Landmine Detecting Robotic Vehicle

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Abstract- *Defence is very essential for every country. The soldiers who form the major part of the defence, are under serious threat by the landmines placed under the ground by the enemies. They remain active even after the war is over, thus being hazardous to every living being. To combat this issue, a robot vehicle capable of detecting them is designed. It scans a particular area and alerts the personnel regarding any landmine, if present. It uses metal detector to detect the metal component in a landmine by the principle of induction. The location of detected landmine is tracked through Global Positioning System (GPS) and sent to the operator using Global System for Mobile Communication (GSM). The robot is also capable of avoiding obstacles using the ultrasonic sensor.*

Keywords- Landmine detecting, Metal sensor, GPS technology, GSM technology, Ultrasonic sensor.

I. INTRODUCTION

A land mine is an explosive device hidden under the ground and designed to destroy or disable enemy targets, ranging from combatants to vehicles and tanks, as they pass over or near it. Such a device is usuallytriggered automatically by the application of pressure when a target steps on it or drives over it, although other triggering mechanisms can be used. A land mine may cause damage by direct blast effect, by fragments that are thrown by the blast, or by both.

They can remain dangerous many years after a conflict has ended, harming the economy and civilians. Land mines are divided into two types: anti- personnel mines and anti-tank mines.Anti-personnel mines are designed primarily to kill or injure people, as opposed to vehicles. They are often designed to injure rather than kill in order to increase the logistical support (evacuation, medical) burden on the opposing force. It can also damage the tracks or wheels of armoured vehicles. Anti-tank mines are typically larger than anti-personnel mines and require more pressure to detonate. The high trigger pressure, normally requiring 100 kilograms prevents them from being set off by infantry or smaller vehicles.

The use of land mines is controversial because they are indiscriminate weapons, harming soldier and civilian alike. They remain dangerous even after the conflict in which they were deployed has ended, killing and injuring civilians and making the land impassable and unusable for decades. To make things worse, many countries have not kept accurate records (or any at all) of the exact locations of their minefields, making removal efforts very slow. These facts pose serious difficulties in many developing nations where the presence of mines endangers resettlement, agriculture, and tourism. The International Campaign to Ban Landmines campaigned successfully to prohibit their use, culminating in the 1997 Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction, known informally as the “Ottawa Treaty”.

Fig. 1 Anti-Personnel Landmine

Fig. 2 Anti-Tank Landmine

Typically, the landmines are detected manually or using trained dogs which is highly dangerous. To resolve this issue, the proposed system uses a metal detector mounted onto a robotic vehicle. The DC motors required for the movement

of the robot, is driven by L293D Motor Driver. It works on the principle of H-Bridge, controlling the forward and backward motion of the motors by changing the voltage polarity. To avoid any obstacle present in the robot's path, ultrasonic sensor is used. The transmitter sends an ultrasonic wave which bounces of any object in the path. This reflected wave received by the receiver guides the robotic vehicle to take an alternate route.

The metal detector works on the principle of electromagnetic induction. The oscillator in the detector, produces eddy currents in the metal component present inside a landmine, which in turn generates alternating magnetic current. Another coil is used to measure the change in the magnetic field due to the metal component, thus detecting the landmine.

The location of the detected landmine is tracked by Global Positioning System (GPS). A GPS tracking unit is a device that uses the Global Positioning System to determine the precise location of a vehicle, person, or other asset to which it is attached and to record the position of the asset at regular intervals. The recorded location data can be stored within the tracking unit, or it may be transmitted to a central location data base, or internet-connected computer, using a cellular (GPRS). This allows the asset's location to be displayed against a map.

Tracked location is sent to the operator through Global System for Mobile communication (GSM). The mobile number of the operator is fixed during coding so that the text containing the longitude and latitude of the detected landmine can be sent.

II. RELATED WORK

"Automatic and Obstacle Avoidance in Metal Detector Robot" This project aims to develop a mobile robot that can sense metals ahead of its path. The metal detector robot is controlled by a microcontroller; Arduino Uno R3. Ultrasonic sensor detects the presence of objects or obstacles and the robot will avoid the obstacles[1].

"Autonomous Landmine Detecting and Mapping Robot" The purpose of this project is to design a robot which is capable of detecting buried land mines and marking their locations, while enabling the operator to control the robot wirelessly from a distance[2].

"Design and Development of Landmine Detecting Robot" In this paper, we present the use of a low-cost robot for the detection of anti–personnel metal landmines using GSM technology. For this purpose, we have developed a robot whose movement and directions can be controlled remotely using GSM modem. A metal detector circuit with buzzer is implemented and AT89C51 microcontroller is used to regulate the complete operation[3].

"Ardunio Controlled Landmine Detection Robot" This research work proposed to have a proto type model of a land-mine detection robot (LDR), which can be operated remotely using Wi-fi. Technology. The safety of humans was addressed and designed robot with special range sensors employed to avoid obstacles. Fabrication of this project prototype was done using lightweight temperature resistant metal[4].

"Landmine Detection Robotic Vehicle with GPS Positioning" The aim of this project to design Landmine detection, if any on the position of land surface; it detects and alert the respective department using notification on android app. It also locates the mine position of land surface using GPS[5].

"Wireless Detection of Landmines using GPS & GSM" This system uses the Global Positioning System (GPS) tracking technology in combination with Global System for Mobile (GSM) technology. GPS sends the location of the robot via Bluetooth data connection. Then the GSM module transmits the received data to the authorized Mobile user[6].

"Automatic Land Mine Detection and Sweeper Robot Using Microcontroller" The purpose of this paper is to design a robot prototype which is capable of detecting buried land mines and changing their locations, while enabling the operator to control the robot wirelessly from a distance. This technology interfaces the metal detector circuit in a robot to search the land mines[7].

"Smart Controlled Landmines Detection System for Soldiers in the Battlefield Using GPS and Wireless Body Area Sensor Networks (WBASNS)" The proposed system is to track the land mines in the battle field and alert the soldiers about landmines and safe the valuable life of the soldiers. he data obtained from the sensors using GPS receiver is transmitted through the wireless using zig-bee module,and in addition an Emergency switch is provided for the soldiers for seeking help from the control room and makes the rescue immediately to save the valuable soldiers life[8].

III. METHODOLOGY

This paper suggests an alternative design by mounting a metal detector onto a robotic vehicle instead of manually searching the landmines or using trained dogs. It makes use of Renesas microcontroller which interfaces and

controls other modules. Fig. 3 shows the block diagram of the proposed design. The proposed design uses GSM/GPS based module to track the detected landmine. It also uses ultrasound sensor to avoid any obstacles in the path. Inclusion of this module along with GSM and GPS modules makes the system independent of human intervention once deployed. Therefore, the operator can scan an area remotely using this robotic vehicle. Various components required for this design implementation are described in the following subsections.

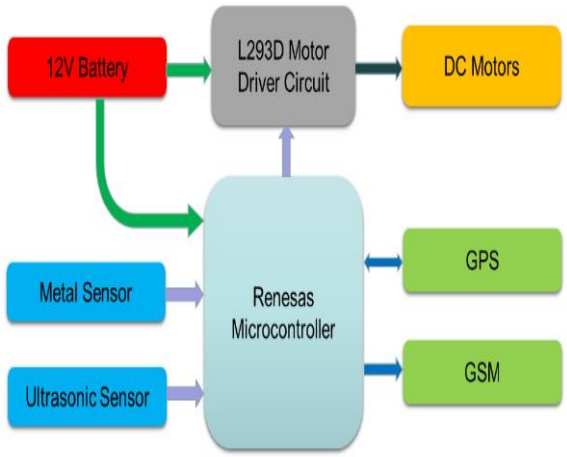

Fig. 3 Block Diagram

A. Renesas Microcontroller

In the proposed design, we have used RL78 Microcontroller from the Renesas family of microcontrollers. All the modules are interfaced and controlled by the microcontroller. On-chip ADC function is used for analog-to-digital conversion.

B. Metal Detector

It works on the principle of works on the principle of electromagnetic induction. The oscillator in the detector, produces eddy currents in the metal component present inside a landmine, which in turn generates alternating magnetic current. Another coil is used to measure the change in the magnetic field due to the metal component, thus detecting the landmine.

C. GPS Module

GPS is an acronym of Global Positioning System and it is used as a navigation system to track the location of a detected landmine. It works on the principle of trilateration where the receiver locates four or more satellites and finds out the distance between each one of them. Using this information, the GPS tracking system finds the current location. The information is presented as latitude and longitude specification.

D. GSM Module

GSM module facilitates functionalities like sending and receiving messages on mobile phone. The GSM module contains an antenna for receiving signal from the network through the user's cell-phone. This GSM module is programmed with AT commands for communication. Here the serial communication with the microcontroller is done through receiver (RX) and transmitter (TX) pins. AT commands are used to check the SIM status, signal strength and connection.

E. Ultrasonic Sensor

Ultrasonic sensors work by emitting sound waves at a frequency too high for humans to hear. They then wait for the sound to be reflected back, calculating distance based on the time required. This is similar to how radar measures the time it takes a radio wave to return after hitting an object. Thus, it helps in avoiding obstacles in the path.

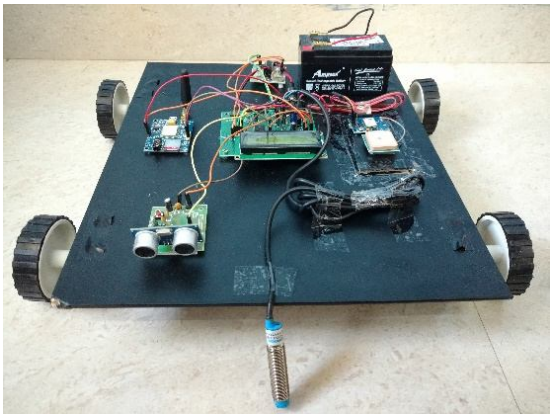

Fig. 4 Setup of the model

All these modules are interfaced to the various ports on the Renesas microcontroller. The operator's mobile number is set during coding. As soon as the robot vehicle is connected to the power supply, it begins with the testing of all modules. A message is sent to the operator when it concludes testing. The robot begins to move with all the sensor modules working sequentially with the Motor Driver circuit. If the metal detector detects any landmines, it triggers the GPS and GSM module. The GPS module tracks the location of the landmine and passes the coordinates to the GSM module, which then sends it to the operator along with a confirmation message that a landmine is detected. After this process completes, the robot resumes its operation. It also sends an alert to the operator, if an obstacle is detected by the ultrasonic sensor, in the path. This guides the robot to take an alternative route to get back on the path by avoiding the obstacle.

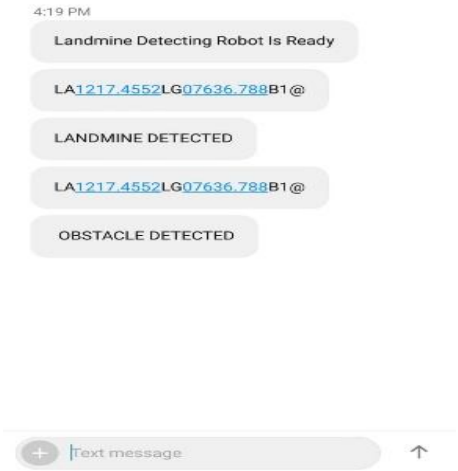

Fig. 5 SMS Alert

IV. CONCLUSION AND FUTURE WORK

In this paper, a safe and accurate method is proposed to detect and track the locations of landmines. It uses GPS and GSM modules to pin point the location of the landmines, detected by the metal detector, and send the coordinates to the operator remotely, without them having to monitor or stay close to the mine region. The Renesas microcontroller, capable of carrying out the operation, is also inexpensive and low power consuming. The ultrasonic sensor enables the robotic vehicle to overcome any obstacles without having human intervention.

In the future work, solar energy can be used to extend the battery life. The robot can also be enhanced to perform the demining action along with the detection.

REFERENCES

[1] ZatieAdibaMohd Zin, FueadAli, Diyana Ab Kadir. "Automatic and Obstacle Avoidance in Metal Detector Robot" Journal of Computing Technologies and Creative Content 1(1), 1-5, August 2016

[2] KishanMalaviya, Mihir Vyas, Ashish Vara "Autonomous Landmine Detecting and Mapping Robot" International Journal of Innovative Research in Computer and Communication Engineering (An ISO 3297: 2007 Certified Organization) Vol. 3, Issue 2, February 2015

[3] K.S. Ruchitha, Soumya Anand, Anurima Das, Rajasree P.M "Design and Development of Landmine Detecting Robot" International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 5, Issue 4, April 2016

[4] V. Abilash, J. Paul Chandra Kumar "Ardunio Controlled Landmine Detection Robot" International Journal of Engineering Science and Computing, May 2017 Volume 7 Issue No.5

[5] TanpureGanesh.D, NangadePradip.N, UkirdeShrikant.V, Asst.Prof. M.H.Gholve Landmine Detection Robotic Vehicle with GPS Positioning" Journal of Information, Knowledge and Research in Electronics and Communication Engineering ISSN: 0975 – 6779| Nov 16 to Oct 17 | Volume – 04, Issue – 02

[6] Prof. R.M. Sahu, Mamata .S. Sawant, Komal .S. Salve, Mangesh .N. Nakade "Wireless Detection of Landmines using GPS & GSM" International Journal Of Innovative Research In Electrical, Electronics, Instrumentation And Control Engineering Vol. 4, Issue 4, April 2016

[7] Bharath J "Automatic Land Mine Detection And Sweeper Robot Using Microcontroller" International Journal of Mechanical Engineering. & Robotic Research. 2015 ISSN 2278 – 0149 Vol. 4, No. 1, January 2015 © 2015 IJMERR

[8] M.Siva Kumar, E.Indhuja, G.Kuzhalini, M.Jenifer and T.Infantasherly, "Smart Controlled Landmines Detection System for Soldiers in the Battlefield Using GPS and Wireless Body Area Sensor Networks (WBASNS)", International Journal for Modern Trends in Science and Technology, Vol. 03, Issue 05, May 2017, pp. 232-237

[9] The Wikipedia website. [Online]. Available:https://en.wikipedia.org/wiki/Land_mine