JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

The LAMIR – Mobile Robot for Landmine Detection

(Mr.A.Venkatesh M.E., Assistant Professor, Department of **Electronics and Instrumentation Engineering,**
Dr. Mahalingam College of Engineering and Technology)

Author Name/s – Pukalenthiran S, Aswath Krishna V, Mathumithra K

*Department of **Electronics and Instrumentation Engineering**, **Dr. Mahalingam College of Engineering and Technology,***
Pollachi 642 001, India
(pukalenthiran24@gmail.com
aswathkrishna2001@gmail.com
kmathumithra@gmail.com)

Abstract— *A landmine is an explosive charge buried just below the surface of the earth, used in military operations against troops and vehicles. Landmine detection process is achieved by different methods. Each method has its strengths and limitations. Using robots in mines detection is a very effective method as it provides various available effective sensors that can be used to sense mines. Using robots provides a safety solution to save deminers lives.*

Using a robot that has multi-sensor system can increase the reliability of the demining process. It has high sensitivity, reliability and also the sensors are accurate and available at low cost. Although robots are less error prone, not affected by heath or other environmental conditions and much more accurate than humans they still suffer from inferior locomotion systems in rough terrain. Therefore, the objective of the project is to design a robot in such a way that it can effectively detect the landmines and can move smoothly by avoiding the obstacles. This can be achieved by manually controlling the robot using a simple mobile application. Thus, the project can ensure safety and accuracy with increased efficiency in detecting the landmines compared to the existing models.

I. INTRODUCTION

Landmines continue to be a burden for 78 countries and a challenge for mobile autonomous robots used for detecting and clearing them. Many land mines are still hidden underground. It causes loss of life, permanent and temporary disability in humans and other living creatures. Many countries have been hit by land mines, making the project a success, spending a lot of national revenue and human efforts to eradicate it. Obstacles naturally take the process too slow and are dangerous for employees. This research has developed a rover-robot that identifies land mines to help in the field, faster, safer and more accurate than usual. Mining discovery is usually done by metal sensors. The distance between the sensor head and the land mine is an important determinant of the ability to detect the explosives of a metal detector. By adjusting the gap and height between the earth bomb and the sensor head, the performance of the metal detector can be improved. The function of the detonation of landmines with the help of robots can be done in a simple way, if the sensor heads keep the same gap at a lower level.

II. LITERATURE SURVEY

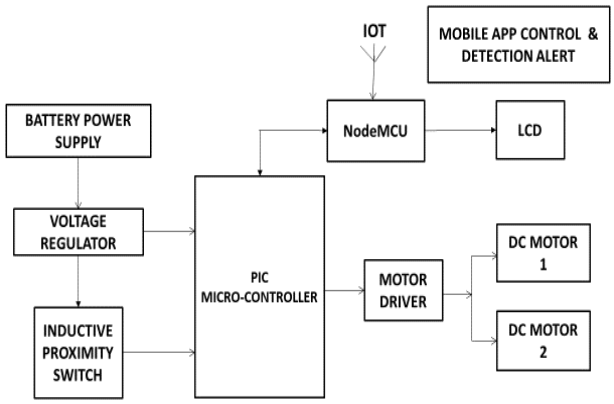
F.Y.C. Albert et.al., [7] describes that Remotely Operated Solar Powered Mobile Metal Detector Robot. A small solar panel is added to recharge the battery. Even though there is an advantage of solar power that can be used to power the rover, the solar system requires a large space, there is an associated disadvantage. With such a design plan, it is very difficult to take the rover inside the jungles. This issue is also addressed in the current research work by a design called the Solar Panel's Foldable Mechanism that makes the rover compact enough to move across different topographies. This mobile robot platforms were designed as considering the system can detect the metallic objects. It can charge the onboard seal lead acid battery through a number of panels. The movement of the mobile robot would be controlled by the handheld remote control by the operator. The video would be monitored by the personal computer.

Hakim Adil Kadhim et.al., [2] describes that a microcontroller Arduino UNO board (ATmega328P) used as a brain to give instructions and analysis the results. Arduino

microcontroller involves physical programmable circuit board and a piece of software that it runs on computer to be used for writing and uploading computer code to the physical board). Uno processes the received data from the computer, run the sensors, receive their results and analysis to send them to the computer, run the motors and move the robot to the targeted place and stop the robot in case of a metal or obstacles disclosed and send an alert to the computer. Besides, the middleware between computer and robotic circuit is a Bluetooth technology which is adapted to be the transmission channel between system peripherals wirelessly. Bluetooth is a short-range wireless connection between computers and other devices. Here, we have achieved the wireless connection using wi-fi thereby enabling longer range control and transmission. The robot can be used from a safe distance or from an area where land mines have already been cleared. As the head of the land mine is shown in front of the rover, the risk of explosion is eliminated.

III. BLOCK DIAGRAM

The block diagram consists of PIC Microcontroller, Sensors, Motor drivers, DC Motors, Power supply unit and a wi-fi module. PIC microcontroller and the sensors are supplied with DC Battery. PIC microcontroller is the controlling unit and the wi-fi module is used to link the robot and the PIC interface. The PIC electronic board receives the input signal from sensors, process it, and send the output signals to the rover.



IV. WORKING AND OPERATION

The operation begins when the robot detects a land mine. As landmines are made of metal, inductive proximity switch is used to detect the presence. On encountering a landmine, the user gets alerted. This can be achieved through wi-fi. The robot can be easily controlled by the developed mobile application. In this regard, a cell phone or laptop computer can be used to place a command via a serial monitor to move a robot. Here, two DC motors aid in the motion of the robot. The battery supply is 12V which in turn converted to 5V by the voltage regulator. NodeMCU is for achieving IOT via wi-fi and connects the robot with the mobile application wirelessly. LCD displays the required messages like the presence and absence of landmine.

Motion control of the system:

Drive-chain mechanism is used in this rover to move as it has to travel over rough terrain like a chain block. According to this circuit only two motors are needed to control the speed. The motor controlling device circuit is connected to PIC pins 4,5,7,6. Here pins 6 and 7 are connected to the right side motor and pins 5 and 4 to the left side motor. The robot can be operated in 4 directions; Back, Right, Left, Fast Right, and Fast Left. The rover- robot starts moving when the "START" command is given. To move the robot in the forward direction the forward arrow key has to be pressed. PIC pins 5 and 7 send signal 1010 to the motor control module so that both DC motors rotate in a clockwise direction. The Left Arrow key is used along with the Forward key to give the command to move the robot to the left. When signal 0010 is given to the motor controller module from pin 5 of the PIC board, the left DC motor stops working while the right DC motor continues to spin clockwise at 23. The robot continues to move in the left direction until the command is changed. To move the robot to the right a command must be given via the right arrow key along with the forward key via the mobile device. The signal 1000 is given to the motor control module from pin 7 of the PIC board so that the right DC motor stops working while the left motor continues to spin in a clockwise direction. Until the command is changed, the robot continues to move in the right direction. A command is given through the bottom arrow key to move the robot backwards. This is done by sending a digital signal 0101 from PIC pins 6 and 4 to drive both DC motors in a counter clockwise direction. A command is given by pressing the right arrow key on the mobile device to make the robot move faster in the right direction. This is achieved by sending signal 1001 to the motor control module from pins 4 and 7 of the PIC board so that the right DC motor spins in a counter clockwise direction while the left DC motor spins in a clockwise direction. A command is given by pressing the left button of the mobile device to move the robot rapidly to the left. This is achieved by sending signal 0110 from pins 6 and 5 of the PIC board to the motor control module so that the left DC motor rotates in anti-clockwise direction, while the right DC motor spins in clockwise direction. This data is briefly shown in Table 1.

Here an Android based application called landmine robot Controller is used to control the robot by providing instructions. Decisions made by the operator and the direction of movements are transferred to c. Metal Detection System PIC is the controller of this metal detector part. An LED and a buzzer are used to indicate output signals in the form of light and sound. A coil and a capacitor for 24 are used to identify the metals. Diodes are used to control the voltage. The resistor is used to limit the current to the PIC pin. The pulse signal generated by the PIC is sent to the LC circuit. And furthermore, the direction is obtained with instructions in table.

Motion of Rover	Left side Motor	Right Side Motor	Active Pins	Signal
Forward	Rotating Clockwise	Rotating Clockwise	7,5	1010
Backward	Rotating Anticlockwise	Rotating Anticlockwise	6,4	0101
Left turn	Stop	Rotating Clockwise	5	0010
Right turn	Rotating Clockwise	Stop	7	1000
Suddenly to left	Rotating Anticlockwise	Rotating Clockwise	6,5	0110
Suddenly to Right	Rotating Clockwise	Rotating Anticlockwise	4,7	1001

Table 1. Motion of rover-robot

V. MOBILE APPLICATION DEVELOPMENT

A mobile application was created using the Blynk app tool and required hardware component and it is interfaced with the NodeMCU module. So that the control of the robot with an android application through wi-fi is made possible. The figure shows the layout of Blynk app. The layout of user interface was created at first for the android application then later the as per the pin configurations and it must connect the microcontroller with the USB board. This port has to configure for wi-fi module additionally in order to have need a popup window it has to be added through that it displays the available wi-fi networks and then connect the smartphone to correct wi-fi network for synchronization with robot.

After the completion of application designing the project should be build and downloaded as (.apk) file format. So that the package installer for android can able to install the application on the smartphone. Application installed in an android device. It uses a graphical user interface (GUI) very similar to the programming languages scratch (programming language) and the star logo, which allows users to drag and drop visual objects to create an application that can run on Android devices. The application is suitable for every version of android till android 11 operating system.

Fig 1. Android application UI layout.

VI. TEST RESULTS

Simulation result

The below Figure shows output of the Proteus simulation of landmine detection robot. Here instead of sensor there are certain limitation for certain sensor so that is recommended to use a switch instead of metal detecting sensor. So, whenever the switch is closed the circuit consider of detecting metal. As a result, output is displayed, “mine detected”.

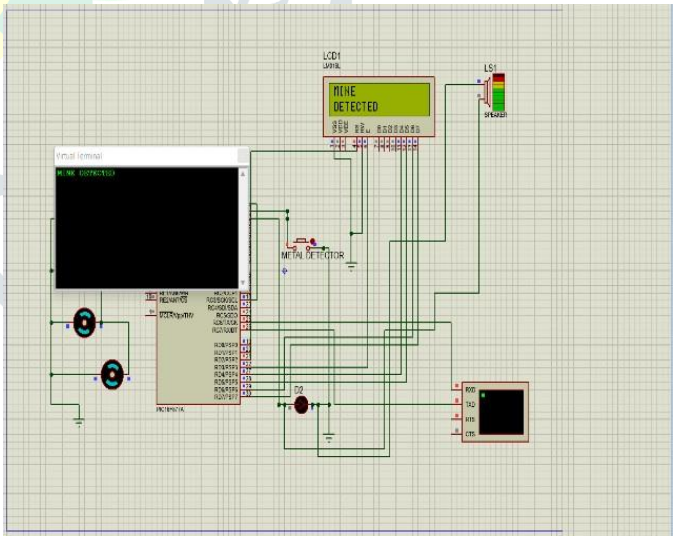


Fig 2. proteus simulation output of landmine detection robot.

Hardware configuration

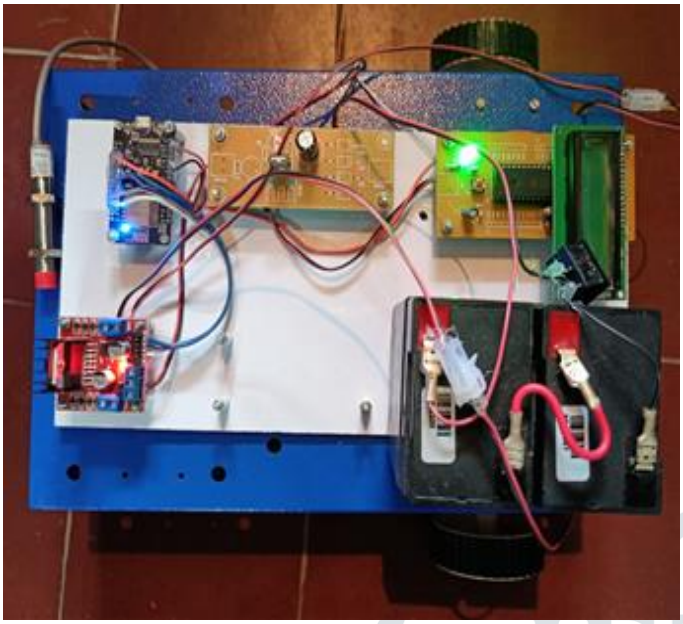


Fig 3. Photography of the hardware setup of the robot

The above picture shows the hardware setup of the landmine detection robot. We have equipped an 12v battery for the power supply stability unit and this robot can be controlled via smartphone application. Along with that, a voltage regulator, nodeMCU, motor driver, PIC microcontroller and a LCD can be seen. The two DC motors are attached to the wheels of the movable plate. Thus, the setup enables the mobility of the robot in order to successfully develop a rover robot.

VI. CONCLUSION AND FUTURE SCOPE

At present, the robot takes the place of almost anyone field including defense field. Robotic use technology is expanding in different fields due to their continuity in development. A robot that tests land mines is built on this research, which can detect instruments in the width of the arm and in them way. The IOT module application is used for control this robot. Inductive proximity switch is used to detect obstacles in its own way in different ways. In the future, a night vision camera can be added for a better picture of the hidden mines. Hardware may include Shock absorbers, self-balance system as well adjusters that can be attached to the wheels for a robot it can run fast in any complex areas. Can also be used in the future to save lives in disaster areas like the construction of a fire, building collapse etc if the image processing system is a system included. It can also be changed in the future to detonate land mines itself if the right arm set is provided with the necessary safety protective measures.

REFERENCES

[1] Kunaraj, A., et al. "Sensor Controlled Defense Purpose Robot for Land Mine Detection." 2020 International Conference on Smart Electronics and Communication (ICOSEC). IEEE, 2020.

[2] Hakim Adil Kadhim, Nabeel Salih Ali, Dheyaa M. Abdulsahib, “Management and achieving system for metal detection robot using wireless-based technology and online database registry,” International Journal of Power Electronics and Drive System (IJPEDS) Vol. 10, No. 1, pp. 219~229, March 2019.

[3] Ruchitha, K. S., and Soumya Anand. "Anurima Das, RajasreePM,“Design and Development of Landmine Detecting Robot,”." International Journal of Innovative Research in Science, Engineering and T echnology 5.4 (2016).

[4] Sandesh Gowda “autonomous robotic landmine detection, mapping and avoidance” master of science in electrical engineering, The university of texas at arlington, May 2015.

[5] Muhammad, Abubakr, et al. "Marwa: A rough terrain landmine detection robot for low budgets." Proceedings of the 43rd International Symposium on Robotics. 2012.

[6] Cardona Rendón, Lorena, Jovani Alberto Jiménez Builes, and Nelson Antonio Vanegas Molina. "Landmine detection technologies to face the demining problem in Antioquia”.

[7] F.Y.C. Albert, C.H.S Mason, C.K.J. Kiing, K.S. Ee, K.W. Chan, “Remotely Operated SolarPowered Mobile Metal Detector Robot International,” Conference on Robot PRIDE 2013-2014 - Medical and Rehabilitation Robotics and Instrumentation, 2013-2014.

[8] Ratto, Christopher "Context-dependent landmine detection with ground-penetrating radar using a hidden Markov context model" IEEE International Geoscience and Remote Sensing Symposium IEEE, 2010

[9] Seiji Masunaga and KenzoNonami, “Controlled Metal Detector Mounted on Mine Detection Robot,” International Journal of Advanced Robotic Systems, Vol. 4, No. 2 (2007), ISSN 1729-8806. Pp. 237 – 245.

[10] T. Fukada, Y. Hasegawa, Y. Kawai, S. Sato, Z. Zyada, and T. Matsuno, “GPR signal processing with geography adaptive scanning using vector radar for antipersonal landmine detection,” International Journal of Advanced Robotic Systems, vol. 4, no. 2, pp. 199–206, 2007.

[11] E. D. Breejen, K. Schutte, and F. Cremer, “Sensor fusion for antipersonnel landmine detection, a case study,” in Proceedings of the Detection and Remediation Technologies for Mines and Minelike Targets IV, vol. 3710, pp. 1235–1245, April 1999.

[12] Ahmed Ismail, Mohammed Elmogy, Hazem El Bakry, "Landmines Detection Using Autonomous Robots", IJETTCS Volume 3, Issue 4, July-August

[13] Tanpure Ganesh.D, Nangade Pradip.N, Ukirde Shrikant.V, 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

[14] Prithviraj Dasgupta, K. R. Guruprasad, Angélica Muñoz-Meléndez, and Janyl Jumadinova, "The COMRADE system for multi robot autonomous landmine detection in post conflict regions," Journal of Robotics, Hindawi Publishing Corporation, Volume 2015, Article ID. 921370