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Low Cost Multifunction Defense and Surveillance Robot with Android Control

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Abstract: ***Low cost multifunction robot with sensors for hazardous gas, temperature, metal detector, obstacle detector and human detection equipped with weapon like poison or stun dart. Robot control by android application and prompt feedback via SMS.***

Keywords: Renesas RL78, microcontroller, GSM, temperature sensor, gas sensor, metal detector, PIR sensor, Android application, defense robot.

I. INTRODUCTION

A low cost defense and surveillance robot with war field data collection capability is a necessity for remote battleground analysis. The robot is made to gather information like the temperature and presence of poisonous gases to check whether soldiers can be deployed. It should also check for probable land mines and also report human activity through infrared analysis. A light weapon like poison dart or stun gun is incorporated with option for control from the remote.

The requirement is for a quad wheel controlled robot for the purpose of battlefield traversal. The need for stealthy operation is also a necessity. The robot is controlled by Renesas microcontroller by the use of GSM. Short Message Service is used to send commands to the controller and collect feedback. A low cost controller is accomplished by using an android phone as a remote control. Motion by default is prioritized and achieved with four motors with low noise. A real time video feedback system is also a necessity.

II. DESIGN

The main working of the robot is dependent on the sensors and the controller. The robot is equipped with temperature, gas, Passive Infra-Red and ultrasonic sensors and a metal detector. The robot is fixed on a chassis of four motor driven wheels. The control is done by the Renesas RL78 R5F100LE, 16 bit microcontroller. The various environmental data is taken in by the sensors and this analog data is converted into digital by the inbuilt analog to digital converter of the RL78 and is then processed by the microcontroller. This data is displayed on the LCD display connected with the system and is also sent as a Short Message Service to a registered mobile number. The robot is connected to the controller (android phone for cost cutting) via the incorporated GSM module. Only SMS feature of the module is put to use. When the robot is turned active, the microcontroller accesses the GSM module and sends a confirmation message to the registered mobile number. Now the android application on the phone can be accessed with username and password and the robot motion as well as the weapon control can be achieved.

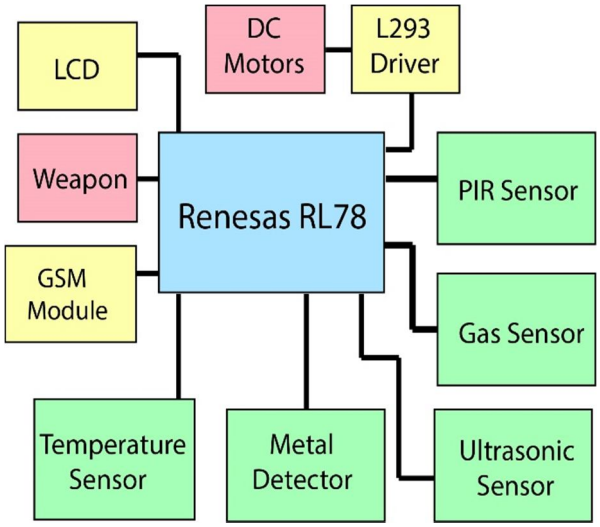

Fig. 1. Block diagram

The ultrasonic sensor equipped on the robot makes sure that the path ahead is obstacle free. The PIR sensor do constantly scan the surroundings for life by seeking Infra-Red radiations. The metal detector connected at the bottom of the robot inspects the ground for any landmine presence. The gas sensor monitors the environment for the presence of any harmful gases. In case of a positive, an SMS is sent by the robot to the registered mobile number in real time and a voice alert is given via the android application to the user who is controlling the robot.

A. Weapon

The weapon attached can be a poison or stun dart or anything light weight too can be used as an alternative. It could be directly controlled from the android application at the controller. A red laser is used as the weapon in the prototype for demonstration purpose.

B. Motion

Robot motion is achieved by the four DC motors attached, each motor for each of the four wheels. The motors used for the demonstration prototype are 9 volt motors. The motors are connected to the microcontroller via the L293 motor driver and the controller decides on the forward, reverse and sideways motion of the robot on the basis of the issued command.

C. Video Feedback

The video feedback setup of the prototype system is achieved by android wireless streaming for demonstration purpose. An android device is used to steam the video feedback wirelessly to a Windows PC. A suitable client is chosen at the android and windows side for the purpose. For practical application, Remote Person Cameras that operate on radio frequency can be utilized or separate camera modules like night vision cameras can be connected as per the requirement.

D. Android Application

Android application for the mobile phone can be coded using Java or Android Studio. The demonstration prototype controller is made by Java programming in Eclipse IDE. The android application should have a secure login with username and password credentials. Also a database list of all the interactions made by the robot should be included.

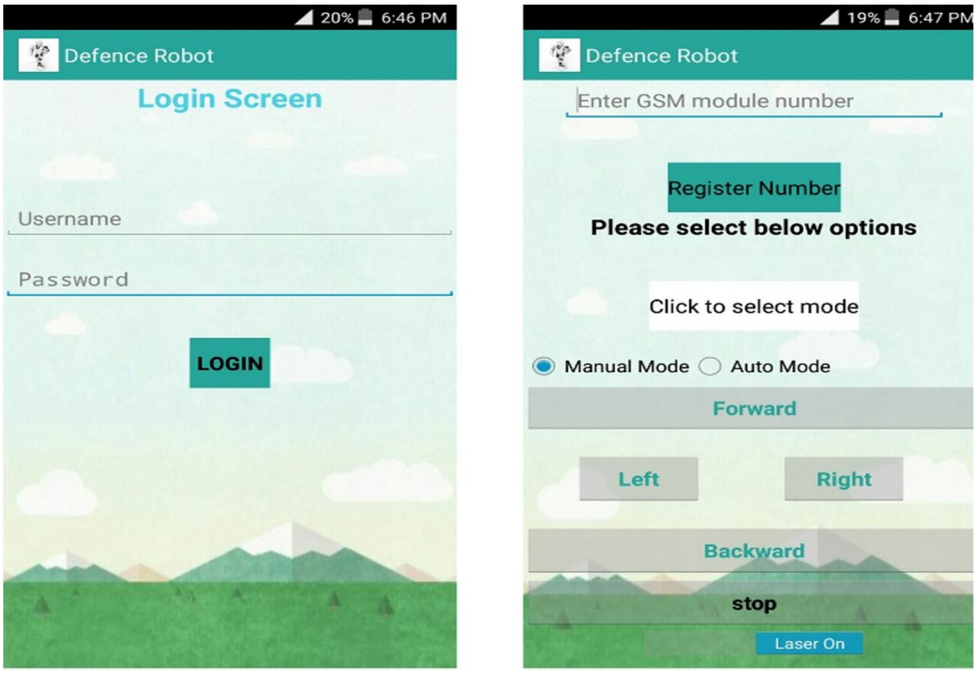

Fig. 2. Android Interface

The required control of the weapon should also be done from the android application. The weapon operation mode can be selected by the mode selection feature incorporated with the android application. Also the toggle button involved enables ease of control for the weapon. The number to which the data collected is to be sent as SMS is to be specified in the programming section itself and the number Id of the GSM Subscriber Identity Module is to be entered in the android application.

E. Programming

The Renesas RL78 supports C language and the programming is done by Cubesuite IDE for the ease of programming work. The code is then flashed onto the controller with the help of Renesas Flash Programmer software. The display, motion, control and data collection sectors are programmed separately and then combined.

F. Power Supply

The robot is equipped with a 9 volt battery as the microcontroller requires 5 volts and the motor section requires 9 volts. For the ease of battlefield operation renewable energy can be put to use by employing solar panels and new generation batteries of reduced size.

III.CONCLUSION

The low cost defense robot is a better alternative to drones as they can directly measure the battlefield conditions by contact. They are dispensable due to the low cost and size. The reduced rotor movement achieved by the control system and the handy weapon features also allow the possibility of using the robot as a remote explosive device.

The prototype developed is hundred percent functional. Various components of the robot can be exchanged as per the requirement and cost effectiveness. As the microcontroller is reprogrammable, the application filed can be changed from defense and surveillance to offence. There still exists option to attach a GPS module to the system and enable ranged tracking and map scouting.

The video feedback system can be made to directly stream the video over radio network and the GSM based control could be changed for radio control compromising the expense and range for better mobility. Also future work can be done on schemes to introduce self-destruct option in the robot in the case of enemy capture by detonating an explosive planted onboard.

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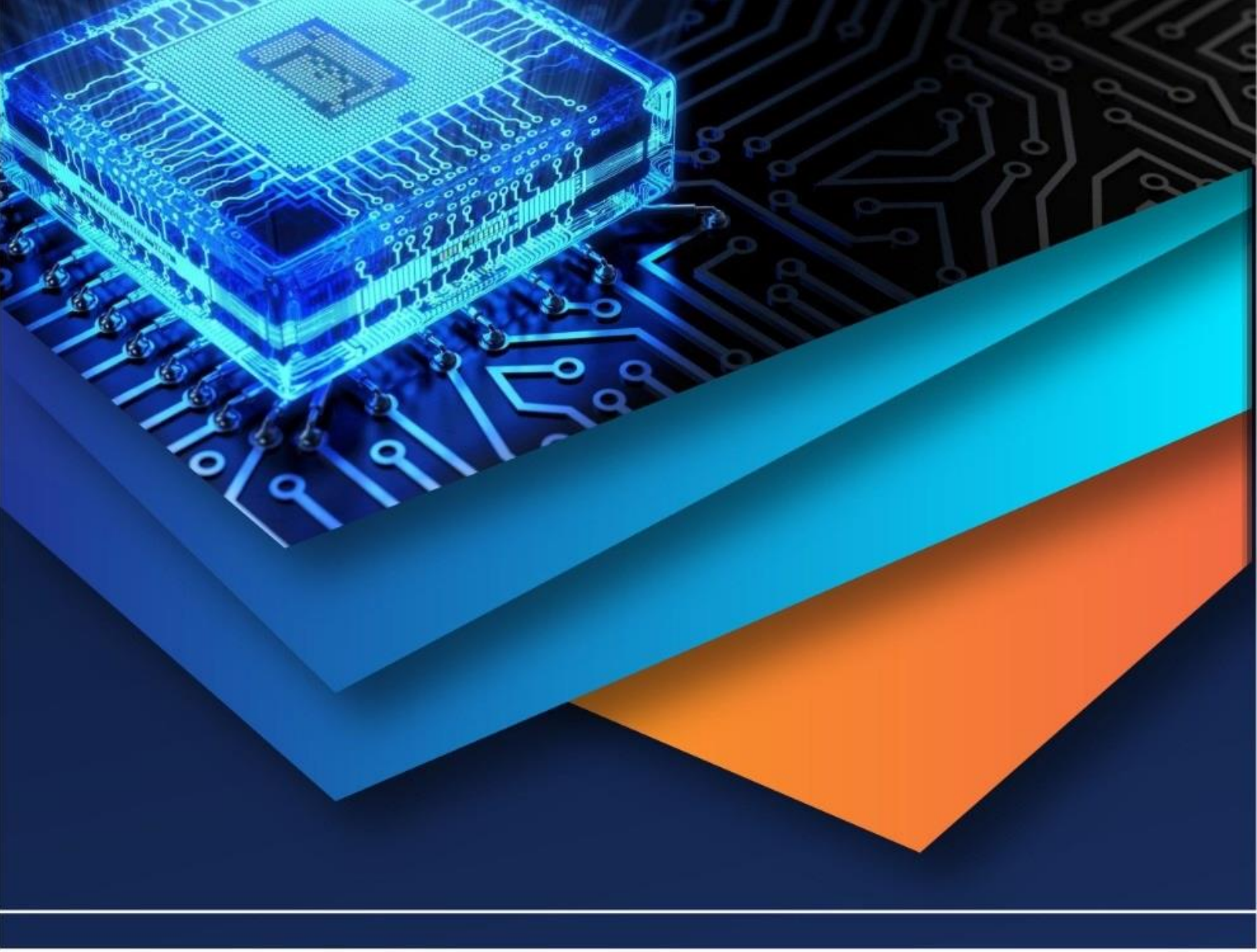

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