Landmine Detecting Wireless Robot

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Abstract— The project deals with designing a robotic vehicle which is capable of detecting landmines, marking their locations and stopping itself to avoid those landmines towards a particular location determined by the user. The specific use of this type of robot is to send supplies to soldiers trapped in hard reaching places during war with minimal loss to human life. It can also be used to scout dangerous locations before entering for bombs or weapons. It will have the ability to detect landmines, marking their locations and prevent itself from stepping on to those mines and detonating them. Various researches in this field have inspired us to improve the mine-detecting robots. We, too, hope to inspire and motivate other engineers by our project.

Key words: landmine, detector, wireless, robot, marking mechanism, metal detector

I. Introduction

The landmine crisis is globally alarming since there are presently 500 million unexploded, buried mines in about 70 countries[1]. Governments from various countries are trying to find ways to eliminate these mines with minimum loss of human life and property.

Our robot is able to operate remotely, so that the operator is safe. It also will scan the area and mark the location of the mines, without detonating them. The geographical nature of the mine field is assumed to be sandy because of the terrain of Indian military borders. Therefore, a minimum clearance height from the ground to the bottom of the vehicle is provided.

We have used a wireless remote controlled robot with metal detector for land mine detection. A metal detector is used instead of a better and more accurate landmine detector because of our budget constraint.

II. Current Technologies for Mine Detection[5]

1) Metal Detector Technologies
2) Electromagnetic Methods
– Ground Penetrating Radar (GPR)
– Nuclear Quadruple Resonance (NQR)
– Microwaves
– Electrical Impedance Tomography
– X-Ray Backscatter
3) Acoustic/Seismic Methods
4) Mechanical Methods
– Prodders and Probes
– Mine Clearing Machines

III. Design Conceptualization

We will be using remote controlled robot with metal detector for land mine detection. In the vehicle, navigation is controlled by the user using remote control & the metal detector is used to detect the mines. When a land mine is detected, the microcontroller sends a signal to the motor drive system of the vehicle and stops the robot and marks the location of the land mine by spraying some paint above it. Detection of the land mine is indicated by a buzzer and an LED. After the completion of the marking of landmine, the user resumes the desired path of the robot.

A block diagram is provided below to better understand the electrical connections of the circuit of the robot:

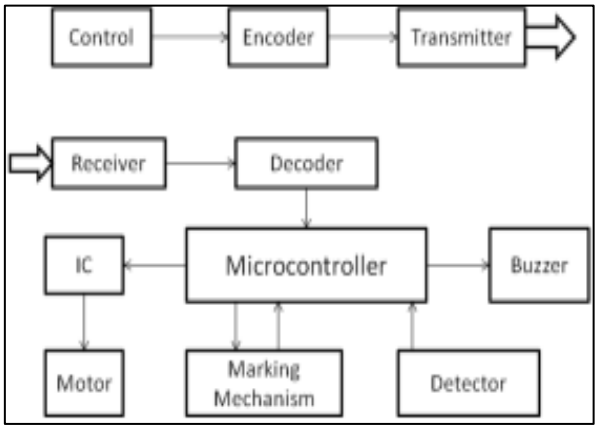

Fig. 1: Block Diagram of the Electrical Circuit

IV. List of Components

1) 434 MHz RF (Radio Frequency) Transmitter Module
2) HT12E Encoder
3) 1N4148 Diode
4) Push on Switches
5) 434 MHz RF Receiver Module
6) L293D Motor Driver
7) HT12D decoder
8) AT89S52 Micro-controller
9) LM7805 Voltage Regulator
10) 10 kΩ 9 pin Resistor pack
11) 11.0592 MHz Crystal
12) 33 pF Capacitor
13) 10 µF / 25 V Capcitor
14) 100 nF Capacitor
15) 1000 µF / 16 V Capacitor
16) 1N4007 Diode
17) BC547 Transistor
18) 12 V Buzzer
19) 12 V SPDT (Single Pull Double Throw) Relay
20) 12 V DC (Direct Current) Pump
21) Metal Detector Sensor
22) 12 V DC 100 rpm (revolutions per minute) Geared Motor
23) 12 V / 1.2 Ah Rechargeble Battery
24) Stainless Steel Chassis

V. WORKING

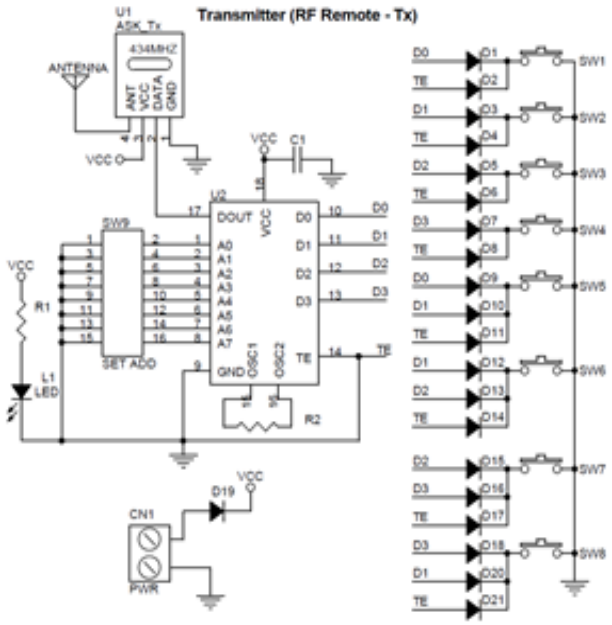

Fig. 2: Transmitter Circuit

Fig. 2. shows the transmitter module fitted on the remote control of the user. There are eight push on switches on the remote control. Switches SW1, SW2, SW3 and SW4 are used for forward, backward, leftward and rightward movements of the robot respectively. The switch SW5 is used to stop the movement of the robot. SW6 and SW7 are used to switch ON and OFF the automatic marking mechanism. SW8 is used to manually mark the location of the landmine in case the automatic mechanism is turned off.

When SW1 is pressed, the inputs to the encoder D0 and TE (transmission enable) are grounded. This signal is send through the encoder to the robot using the RF transmitter antenna. Similarly, all the other switches with different encoder inputs are used to ground those inputs to send different signals to the robot via the transmitter.

Another switch, SW9 is provided to set a frequency of the transmitter signal, so that, it does not interfere with other devices working in the vicinity.

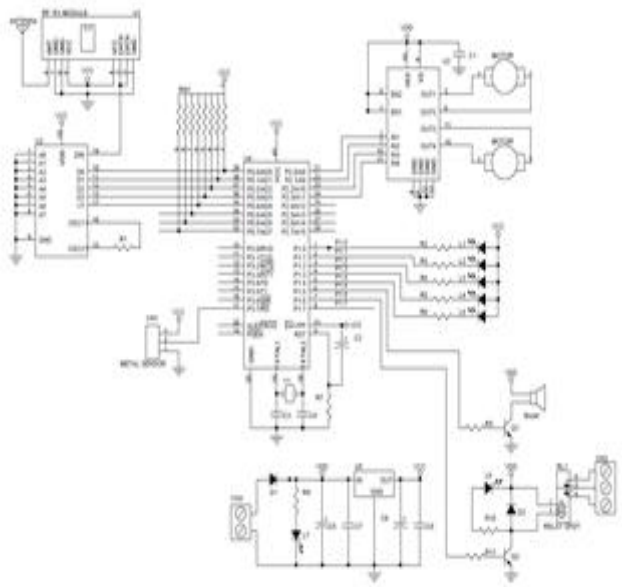

Fig. 3: Receiver and Microcontroller Circuit

Fig. 3. shows the receiver module and the circuit for the whole operation of the robot vehicle. As the RF receiver receives the signal from the transmitter of the remote control, it is decoded by the decoder and this is fed into the microcontroller through a resistor pack for signal stability.

The microcontroller acts on this signal and instructs the motor driver circuit to move the motors connected to it according to the signal received. Thus, the robot vehicle is set in motion.

As the vehicle is moving, the metal detector sensor is scanning the ground for landmine. As soon as a landmine is detected, the sensor sends a signal to the microcontroller. Acting on this signal, the microcontroller sends a signal to the motor driver to stop the vehicle. It also sends a signal to the buzzer and the marking mechanism, activating both. The marking mechanism is activated by magnetizing the relay, which in turn actuates the pump for spraying the paint over the location of the landmine.

Thus, our landmine can be used to traverse a region without any harm from the landmines in that region and also marking their locations.

VI. CHASSIS CONSTRUCTION

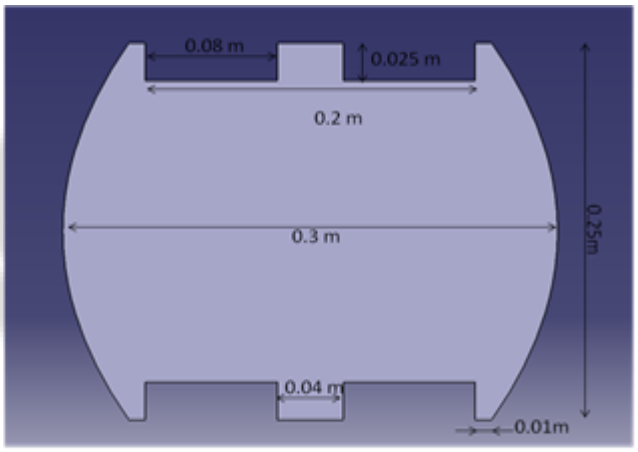

Fig. 4: Chassis Top View

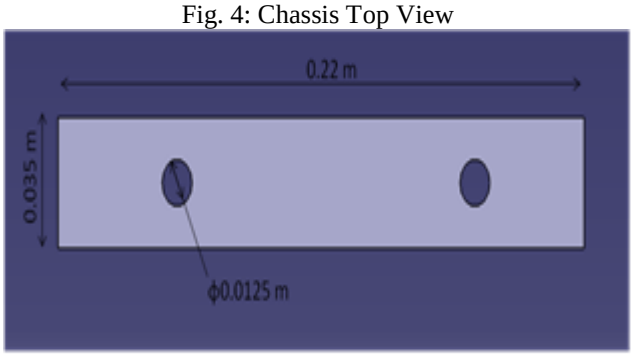

Fig. 5: Chassis Side View

Two SS (stainless steel) plates each of thickness 1.2 mm as shown in Fig. 4 were made with the help of hand cutting machine and cutter. Two side plates of thickness 1.5 mm were made with the help of bending machine. The upper and lower plates were welded to the side plates at right angle using steel welding. The gap in between these plates was used to place the motors. Drilling machine was used with 12 mm diameter drill bit to drill holes in the side plates for placing the motors and the wheels. Surface grinding machine was used for surface machining. Round file was used to give a finish to the drill holes.

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REFERENCES

[1] Nyein Chann, 2007, "Mine Detection and Marking Robot", National University of Singapore, Singapore.
[2] http://en.wikipedia.org/wiki/Land_mine
[3] EML2322L – MAE Design and Manufacturing Laboratory, "Drive Wheel Motor Torque Calculations".
[4] C. P. Gooneratne, S. C. Mukhopahyay, G. Sen Gupta, 2004, "A Review of Sensing Technologies for Landmine Detection: Unmanned Vehicle Based Approach", Institute of Information Sciences and Technology, Massey University, New Zealand
[5] L. Robledo, M. Carrasco and D. Mery, 2009, "A survey of landmine detection technology", International Journal of Remote Sensing, Chile, pp 2399-2410.
[6] Hajime Aoyama, Kazuyoshi Ishikawa, Junya Seki, Mitsuo Okamura, Saori Ishimura, and Yuichi Satsumi, 2006, "Development of Mine Detection Robot System", Fuji Heavy Industries Co. Ltd, Japan.

