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ISSN 2249-3352 (P) 2278-0505 (E)
Cosmos Impact Factor-5.86

Iot Contolled Landmine Detection Robot With IOT Streaming

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ABSTRACT

Landmines pose a significant threat in post-conflict areas, endangering civilian lives and hindering development. This project presents a cost-effective, remote-controlled landmine detection robot designed using Arduino technology. The robot is equipped with a metal detector sensor capable of identifying metallic landmines buried beneath the ground. Controlled via wireless communication (e.g., Bluetooth or RF module), the robot allows the operator to navigate hazardous zones from a safe distance. The system integrates an Arduino microcontroller to process sensor data and control the robot's movement. Upon detecting a potential landmine, the robot provides real-time alerts through visual or audio indicators. This solution aims to enhance safety in mine-affected regions while minimizing risk to human deminers. The simplicity and affordability of the design make it suitable for deployment in low-resource settings. Landmines continue to be a persistent threat in many post-war regions around the world, causing injury and death to civilians long after conflicts have ended. The manual detection and demining process is highly dangerous, time-consuming, and resource-intensive. To address this critical issue, this project proposes the design and implementation of a remote-controlled landmine detection robot using Arduino as the central control unit. The system aims to enhance demining safety and efficiency through automation and remote operation.The robot is equipped with a metal detector sensor that can identify buried metallic objects, typically associated with landmines. The detection mechanism is mounted on a movable robotic platform, which is driven by DC motors controlled via an Arduino Uno microcontroller. The robot can be navigated wirelessly using Bluetooth, RF, or Wi-Fi modules, allowing the operator to control the robot from a safe distance and avoid direct contact with potentially dangerous areas.Upon detecting metal beneath the surface, the sensor sends signals to the Arduino, which then triggers visual (LED indicators) and/or auditory (buzzer) alarms to notify the user of a potential landmine. The robot's movements—forward, backward, left, and right—are controlled remotely through a mobile application or joystick interface, offering precise maneuverability in challenging terrains.

1. INTRODUCTION

Landmines remain one of the most dangerous remnants of war, posing serious risks to civilians and military personnel in post-conflict zones. Traditional landmine detection methods are not only time-consuming but also highly hazardous for human operators. With advancements in robotics and embedded systems, there is an increasing focus on developing intelligent, automated solutions to reduce human involvement in dangerous operations.This project presents a remote-controlled landmine detection robot integrated with a robotic arm, designed using Arduino as the central microcontroller. The robot is equipped with a metal detector sensor capable of identifying buried metallic landmines and a robotic arm that can be used for marking, manipulating, or cautiously handling suspicious objects. The system is wirelessly controlled using Bluetooth, RF, or Wi-Fi modules, allowing the operator to remain at a safe distance while navigating and managing operations in hazardous areas.The robotic platform offers high mobility, obstacle navigation, and real-time detection, making it suitable for mine-affected terrains. The integration of the robotic arm adds significant functionality by enabling remote

interaction with detected objects, which enhances both safety and versatility. Powered by a rechargeable battery and built on a durable chassis, the robot provides a reliable and low-cost solution for mine detection tasks.By combining sensor technology, wireless control, and robotic manipulation, this project aims to contribute a safer, efficient, and practical alternative to traditional mine detection methods. Landmines, remnants of past wars and conflicts, continue to pose a serious humanitarian and security challenge in many parts of the world. Every year, thousands of people are injured or killed by accidental landmine detonations, many of whom are civilians, including children. The conventional methods used for landmine detection—such as manual probing, sniffer dogs, and trained personnel—are not only slow and costly but also extremely dangerous. As a result, there is an urgent need for the development of safer, more efficient, and cost-effective technological solutions to address this global issue. In response to this challenge, this project focuses on the development of a remote-controlled landmine detection robot integrated with a robotic arm, built using the Arduino microcontroller platform. Arduino is chosen for its open-source flexibility, ease of programming, and extensive support for interfacing with various sensors and actuators. The core objective of this robot is to detect buried metallic landmines using a metal detector sensor and to allow remote handling or marking of suspected objects using a robotic arm—all while keeping the operator at a safe distance from the hazardous area.

2. LITERATURE REVIEW

Acute Manandhar, Peter A. Torrione, Leslie M. Collins and Kenneth D. Morton, "Multiple-Instance Hidden Markov Model for GPR-Based Landmine Detection," IEEE transactions on Geosciences and remote sensing, vol. 53, no. 4, pp. 1737-1745, April 2015. 2)Jaradat, M.A, "Autonomous navigation robot for landmine detection applications," IEEE transactions on Mechatronics and its Applications, vol.16, no. 3, pp. 1-5, April 2012.3)"Design and Implementation of Landmine Robot" Wade Ghribi, Ahmed Said Badawy, Mohammed Rahmathullah, Suresh Babu Changalasetty. IJEIT Volume 2, Issue 11, May 2013. 4)Ghribi, W., Badawy, A.S., Rahmathullah, M. and Changalasetty, S.B." Design and implementation of landmine robot". Int. J. Engg. Innov. Technol. 2(11): 250-256, March 2013. 5)P. Gonzalez de Santos, E. Garcia, J. Estremera and M.A. "Using walking robots for landmine detection and location". Armada Industrial Automation Institute-CSIC . Camp Real, Km. 0,200- La Poveda 28500 Arganda del Rey, Madrid, Spain, January 2014. 6)Ilaria Bottigliero. 120 Million Landmines Deployed Worldwide: Fact or Fiction. Pen and Sword Books Ltd, Barnsley, South Yorkshire, UK, June 2014. 7)MacDonald J., Lockwood J.R., Mc Fee J.E., Altshuler T., Broach J. T., L. Carin,Harmon R.S., Rappaport C., Scott W.R., and Weaver R. Alternatives for landmine detection. Technical report, RAND (http://www.rand.org/ publications/ MR/ MR 1608/ MR 1608. appg.pdf), February2013. 8)Jaradat M A, Bani Salim M N and Awad F H, "Autonomous Navigation Robot for Landmine Detection Applications", 8th International Symposium on Mechatronics and its Applications (ISMA), April 2012. L. Robledo, M. Carrasco and D. Mery," A survey of land mine detection technology" International Journal of Remote Sensing Vol. 30, No. 9, 10 May 2009, 2399–2410 [2] Jebasingh Kirubakaran.S.J, Anish kumar jha, Dheeraj kumar, Sadambi Poorna chandram Prakash, "Mine Detecting Robot with Multi Sensors Controlled Using HC-12 Module" International Journal of Engineering & Technology [3] Bharath J, "Automatic Land Mine Detection Robot Using Microcontroller", International Journal of Advance Engineering and Research Development Volume 4, Issue 3, March-2017 [4] Zhenjun He, Jiang Zhang, Peng Xu, Jiaheng Qin and Yunkai Zhu, "Mine Detecting Robot Based on Wireless Communication with Multi-sensor". [5] Jaradat M A, Bani Salim M N and Awad F H (2012), "Autonomous Navigation Robot for Landmine Detection Applications". [6] Kuo-Lan Su, Hsu-Shan Su, Sheng-Wen Shiao and JrHung Guo (2011), "Motion

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3. PROPOSED SYSTEM

The robot consists of a rugged four-wheel drive or tracked chassis capable of traversing uneven and dangerous terrains. A metal detector coil is mounted at the front and close to the ground to scan for buried metallic objects. A robotic arm, controlled via servos, is attached to the body and can be used to place markers, lift small debris, or assist in examining suspected landmine locations. The robot is operated remotely using RF or Wi-Fi communication via a custom controller or smartphone interface.

An Arduino Uno or ESP32 microcontroller serves as the brain of the system, handling motor control, sensor data processing, and arm movement. Ultrasonic sensors are used for obstacle detection, while a wireless camera provides a live video feed to assist the operator in navigating and operating the robot and arm. A buzzer and LED system provides immediate alerts when a metallic object is detected.

In addition to enhancing safety during demining operations, the inclusion of a robotic arm significantly expands the robot's functionality beyond simple detection. The arm can be used to place warning flags or markers at the location of a detected mine, helping demining teams avoid dangerous areas and plan extraction routes more effectively. In some cases, it may also be used to gently remove surface debris such as leaves, rocks, or loose soil that may be covering the mine, allowing for better visibility without direct human contact. The arm's movement is precisely controlled via servos and can be manipulated remotely through a dedicated controller or interface, ensuring accurate and delicate operation even from a safe distance. To further improve the robot's effectiveness, it can be equipped with a GPS module to record and map mine locations. This geolocation data can be transmitted in real time or stored for later analysis, creating a digital record of suspected minefields. The robot's design also allows for future upgrades, such as integrating AI for object recognition, adding temperature or humidity sensors to assess terrain conditions, or using GPRS modules for long-range communication. Overall, the proposed system offers a modular, scalable, and user-friendly solution to one of the world's most dangerous humanitarian challenges—landmine detection and clearance.

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Cosmos Impact Factor-5.86

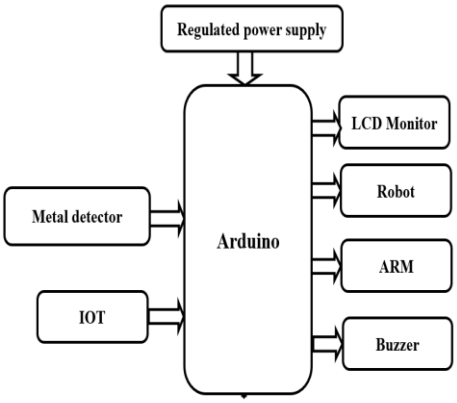

Fig 1: Block diagram

1. Overview of the System

The block diagram represents a remote-controlled landmine detection robotic system designed for safe and efficient mine detection operations. At the heart of the system lies the Arduino microcontroller, which acts as the central unit responsible for processing data, managing sensor inputs, controlling outputs, and maintaining overall coordination of the robot's functionality. The system integrates key components including a metal detector, robotic arm, buzzer, IoT module, LCD monitor, and robotic drive unit, all powered by a regulated power supply.

The purpose of this robot is to detect buried metallic landmines, alert the operator, and optionally mark or manipulate the area using a robotic arm. Through remote communication,

possibly via IoT or Bluetooth, the robot can be operated from a safe distance, reducing human risk in hazardous areas.

2. Regulated Power Supply

The entire system is powered by a **regulated power supply**, which ensures that all components receive a stable and appropriate voltage level. The Arduino board, sensors, motors, and display modules typically operate on 5V or 12V DC. This regulated power source protects the electronic components from voltage fluctuations and overloads that could otherwise damage the circuitry or lead to malfunction.

Power is distributed to all peripherals from this supply unit, making it a critical part of the robot's infrastructure. The power supply can be implemented using a battery pack (e.g., 12V rechargeable battery) with voltage regulators like the 7805 IC to provide 5V output for Arduino and sensors.

3. Arduino (Microcontroller Unit)

The **Arduino** acts as the **brain of the system**, controlling every input and output. It receives data from the **metal detector** and **IoT module**, processes this data, and responds by sending signals to other components such as the **buzzer**, **LCD monitor**, **robot motors**, and **robotic arm**.

It reads analog or digital signals from the metal detector to determine if a metallic object (possibly a landmine) is present. It then commands the buzzer to alert, displays information on the LCD, and can be programmed to stop or slow down the robot. Additionally, it controls the robotic arm's movement based on manual commands or pre-programmed instructions.

4. Metal Detector

The **metal detector** is a crucial part of the robot, responsible for identifying the presence of metallic materials buried underground. It generally works based on the principle of electromagnetic induction: when the coil in the detector passes over a metallic object, it experiences a change in inductance, producing a signal. This signal is fed to the Arduino, which interprets the reading and triggers an alert if a potential landmine is detected. The detector is typically mounted close to the ground on the front of the robot, scanning the soil as the robot moves.

5. IoT Module

The IoT (Internet of Things) module allows the robot to communicate with a remote monitoring system via the internet. Using Wi-Fi-enabled modules like the ESP8266 or ESP32, the robot can transmit data such as detection events, robot status, location (if GPS is included), and even stream images or video if a camera is attached.This enables real-time remote monitoring and control, enhancing operational safety and effectiveness. Operators can control the robot and receive detection alerts through a web or mobile app interface.

6. LCD Monitor

The LCD monitor is used for displaying critical real-time data such as detection status, sensor readings, system status, and control feedback. For example, when a landmine is detected, the display can show messages like "Metal Detected," signal strength, or even GPS coordinates if applicable.

This helps field personnel quickly interpret the situation without needing external monitoring systems. A 16x2 or 20x4 LCD is typically used due to its ease of integration with Arduino and good visibility in daylight.

7. Robot (Drive Unit)

This block represents the movement mechanism of the robot, which includes the DC motors, motor drivers (like L298N or L293D), wheels or tracks, and chassis. The robot's movement (forward, backward, left, right, stop) is controlled through the Arduino based on user input from the remote controller or IoT interface.The mobility system is designed to be robust enough to traverse rough or uneven terrain where landmines may be buried. Motor drivers are essential to interface the Arduino with the high-current motors used in the drive system.

8. Robotic Arm

The **robotic arm** is a major enhancement in this design. It allows the robot to **interact physically** with the environment — for example, placing a marker at the location of a detected mine or clearing surface debris like leaves or soil. The arm is typically driven by **servo motors** and can be 4-DOF (Degrees of Freedom) or more, depending on the application. The Arduino sends pulse-width modulation (PWM) signals to each servo to control joint angles and movement. The arm is controlled remotely and requires precise command handling.

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9. Buzzer

The buzzer acts as an audio alert system that is triggered when the metal detector senses a potential landmine. It provides instant audible feedback to nearby operators or rescue workers. In some designs, a visual LED indicator is also included to complement the buzzer. This simple yet effective alarm system ensures that even if the operator misses an LCD message or camera feed, they are still alerted to a possible danger through sound.

4. RESULTS

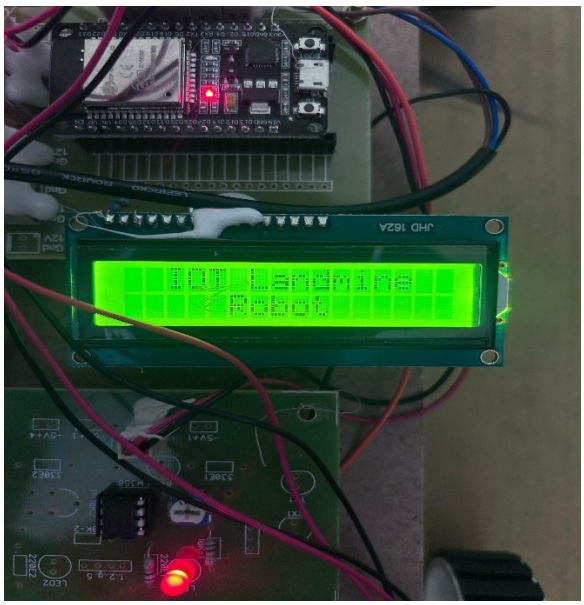

Fig 2: LED screen

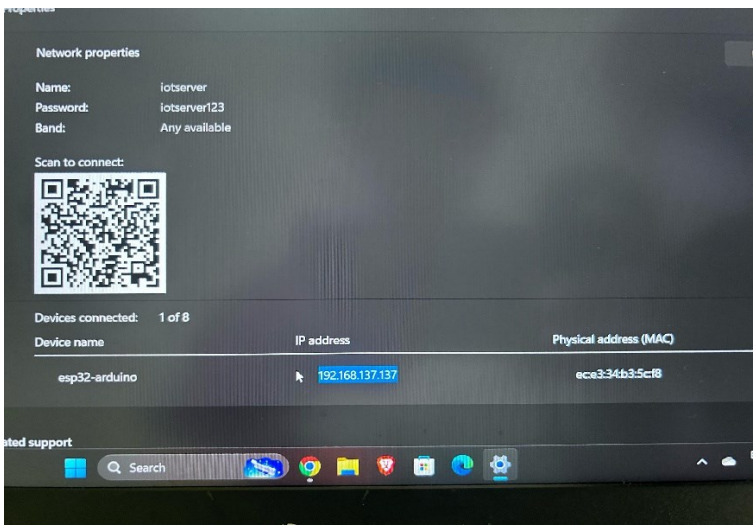

Fig 3:setting up mobile hotspot in laptop

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Cosmos Impact Factor-5.86

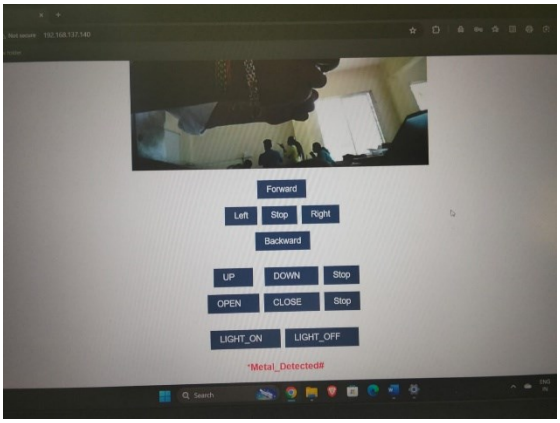
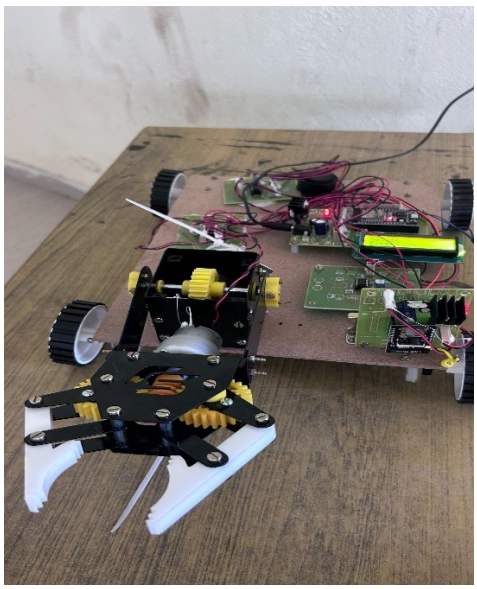


Fig 4: Showing detected in Laptop



5. CONCLUSION

The development of the remote-controlled landmine detection robot with an integrated robotic arm presents a significant advancement in ensuring human safety during landmine clearance operations. By combining metal detection, robotic mobility, remote communication, and manipulation capabilities, this system offers a reliable and efficient solution for identifying and marking potentially hazardous areas without exposing personnel to danger. The use of an Arduino microcontroller enables seamless coordination between various modules such as the metal detector, robotic arm, buzzer alert system, and IoT-based communication. This enhances real-time control, feedback, and monitoring, making the system both user-friendly and technically robust. The addition of the robotic arm further improves functionality by enabling the robot to mark or interact with detected sites, thus increasing precision and usability in field operations. The project demonstrates how embedded systems, robotics, and wireless technology can be effectively integrated to address real-world problems. With further enhancements like GPS tracking, autonomous navigation, and advanced sensor integration, this system has the potential to evolve into a fully autonomous mine detection and mapping solution that can be deployed in real demining missions across the globe.

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