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An Implementation Of A Gsm Controlled Security Robotic Vehicle

Peter A. Akor[1] Jonathan A. Enokela[2] David O. Agbo[3]
[1, 2, 3]Department of Electrical and Electronics Engineering, Federal University of Agriculture, P.M.B 2373, Makurdi, Benue State, Nigeria

ABSTRACT— *Over the years, robotic vehicles used in unmanned rescue missions, security in jewelry stores, military combat, security in bank vaults and many others, make use of wireless technology in controlling the vehicles. The major drawback of these wireless unmanned robots is that they make use of radio frequency (RF) circuits for maneuver and control. Principally, RF circuits suffer from the disadvantageof limited control range. To overcome this challenge, other methods have been implemented which make use of the global system for mobile communication (GSM) network and the dual tone multiple frequency (DTMF) function of a cell phone to control the robotic vehicle. Although this work uses the same principle as the technology of the GSM network, it essentially shows the construction of a circuit using Graphical User Interface (GUI) and GSM modules which send commands to control the movement of the vehicle with the use of a microcontroller. The GUI generates different coded signals with the help of visual basic. These signals are transmitted through the communication (COM) port of the personal computer (PC) to the GSM module interface. These commands are sent wirelessly to another GSM module interfaced with the microcontroller and they control the robot accordingly. As the vehicle moves about the target area, once human presence is detected by the PIR sensor interfaced with the microcontroller, the onboard global positioning system(GPS) module interfaced with the microcontroller sends both the latitude and the longitude information of the detected human presence to the control station via the GSM module to initiate emergency response from the control station. The robotic vehicle was implemented, the PIR sensor detected human presence and sent an SMS containing the latitude and longitude of the location to the control station which was viewed from the Google Map on the GUI application. GUI Commands sent from the remote robot control station were received and the robot moved accordingly.*

Keywords*- GPS; GSM; GUI; Microcontroller; PIR; Robot.*

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I. INTRODUCTION

Many researches have been carried out on the general concept of remote controlled system. The main target is to control electronic gadgets from a certain distance. Initially, only one gadget could be controlled within a very short range. However, the recent advances in technology, telecommunication networks and electronics make it possible to control a host of applications from a very long distance. Although wireless Fidelity (Wi-Fi) enabled devices could transmit data and receive data and control devices remotely, the network has a limited frequency range and is easily affected when there are obstacles such as walls, trees, etc. Bluetooth technology has also been used as a medium for sending and receiving data but it can only work for a very short distance. Finally the infrared (IR) systems which employ the infrared technology work only on the principle of line of sight (Mandakini *et al.*, 2015).

Different types of technologies have been deployed over the past few years with a view to controlling a robot from a remote location. Bourdillon *et al.* (2015) present a method whereby a GSM/RF based remote control system is used to control a robotic car. This is done in such a way that to control the robot, the user makes a phone call to the phone attached to the robot which automatically answers the call. During the phone call, the user can control the robotic car with the keys on the phone. Hence the user can control the robotic car from anywhere no matter the distance without interference so far as the robotic car can be seen by the user. Dharmani (2009) used an IR Remote system to control a robotic car which uses two pulse width modulation (PWM) channels of ATmega8 microcontroller for controlling the speed and direction of the car. Although speed control of the car was made possible, the car was unable to make a turn. Poor range of control and line-of-sight alignment was also a problem. Mandakini (2015) designed an unmanned vehicle targeted at helping to increase human safety by enabling the human to control the vehicle from remote locations. Gupta *et al.* (2013) and Ranu *et al.* (2013) were able to control a robotic car using DTMF signals with the use of a microcontroller. In these works, the received tone is processed by an ATmega16 microcontroller with the help of DTMF decoder, MT8870 (MT8870D-Datasheet-Oct, 2006). The MT8870 decodes the DTMF signal into its binary equivalent and this is sent to the microcontroller programmed to take a decision for a particular input and outputs its decision to the motor drivers in order to drive the robot forward, backward, left or right. In situations where there is no GSM network, these robots cannot be controlled hence there is need to add an alternative way for controlling the robotic car. Fadnavis (2012) aimed at illustrating a notable application using the microcontroller 8051 (Atmel Corporation, 2001). This application proposes a new and unique technique to regulate wireless car with the help of GUI. In this project, a GSM based wireless system is used for efficient communication. A GUI is designed from visual basic to control the direction of the robot. The GUI commands are sent as an SMS through the GSM module interfaced with the PC to the GSM module that is interfaced with the microcontroller on the robotic vehicle. Once the GUI command is received from the control station by the GSM module on the robotic vehicle, the microcontroller processes the command and sends it to the motor driver which directs the motor to proceed according to the command received. With this method, the robot can be controlled from any location within the coverage area of the GSM network without having to attach a mobile phone to the robot or making a call to the robot as in DTMF applications. Also with the GSM module interfaced with the microcontroller, two important features has been attached. A PIR sensor interfaced with the microcontroller will detect human presence in the target location and notify the control station through an SMS containing the latitude and the longitude data of the location of the vehicle through the GPS module that is also interfaced. These data can be used to view the location from the control station through the Google map loaded on the GUI or given to security personnels and rescue teams as the case may be.

II. MATERIALS AND METHODS

The block diagrams for the robotic system are shown in figures 1(a) and 1(b). Figure 1(a) shows the robot control station where a GSM module is interfaced with the COM port of the PC that hosts the GUI developed from visual basic. Figure 1(b) essentially consists of a PIC microcontroller which serves as the brain connecting all other components together. The GSM module is connected directly to the microcontroller. This GSM module receives commands from the GUI through the GSM module attached to the PC according to what was programmed. These commands are used to control the movement of the robot in various direction. Visible on the diagram is a motor driver and motors which receive command from the microcontroller and proceeds in the desired direction. Interfaced with the microcontroller also is a PIR sensor which detects human presence and sends an SMS containing the latitude and longitude information of the location received by the GPS module to the control station. The received data uploads the Google map immediately on the GUI once the PC is internet enabled. The LCD displays the status of the robot. The circuit used in simulating the operations of the robotic vehicle was built in Proteus Design Suite Version 8.0 (Labcenter Electronics, 2015) and is shown in figure 2.

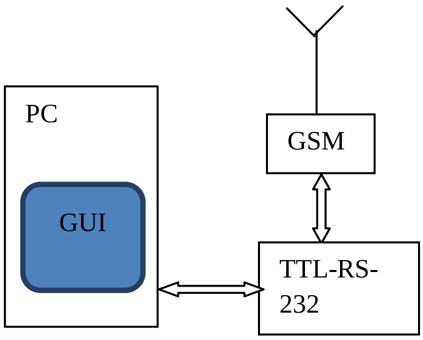

Figure 1(a): Block Diagram of the Robotic Vehicle Control Station

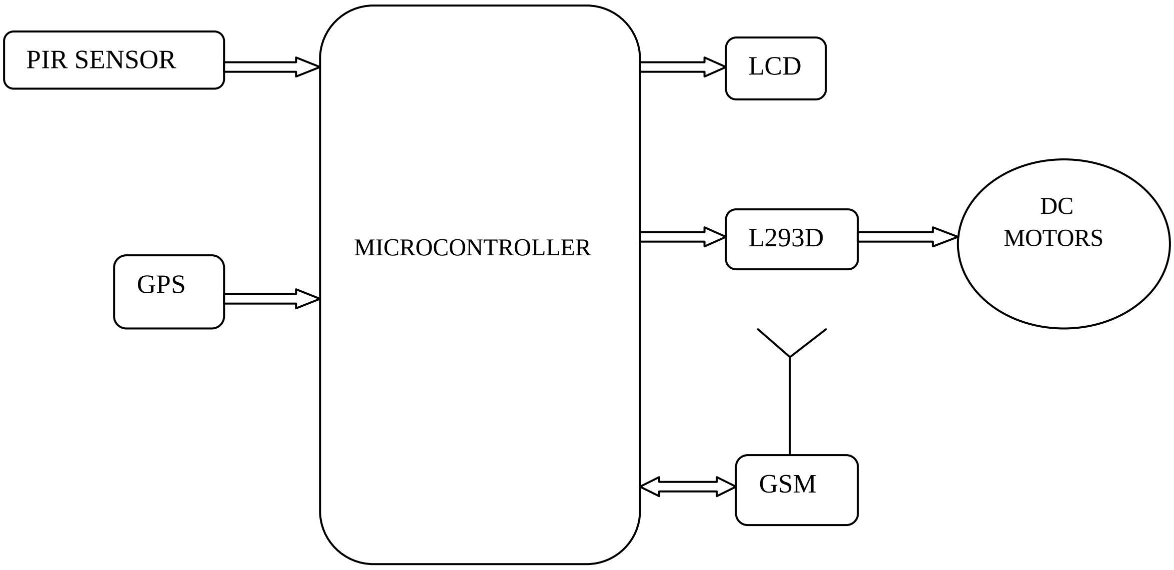

Figure 1(b): Block Diagram of the Main Robotic System

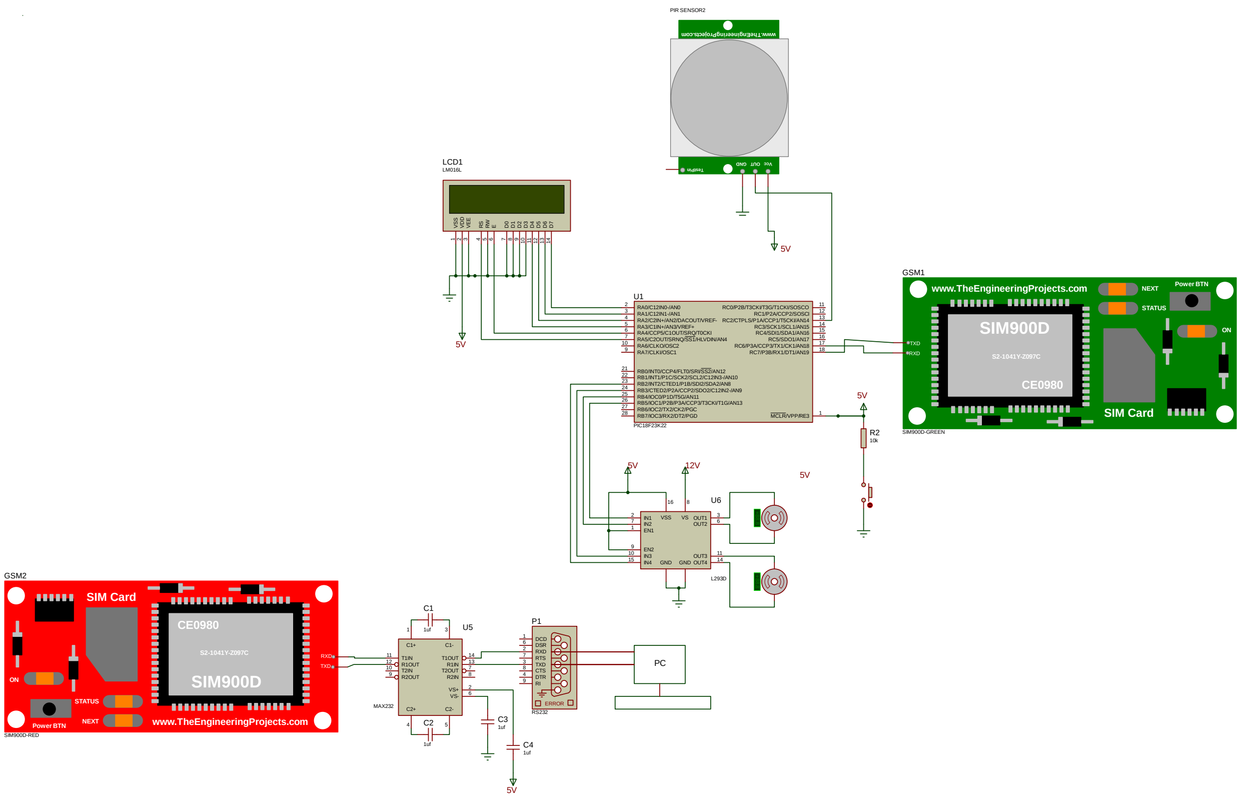

Figure 2: Schematic Diagram of the GSM Controlled Robotic Vehicle

III. RESULTS

The PIC microcontroller was programmed using C language and the hex file was generated using the MikroC IDE Version 6.6.1 (MikroElektronika, 2015). The hex file was loaded into the Proteus Design suite IDE where the hardware circuit shown in figure 2 was simulated and later constructed. The development of the program is shown in figure 3. Figure 4 shows the simulation result for the GPS data received. Upon successful completion of the simulation, the systems hardware was constructed on the Vero board and the results obtained after the construction of the circuit are shown in figures 5, 6, 7 and 8.

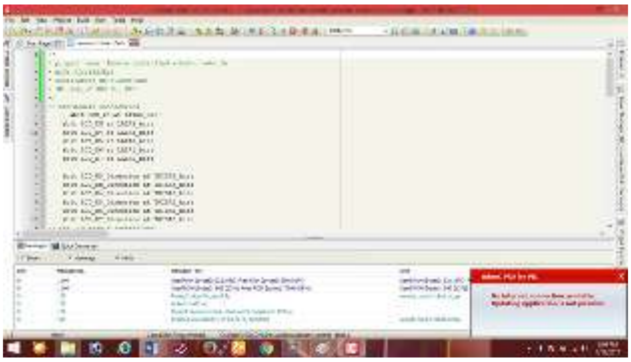

Figure 3: Program Development Using MikroC IDE

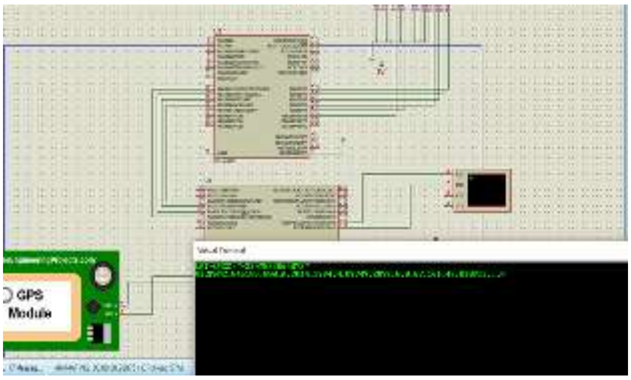

Figure 4: Simulation of the GPS Module

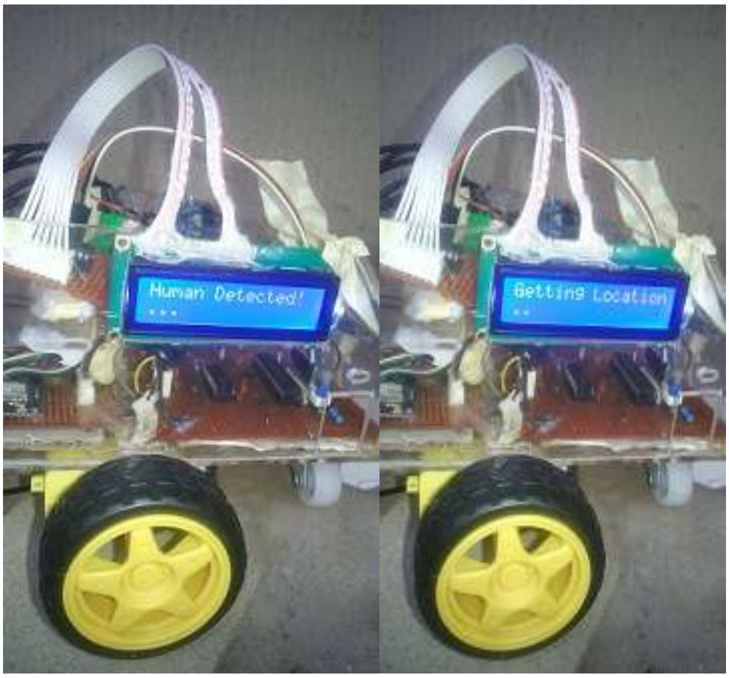

Figure 5: LCD Showing Human Detected and Acquiring GPS Data

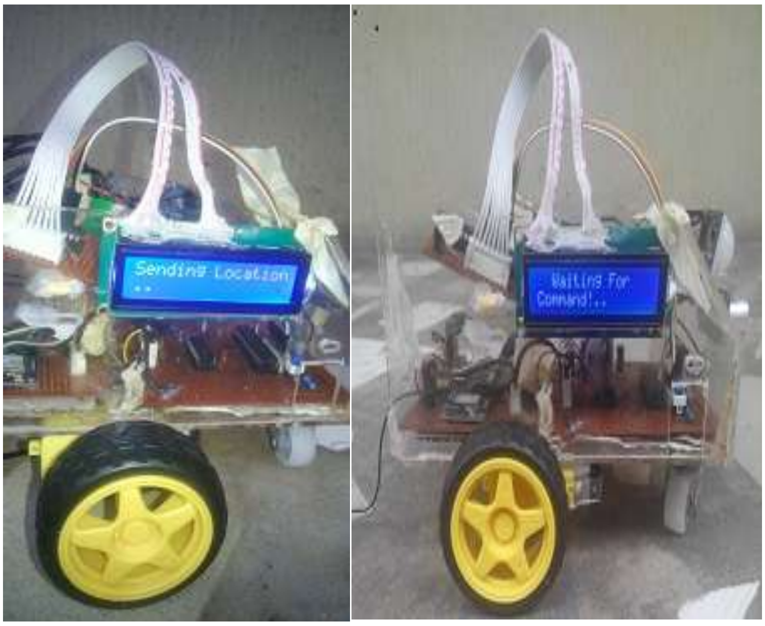

Figure 6: LCD Showing the Vehicle Sending GPS Location and Waiting for Further Command from the Control Station

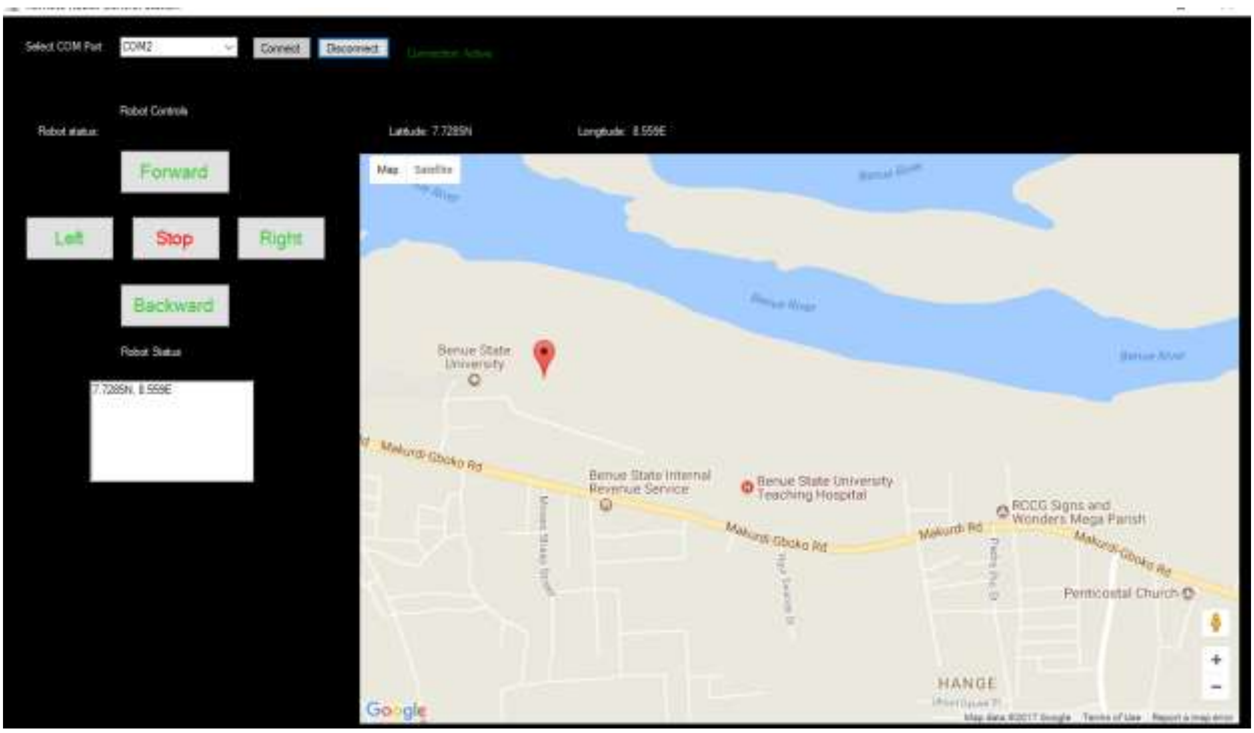

Figure 7: The GUI Showing the Location of the Remote Robot on Google Map at the Control Station.


Figure 8: The Remote Control Station and the Robotic Vehicle

IV. DISCUSSION

From the results, control commands sent from the GUI was received and the security robotic vehicle was controlled from any distance within the coverage area of the GSM network used in the implementation of the design. The PIR sensor was able to differentiate between human beings and objects placed on its path. However, it was observed that the functionality of the PIR sensor is affected by light rays. It detect changes in radiation, therefore it works better under a constant light source. The constant GPS location data sent to the control station enables the controller to know and view the position of the vehicle at intervals of time. Thus, this system also performs the function of a data pushing GPS tracker. Nevertheless, thereception of signals by the GPS module is not uniform in every place.

V. CONCLUSIONS

The GSM controlled security robotic vehicle has been designed and implemented using a PIC Microcontroller. The use of GSM module instead of a mobile phone on the robot for the reception of control commands makes the system to be low cost and provides the flexibility of further programming. The robot can function in terrains inaccessible to human beings while being monitored from the remote control station using the GPS and Google map applications. The system provides a solution to the security challenges in a secured (conditioned) environments by notifying the operators of any unauthorized presence in the target location. This notification which includes the latitude and longitude data of the area under surveillance can be given to security personnel for immediate response.

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