Design and Implementation of a GUI Controlled Robotic Vehicle

Peter A. Akor[1], Anande Joseph[2], Attai I. Abubakar[3]
[1, 2, 3] Department of Electrical and Electronics Engineering, Federal University of Agriculture,
P.M.B. 2373, Makurdi, Benue State, Nigeria
[1]Email: akorpeters@gmail.com, [2]Email : anandejoseph@yahoo.com, [3]Email : abubakarattai@gmail.com

ABSTRACT

In the recent past, robotic vehicles used for various applications make use of wireless technology in controlling the vehicles. The major drawback of these wireless unmanned robots is that they normally make use of radio frequency (RF) circuits for maneuver and control. Principally RF circuits suffer from a lot of disadvantages such as limited control and limited frequency range i.e. working range. To overcome these challenges associated with RF control, 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 and direction of the vehicle with the use of a PIC microcontroller. GUI is the main controlling system of the vehicle. The GUI generates five 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 as a short messaging services (SMS) to another GSM module interfaced with the microcontroller and they control the robot accordingly. As the vehicle moves about the target area, once any GUI control button is clicked on the PC, an SMS is sent is through the GSM module interfaced with the PC to the GSM module on the remote robotic vehicle to control the direction of the robot.This robotic vehicle was implemented, GUI Commands sent from the remote robot control station were received and the robot moved accordingly.

Keywords: GUI, GSM, Microcontroller, Remote Control, Vehicle.

1. INTRODUCTION

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) on the design analysis of a GSM/RF based remote controlled robotic car presents 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) on IR remote controlled car 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) on design and implementation of unmanned ground vehicle using GSM network designed an unmanned vehicle targeted at helping to increase human safety by enabling the human to control the vehicle from remote location. This paper describes the design and implementation of unmanned vehicle which is controlled or handled by SMS or called with the help of GSM network. Similar works by Gupta *et al.* (2013) on design and implementation of mobile operated toy car by DTMF and Ranu*et al.* (2013) on GSM mobile controlled robotic car 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. The decoder 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) on the design of GUI based wireless robotic car aimed at illustrating a notable application using a microcontroller 8051. This application proposes to a new and unique technique to regulate wireless car with the help of GUI.

In this project, we are using a GSM based wireless system 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 interfaced with the microcontroller on the robotic vehicle. Once the GUI command is received as an SMS 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.

2. MATERIALS AND METHODS

The block diagram for the robotic system is as shown in figures 1(a) and1(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 directions.Visible on the diagram is a motor driver and motors which receive command from the microcontroller and proceeds in the desired direction. 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 2.0

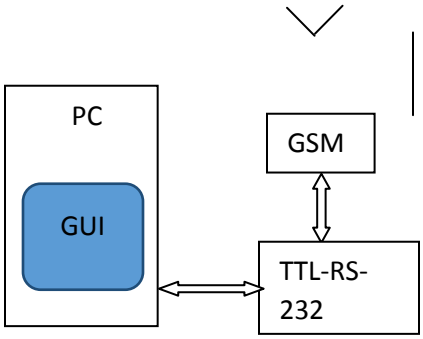

Figure 1: Block Diagram of the Robotic Vehicle Control Station

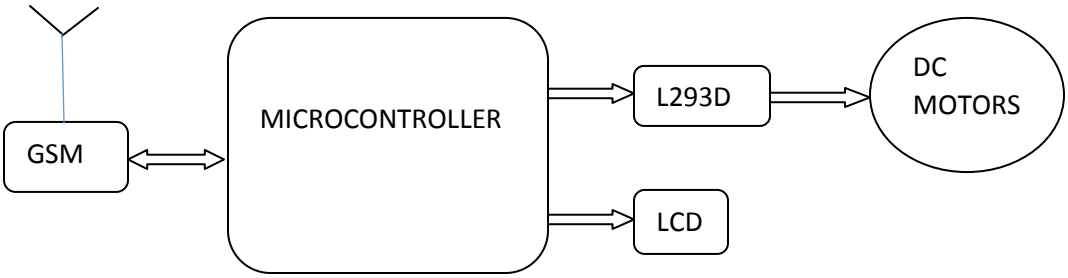

Figure 1(b): Block Diagram of the Main Robotic System

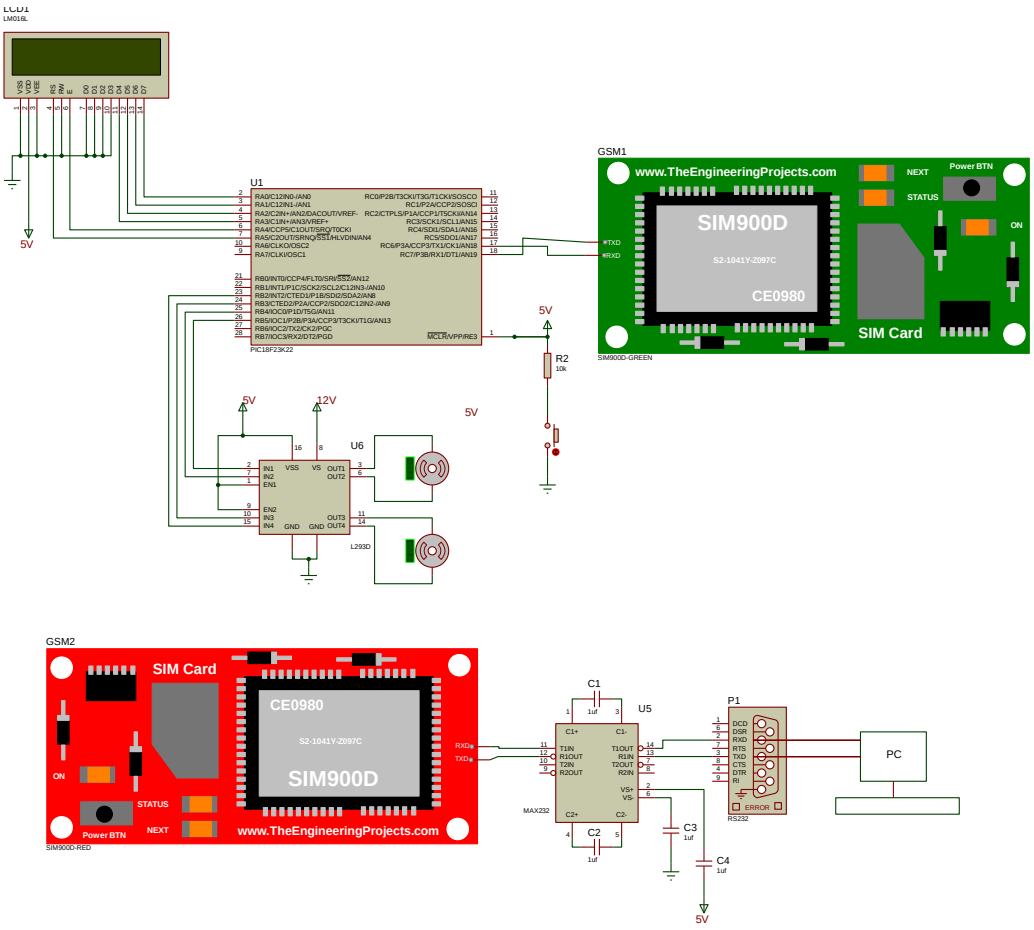

Figure 2: Schematic Diagram of the Simulation of the GUI Controlled Robotic Vehicle

3. RESULTS

The PIC microcontroller code was written in C language and the hex file was generated using the MikroC IDE Version 6.6.1 (MicroElektronica 2015). The executable file was next imported into the Proteus Design suite IDE where the hardware circuit shown in figure 2 was constructed and simulated. The program development is shown in figure 3. Figure 4 show the simulation result for the configuration of the GSM module. The GUI that controls the movement of the robot was designed using visual basic and shown in figure 5. 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 figure 5.

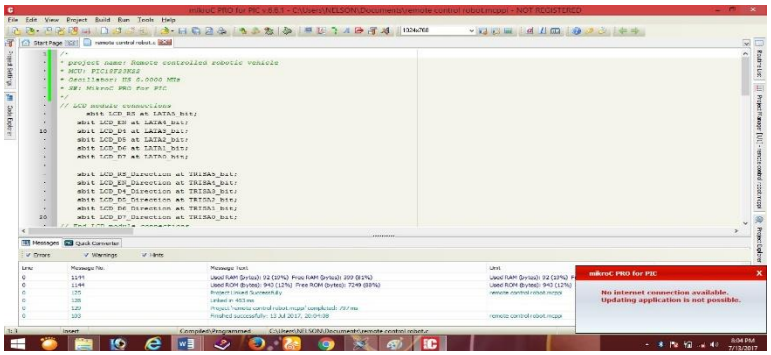

Figure 3. Program Development Using MikroC IDE

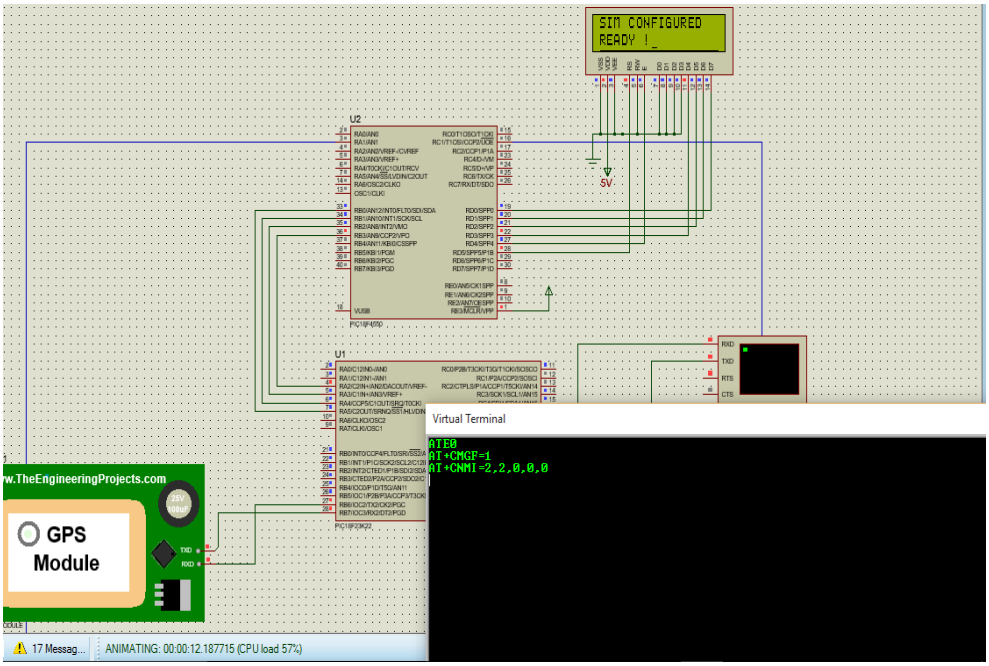

Figure 5: Simulation of the GSM Module

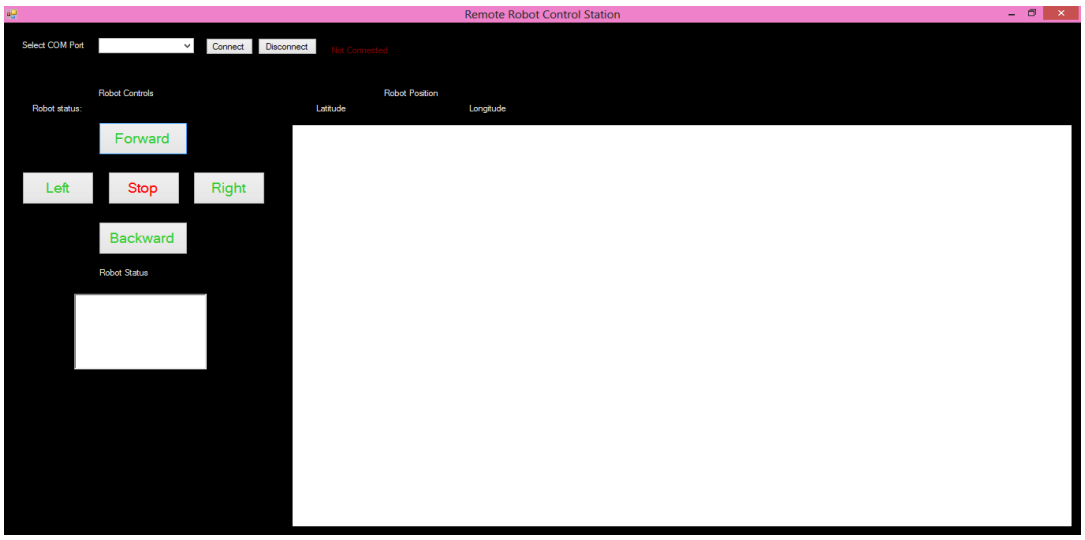

Figure 4: The Remote Robot Control Station

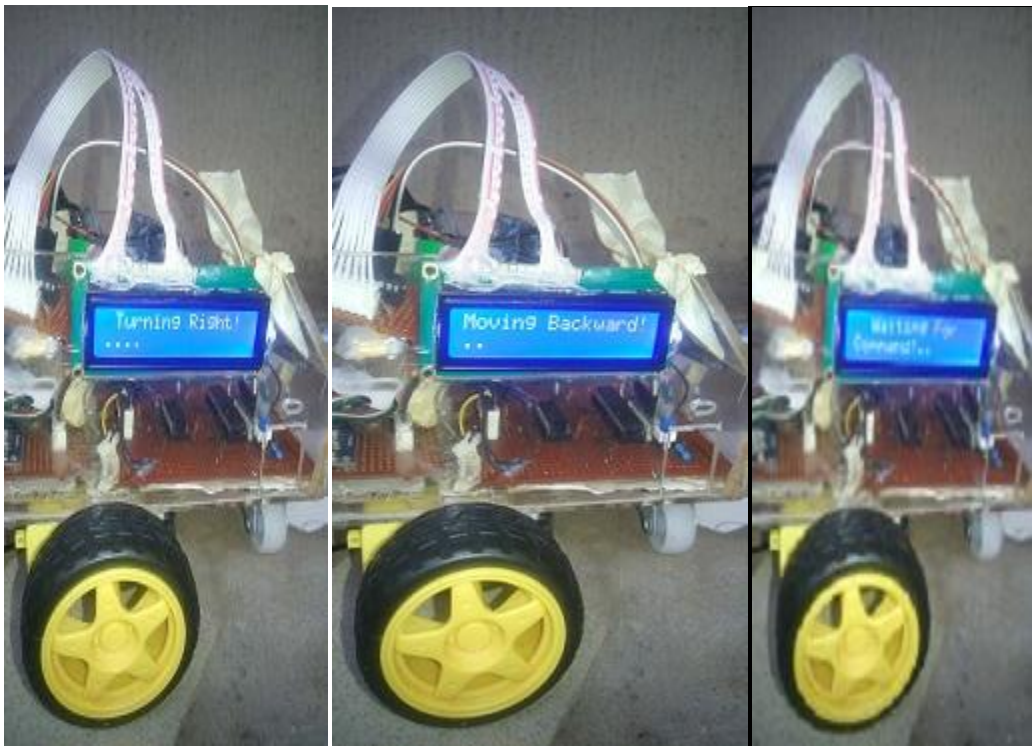

Figure 5: LCD Showing Few Results of the Constructed Work

4. DISCUSSION

From the results, control commands sent from the GUI was received and so the security robotic vehicle was controlled from any distance within the coverage area of the GSM network used in the implementation of the design. It was observed that SMS delivery time varies according to the network condition at which the SMS is sent. The faster the GSM network, the faster the response and vice versa.

5. CONCLUSION

The GUI controlled robotic vehicle has been designed and implemented using a PIC microcontroller. The robot can function in terrains inaccessible to human beings while being controlled from the remote control station. Considerable success has also been achieved in search and rescue operations as the robot can be controlled from any location within the coverage area of the GSM network used.

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