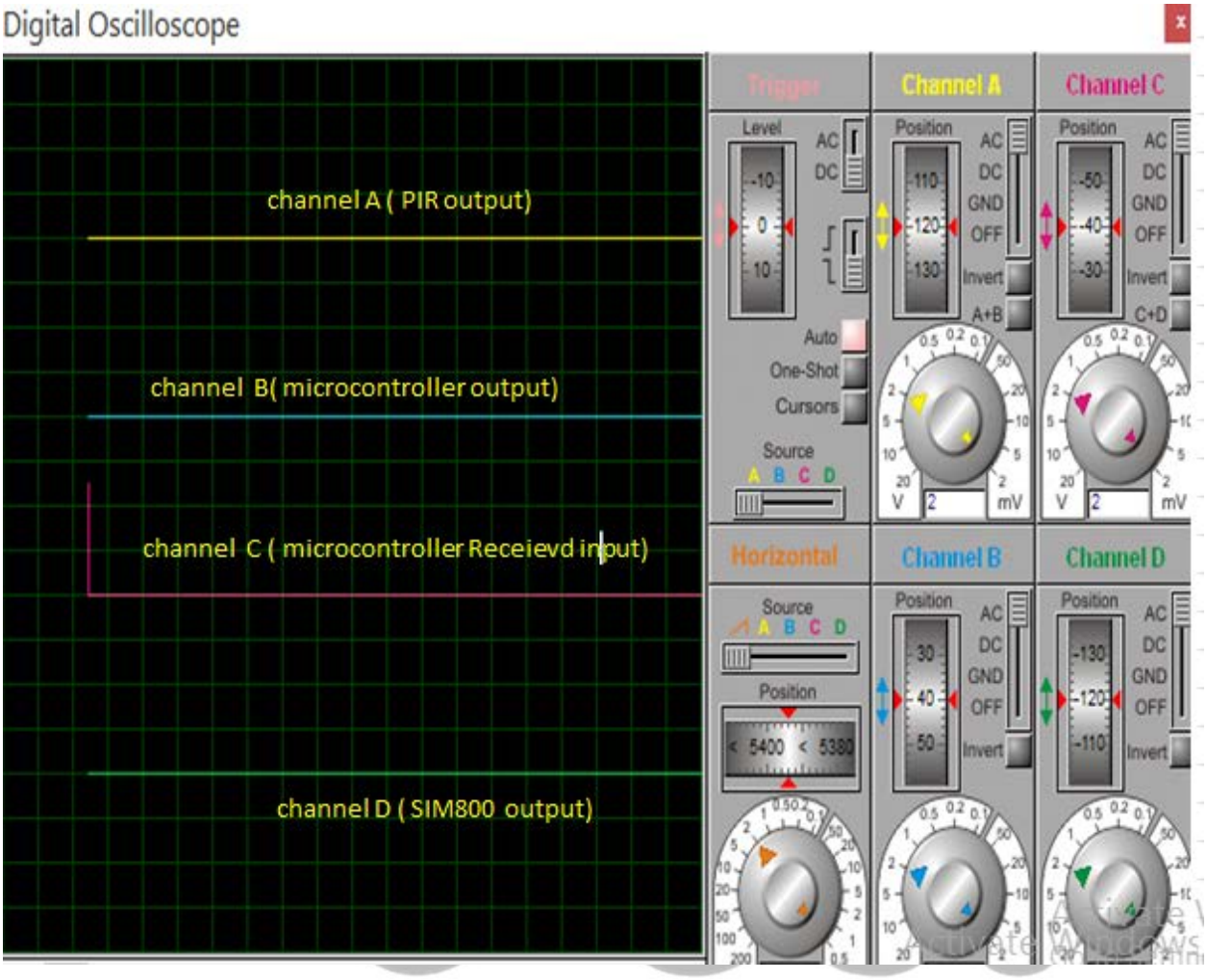

Figure 5:Graph of Motion Sensor Reaction to No Motion

II. Performance Evaluation of the Arduino Nano (Microcontroller)

The microcontroller always checks the state of the PIR if its state is low or high, if it senses a high it starts to send messages to the SIM800 immediately after it completes loading set up files from its memory, which it does in about 170ms, shown by the virtual terminal in figure 6.

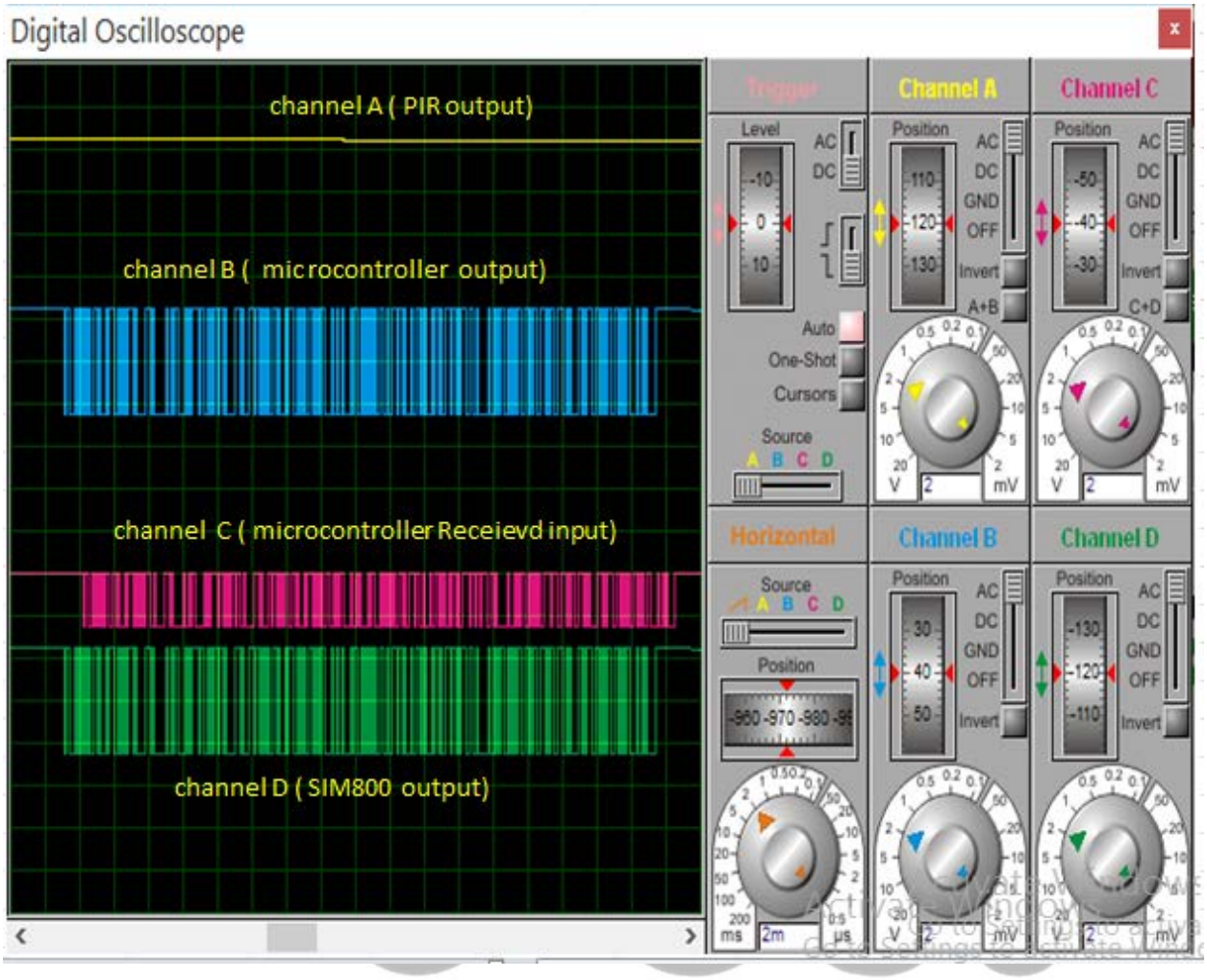

Figure 6:Reaction of Microcontroller to Motion

The signal sent by the PIR sensor is received by the microcontroller through digital pin 2. The signal received by the microcontroller is checked for its corresponding states. If LOW (0V), the microcontroller interprets this to be the absence of human presence, within the sensing range of the sensor. If HIGH (3.3V-5V), the controller interprets this to be human presence. The microcontroller thus sends a logic HIGH to the buzzer, which actuates an alarm after 5 seconds delay and then transmit its pre-installed data to the next module.

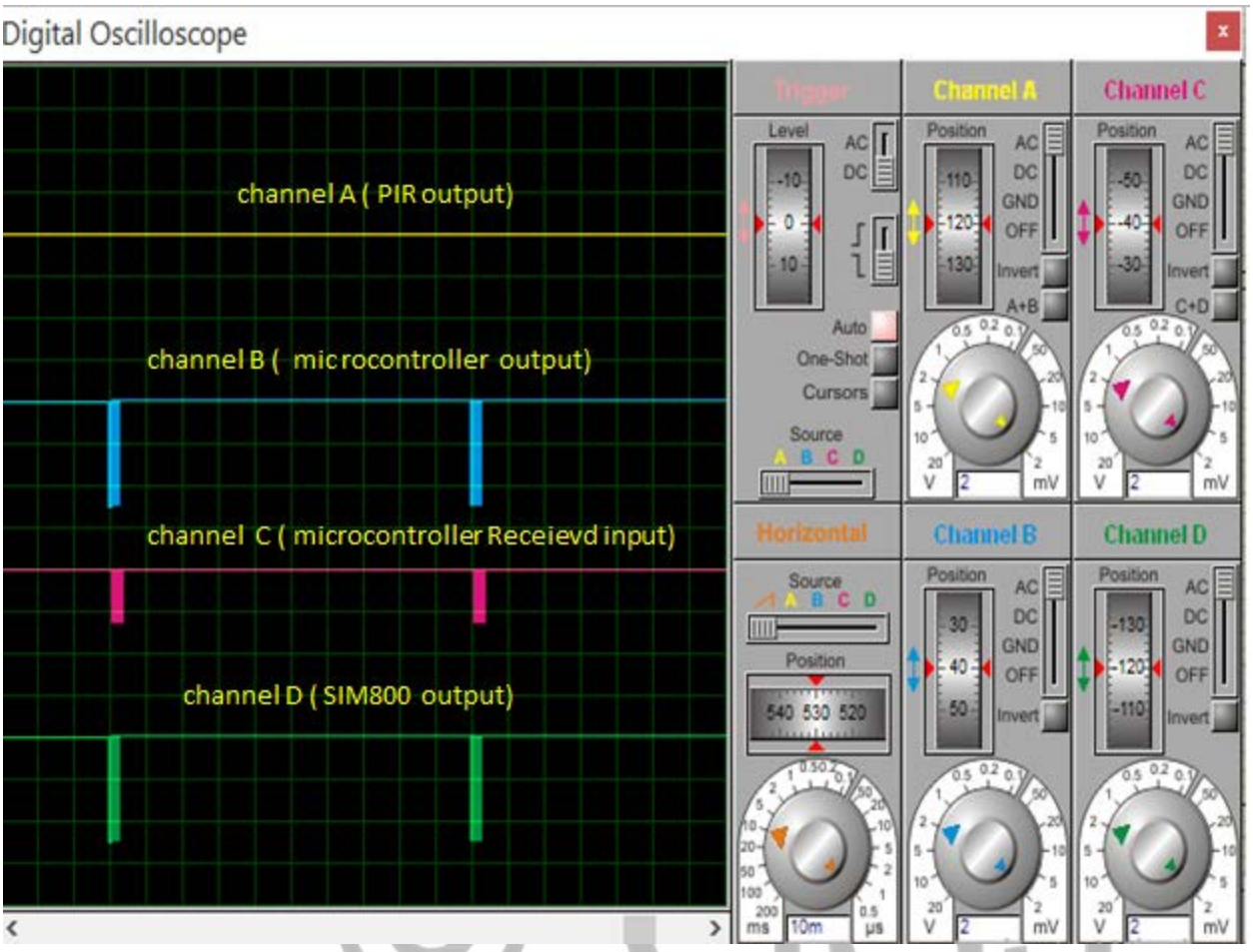

Figure 7: Reaction of Microcontroller to No Motion

After our pre-installed message has been sent, the program loop in the microcontroller still continues as can be seen in figure 7 in every 100ms, implying that it is continually checking the state of the PIR. If zero, the loop continues but if 1 the device repeats sending message.

III. Performance Evaluation of SIM800 Module to Send Pre-Installed Message.

When a HIGH signal is received from the PIR sensor, the microcontroller through the use of “AT commands” send begins a software serial communication with the SIM800 module. These commands are sent from the Tx pin of the Arduino Nano to the Rx pin of the sim800 module, which sends the pre-written text message to the pre-assigned phone numbers., with the words; “ Vandal Alert at Pole one”.

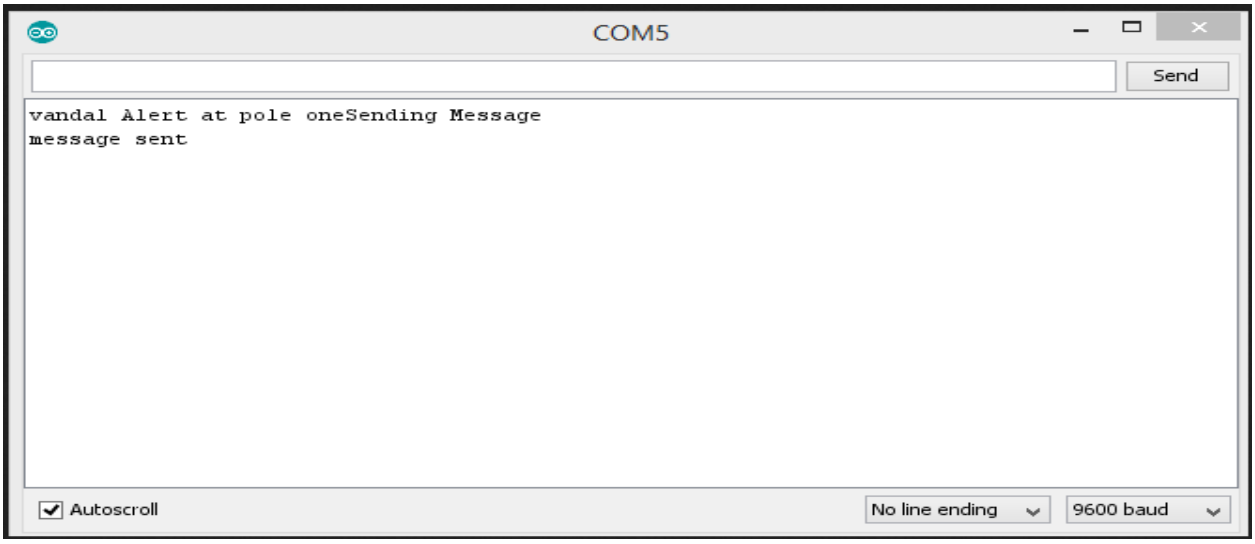

Figure 8:SIM800 Sendig Alert

4.0 CONCLUSION

From the result so far one can see that;

It is possible to report the presence of an intruder from a remote area electronically by using a motion sensor. When any human comes within the field of view of a motion sensor the infrared rate generated by the human body falls on the first side of the sensor. This makes its voltage to rise more than that of the second sensor plate. The voltage difference is what is amplified and interpreted as human presence which is the first step to identifying the intruder intended spots.

That a microcontroller which is basically a computer without a keyboard and peripherals can read and interpret the signal from the input transducer and take relevant actions as specified in its code. The program for the micro controller is written in C++ Language and Arduino and Proteus Professional application were used for writing the code, design and simulation of the system to study the expected behaviour of the system. The microcontroller is what controls the actuator (speaker for sound and sim800 module) to come in and carry out their designed purposes.

That a text message already written and stored in the microcontroller can be sent to pre-coded numbers whenever human presence is detected by the input transducer (motion sensor) informing them of the presence of a human in the vicinity of their poles,

An alarm can sound when a human is found within the monitored space of the power cable lines.

These steps are very vital in tackling the problem of vandalism of power cables transmission lines, that is plaguing the power sector; hence giving the service provider timely and accurate information that is needed for appropriate action(s)..

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