

Wireless Landmine Detection Robot

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Abstract — The existence of landmines in various battle zones and post-war regions poses a remarkable danger to civilian populations and hinders socioeconomic growth. This abstract introduces an original approach to mitigate this danger through the development of a Wireless Landmine Detection Robot (WLDR). This robotic system is equipped with cutting-edge technologies to autonomously detect, locate, and mark landmines, ensuring safety while minimizing human exposure to risk in dangerous terrains. For that, various devices and modules are used such as Bluetooth, sensors, controller, motors and drivers etc. In this research, the robot system is equipped with a metal detector used to detect the metal presence based on coil induction when it's approaching the metal. Wireless data are transmitted through a Bluetooth module. The robot's movement is controlled by DC's current motor programmed using Arduino UNO.

Keywords: Land Mine Detection, Wireless Robot & Landmine Detection Sensors

I. INTRODUCTION

Wireless landmine detection robots signify a groundbreaking advancement in the field of robotics and humanitarian efforts. These robots are specifically designed to navigate hazardous terrains, detect buried landmines, and help safeguard the safety of civilians and military personnel. By employing cutting-edge technologies, these automated systems play a vital role in the clearance and removal of landmines, a task that is conventionally risky and time-consuming.

National security is of chief importance in today's weapon peppered world and therefore the need to consider the safety of the army personnel and people living in war prone areas becomes very vital. A Landmine is basically an explosive device hidden underground by the adversary and detonates when any personnel or vehicle steps or drives over it. The Pressure created by the personnel or the vehicle on the ground below which the mine is laid acts as the trigger for the mine explosion. The damage caused by the Landmine explosion is lethal and hence detecting landmines becomes essential before the army personnel or vehicle accidentally steps over it. The major challenge is detecting these landmines without causing any explosion and diffusing them once they are found. The process of detecting landmines is technically termed as minesweeping and process of removing or defusing the mines is known as demining or mine clearance. Minesweeping was earlier done using trained animals like dogs and rats but modern methods include metal detectors and various tools attached to the vehicles. But any manual intervention of a human is always dangerous.

Landmines are one of the great scourges on the human life. Thousands of people are injured each year by accidental landmine explosions on the known or unknown environment. There are approximately 100 million landmines buried throughout the world in approximately 70 different countries. Current methods can neutralize only about 100000

per year. The procedure for landmine removal varies greatly depending on such factors as: location, terrain, landmine distribution, soil density, age of minefield, covering vegetation and locally available resources. How to develop a safety processing method to detect landmines is a challenging problem.

The deployment of wireless landmine detection robots pointedly reduces the risk to human life by minimalizing direct contact with perilous areas, allowing for swift and precise identification of landmines while maintaining operator safety. Furthermore, their ability to cover rough terrains, including rugged landscapes and unstable environments, makes them an vital asset in humanitarian mine clearance efforts.

These robots not only contribute to saving lives but also facilitate the restoration of land for productive use, aiding in the post-conflict recovery and socio-economic progress of affected regions.

Their novelty lies not only in their technical capabilities but also in their potential to make a considerable difference in global efforts to eradicate the threat of landmines and support communities in reclaiming safe and habitable spaces. As technology continues to advance, wireless landmine detection robots stand as a testament to the powerful synergy between robotics and humanitarian aid.

II. LITERATURE REVIEW

Rasaq Bello, Literature Review on Landmines and Detection Methods [1]. This paper has a review on landmines and detection methods, various types of landmine are explained in details such as Anti-personnel, Anti-tank, Common anti-personnel.

V. Abilash and J. Paul Chandra Kumar, Arduino Controlled Landmine Detection Robot [2]. This paper demonstrates a prototype model of a land-mine detection robot which can be operated remotely using Wi-Fi. Technology. A Global Positioning System (GPS) sensor is employed, which identifies and broadcasts the present location of the robot. Path planning, obstacle detection and avoidance algorithms were used to control accurately and to navigation of the proposed path by avoiding obstacles. Arduino microcontroller is employed in this robot.

Bharath J, Automatic Land Mine Detection Robot Using Microcontroller [3]. This paper demonstrates the landmine detection robot. In this the metal detector circuit is interfaced with the robot and it is left on the required search area in order to detect the metallic components used in the landmines.

Jebasingh Kirubakaran. S. J, Anish Kumar Jha, Dheeraj Kumar, Sadambi Poornachandran Prakash, Mine Detecting Robot with Multi Sensors Controlled Using HC-12 Module [4]. This paper demonstrates a mine detecting robot guided by HC-12 module that allows it to scan the testing area within 1.8km and metal detector is used as mine detecting

sensor placed in front of the vehicle, while GPS is used to provide the exact location of the infected area. The embedded system is based on Arduino technologies and guided by an HC -12Module

Waqar Farooq, Nehal Butt, Sameed Shukat, Nouman Ali Baig, Sheikh Muhammad Ahmed, Wirelessly Controlled Mine Detection Robot [5]. This paper demonstrates the problem and effects of landmines in defense fields. The robot is equipped with special wheels controlled by H-Bridge module, allowing it to move in all possible directions.

III. COMPONENTS

A. Wi-Fi Module

The NodeMcu ESP8266 is a development board that uses the CH340G USB-to-serial chip and supports wireless communication through Wi-Fi. It's commonly used for IoT projects and can be programmed using the Arduino IDE. The NodeMcu ESP8266 is a wireless Wi-Fi module. It integrates the ESP8266 Wi-Fi module with a microcontroller and provides a convenient platform for developing Internet of Things (IoT) applications. You can use it to connect your projects to Wi-Fi networks and communicate with other devices over the internet.

The NodeMcu ESP8266 works by combining an ESP8266 Wi-Fi module with a microcontroller. Here's a simplified explanation of how it works:

- 1) **Microcontroller:** The board includes a microcontroller (usually based on the Lua interpreter), which you can program using the Arduino IDE or other development environments.
- 2) **ESP8266 Wi-Fi Module:** This module provides the ability to connect to Wi-Fi networks. It handles the communication over the wireless network and allows your device to send and receive data.
- 3) **Programming:** You write code for your project using a programming language supported by the microcontroller. In the case of NodeMcu, Lua is often used, but you can also program it using the Arduino IDE, which simplifies the process for those familiar with Arduino.
- 4) **Upload Code:** You upload your code to the NodeMcu board via a USB connection. The CH340G chip on the board helps convert USB signals to serial, facilitating this communication
- 5) **Execution:** Once the code is uploaded, the microcontroller executes your instructions. This can include tasks like reading sensors, controlling actuators, and using the ESP8266 module to connect to the internet through Wi-Fi.
- 6) **Wi-Fi Communication:** The ESP8266 module handles the Wi-Fi communication, allowing your device to send and receive data to and from the internet. This is crucial for IoT applications where connectivity is essential.

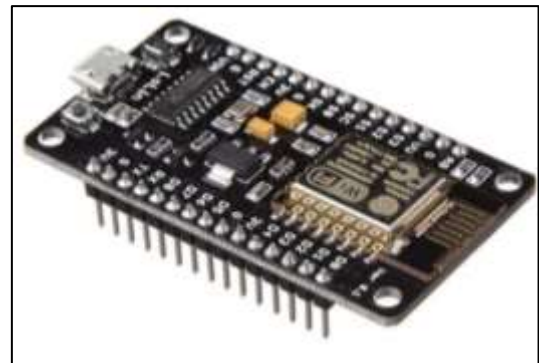


Fig. 1. Wifi Module

B. Jumper Wire

Jumper wires are simple electrical wires with connectors at each end, commonly used in electronics, prototyping, and circuit building. They are often made of flexible, insulated material like plastic or rubber, with conductive metal cores (such as copper) to allow the flow of electricity.



Fig. 2: Jumper Wires

C. Motor Driver

The motor driver is used to control the direction of rotation and speed of the Bo DC motor, which is the main driving force of the robot. This motor driver will be programmed using Arduino Uno microcontroller. A motor driver IC is an integrated circuit chip that controls motors in autonomous robots and embedded circuits. L293D and ULN2003 are the most commonly used motor Driver IC that is used in simple robots and RC cars. A motor driver is unquestionably something that causes the motor to move in accordance with the given instructions or inputs (high and low). It listens to the low voltage from the controller/processor and controls an actual motor that needs high input voltage A motor driver IC, in simple terms, controls the direction of the motor based on the commands or instructions received from the controller

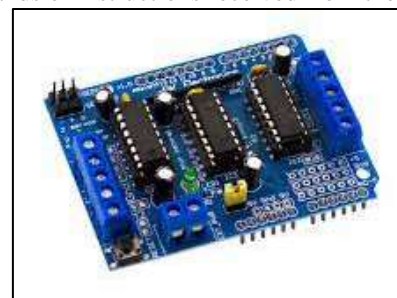


Fig. 3: Motor Driver

D. Bo DC Motor

This motor is placed on all four wheels of the robot to control its motion. It uses direct current (DC) to produce mechanical force. A BO motor is a type of electric motor that is powered by a rechargeable battery. These are commonly used in portable devices and vehicles, as they offer the convenience of cordless operation. BO Wheels are used for making robots and robotic vehicles. These Wheels can be easily coupled with BO Motors. Wheel's wider grip allows the vehicle or robot to be stable on high terrain or smooth surface as well. The big size and Yellow-Black color combination give an attractive look to your robot or robotic vehicle.



Fig. 4: Bo DC Motor

E. Metal Detector Sensor

This component is the most important part in the design of a metal sensor robot, with this component where the metal can be detected. For this study, researchers used metal sensors with the following specifications.

- 1) Detection distance: 0-8mm;
- 2) Object of detection: Metal (Iron, Aluminum etc.);
- 3) Working voltage: 10-30V DC;
- 4) current Output: 300mA;
- 5) There are indicators: Yes (Red);
- 6) Working temperature: -25 to +70 C;
- 7) Size: 18x18x36 mm;
- 8) Cable length: 1.5m;
- 9) 34mm x 18.2mm x 17.5mm.

A metal detector sensor module is a device that uses electromagnetic induction to detect the presence of metal objects. The module typically consists of a transmitter coil that generates a magnetic field, and a receiver coil that detects changes in the magnetic field caused by the presence of metal.

When a metal object comes into proximity of the sensor, it will disrupt the magnetic field and the sensor will generate an output signal indicating the presence of metal. These types of sensors can be used in a variety of applications, such as security systems, industrial automation, and even in hobby projects

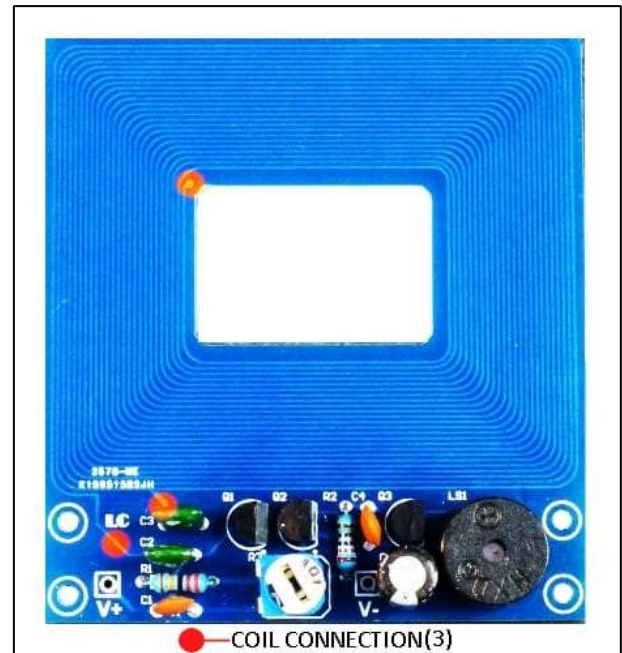


Fig. 5: Metal Detector Sensor

F. Transistor

A transistor is a miniature semiconductor that regulates or controls current or voltage flow in addition amplifying and generating these electrical signals and acting as a switch/gate for them. Typically, transistors consist of three layers, or terminals, of a semiconductor material, each of which can carry a current. There are three terminals for a transistor. They are listed below:

- Base: This is used to activate the transistor.
- Collector: It is the positive lead of the transistor.
- Emitter: It is the negative lead of the transistor.

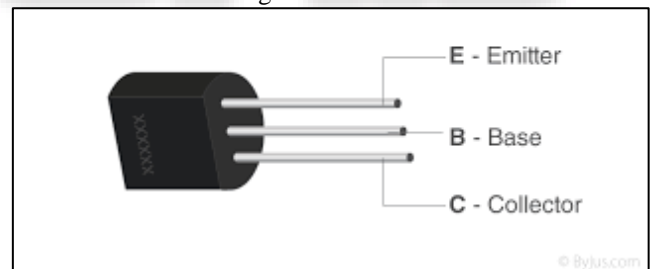


Fig. 6: Transistor

G. LED

A light-emitting diode (LED) is a semiconductor device that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor.



Fig. 7: LED

IV. CIRCUIT DIAGRAM



Fig. 8: Circuit Diagram

V. CONCLUSION

In this paper the overall design of wireless landmine detection robot has described. We have tried to make the system less expensive and compact. The future scope for this project is the robot model can be modified with drone. Instead on metal detector GPR module can implemented. Some demining features can be added. Also, we can use color spray at robot side to mark the probable landmine location. The development and implementation of wireless landmine detection robots stand as a significant leap in addressing the critical issue of landmines worldwide. These robots have revolutionized the field of demining, introducing a safer, more efficient, and technologically advanced approach to detecting and eliminating landmines. The advent of wireless landmine detection robots marks a crucial turning point in humanitarian efforts, bringing about a paradigm shift in the way landmines are detected and neutralized. These robots, equipped with sophisticated sensors and wireless capabilities, offer a safer alternative to traditional manual demining methods, reducing the risks faced by human deminers. Their ability to navigate treacherous terrains, accurately detect buried landmines using ground-penetrating radar, metal detectors, or infrared imaging, and transmit real-time data wirelessly has not only increased the efficiency and precision of mine clearance operations but also significantly minimized the threat to human lives. As research and technological advancements continue, wireless landmine detection robots remain at the forefront of efforts to rid the world of this persistent danger, offering hope for a future free from the

devastating impact of landmines on communities and regions across the globe.

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