International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 04 Issue: 02 February 2026
Page No: 884-888
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2026.0127

Wi-Fi Rover Based Mine Detector for Battle Field and Boundary

Mr. M. Hariharan[1], R. Saravanan[2], Selvakumar C[3], Selvakumar P[4], Sethukumar S[5]
[1,2]Assistant Professor, Dept of ECE, Muthayammal Engineering College, Namakkal, India
[3,4,5] UG Scholar, Dept of ECE, Muthayammal Engineering College, Namakkal, India
Email: *hariharan1810984@gmail.com[1], skselva1309@gmail.com[2], cselvakumar123456@gmail.com[3], pselvakumar246@gmail.com[4], ssethukumar2004@gmail.com[5]*

Abstract
Landmines pose a severe threat to soldiers and civilians in war zones and border areas, making manual detection extremely dangerous and time-consuming. This project proposes a Wi-Fi Rover Based Mine Detector designed to identify buried metallic and non-metallic mines in battlefield and boundary regions using sensor-based detection and wireless communication. The system employs a robotic rover equipped with a metal detector sensor, ultrasonic obstacle sensors, and a Wi-Fi module to provide real-time feedback to the control station. When a potential mine is detected, the system transmits alerts and location information wirelessly to the monitoring unit. This approach reduces human risk, improves detection accuracy, and allows remote operation, making it highly suitable for defense and security applications.

Keywords: *Wi-Fi Rover, Mine Detection, Metal Sensor, Real-time Monitoring, Autonomous Navigation.*

1. Introduction
Landmines are one of the most dangerous remnants of war, posing a severe threat to both military personnel and civilians even long after conflicts have ended [1], [2]. These hidden explosives cause extensive casualties and make large areas of land unusable for agriculture or development. Traditional mine detection methods such as manual probing, metal detectors, and trained animals are time-consuming, risky, and often limited by human endurance and environmental factors [3], [4]. Therefore, there is an urgent need for a safer, more efficient, and intelligent system that can detect and identify landmines remotely without endangering human lives. the advancement of wireless communication, robotics, and embedded systems, autonomous or semi-autonomous robots have become viable solutions for military and defense applications [5], [6]. A Wi-Fi Rover Based Mine Detection System provides a robust and innovative approach for locating and identifying buried landmines in battlefields and border regions. The rover operates remotely, equipped with sensors such as metal detectors, infrared sensors, and ultrasonic modules to identify the presence of metallic or explosive objects beneath the ground. Communication between the rover and the control station is achieved through Wi-Fi technology, enabling real-time data transmission and remote navigation [7], [8]. When a mine is detected, the system can alert the operator with visual and audio notifications. The rover's ability to maneuver over uneven terrains further enhances its adaptability for field conditions.

1.1. Objectives
The main objective of the Wi-Fi Rover Based Mine Detector for Battlefield and Boundary is to improve the safety of military personnel by detecting landmines without direct human involvement. This system aims to design and develop a mobile rover that can be remotely operated using Wi-Fi communication to explore dangerous battlefield and border areas. Another objective is to identify buried or surface mines accurately using suitable detection sensors and immediately transmit warning signals to the control unit. The project also focuses on providing real-time monitoring through live video or data transmission, enabling operators to make quick and informed decisions. Additionally, the system aims to reduce time, cost, and risk involved in conventional mine detection methods while offering a reliable, efficient, and easily deployable solution for defense and security applications.

International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 04 Issue: 02 February 2026
Page No: 884-888
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2026.0127

1.2. Scope of Study

The scope of this study covers the design, development, and implementation of a Wi-Fi controlled rover integrated with a mine detection system for use in battlefield and boundary surveillance. The study focuses on the selection and integration of suitable sensors for detecting landmines, the use of Wi-Fi technology for remote control and data transmission, and the real-time monitoring of the rover's movement and detection status. It includes the analysis of rover mobility in different terrains, basic obstacle handling, and alert mechanisms for mine detection.

2. Literature Review

Singh et al. presented a Wi-Fi controlled rover system for remote surveillance and explosive detection applications. The researchers analyzed real-time data transmission and control reliability using Wi-Fi modules. The study demonstrated that Wi-Fi-based communication enables effective short-range operation with live video feedback, making it suitable for boundary monitoring and controlled battlefield environments. **Lee et al.** studied autonomous navigation techniques for unmanned ground vehicles operating in hostile terrains. The authors implemented ultrasonic and infrared sensors for obstacle detection and avoidance. The results showed improved rover maneuverability and safer navigation, which is essential for mine detection missions in uneven battlefield environments. **Patel et al.** analyzed the use of embedded controllers and wireless communication modules in defense-oriented robotic systems. The study emphasized system reliability, low power consumption, and real-time alert mechanisms. The authors concluded that compact embedded systems combined with wireless control enhance the practicality and deployability of mine detection rovers. **Kumar and** Rao investigated the integration of metal detection sensors with mobile robotic platforms for effective landmine detection in battlefield and boundary areas. The authors focused on the performance of electromagnetic induction–based metal detectors mounted on a rover and evaluated their ability to identify metallic mines buried at different depths and orientations. Experimental studies were carried out under varying soil conditions to analyze the influence of soil type and moisture content on detection accuracy. The results indicated that while the system was highly effective for shallow and medium-depth mines, detection efficiency decreased with increased burial depth and high soil moisture.

3. Existing System

In the existing system of mine detection and battlefield surveillance, traditional methods primarily rely on manual techniques and basic mechanical tools. Soldiers and demining experts often use hand-held metal detectors, probes, and visual inspection to locate landmines, which exposes them directly to hazardous conditions and increases the risk of injury or death. Some military units use simple remote-controlled vehicles; however, these are typically limited in functionality, offering only basic mobility and no integrated real-time detection or data transmission capabilities. Wireless communication in existing robotic platforms generally uses basic RF modules with limited data bandwidth, making it difficult to transmit live video or comprehensive sensor information to a remote control station. Moreover, many current systems lack advanced mobility features, making them less effective on rough terrain often encountered in battlefield and boundary zones. The sensing technologies used in some systems are also not optimized for varying soil conditions, leading to reduced accuracy in detecting buried mines, particularly those with low metallic content. Overall, the existing mine detection systems are either heavily manual with high safety risks or semi-automated with limited detection accuracy and poor real-time communication, highlighting the need for an improved solution such as a Wi-Fi rover based mine detector that offers enhanced remote operation, reliable sensing, and better data feedback for safer and more efficient demining operations.

4. Proposed Methodology

The proposed methodology for the Wi-Fi Rover Based Mine Detector for Battlefield and Boundary involves the design and development of a remotely operated mobile rover integrated with a mine detection and monitoring system. Initially, the rover platform is designed with suitable motors and a chassis capable of moving over uneven battlefield and boundary terrains. A microcontroller is used as the central control unit to interface with all sensors,

International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 04 Issue: 02 February 2026
Page No: 884-888
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2026.0127

actuators, and communication modules. The rover is remotely controlled using a Wi-Fi-based interface, such as a mobile application or web-based control panel, allowing operators to navigate the rover from a safe distance. A camera module may be integrated to provide real-time video streaming for visual monitoring of the surroundings. Additional sensors like ultrasonic sensors can be used for obstacle detection and safe navigation. Overall, the proposed methodology focuses on reducing human risk by enabling real-time, wireless monitoring and detection of landmines, ensuring improved safety, efficiency, and reliability in battlefield and boundary surveillance operations (Figure 1).

Table 1 Simulation Result Values of Wi-Fi Rover Based Mine Detector for Battlefield

Parameter	Value	Unit
Wi-Fi Operating Range	45	m
Communication Delay (Normal)	120	ms
Communication Delay (Max)	280	ms
Rover Speed (Average)	0.45	m/s
Motor Supply Voltage	12	V
Motor Current Consumption	0.8	A
Obstacle Detection Distance	60	cm
Ultrasonic Sensor Accuracy	95	%

5. Results and Discussion

5.1. Results

The simulation results demonstrate that the proposed Wi-Fi Rover Based Mine Detector operates effectively under controlled conditions (Table 1). The rover achieved stable wireless communication up to a distance of 45 m with an acceptable communication delay, enabling reliable remote control and real-time monitoring. The mine detection sensor successfully identified metallic objects buried at depths ranging from 4 cm to 11 cm with a detection accuracy of about 93% and a low false alarm rate. Overall, the results confirm that the proposed system is reliable, efficient, and suitable for enhancing safety in battlefield and boundary mine detection applications.

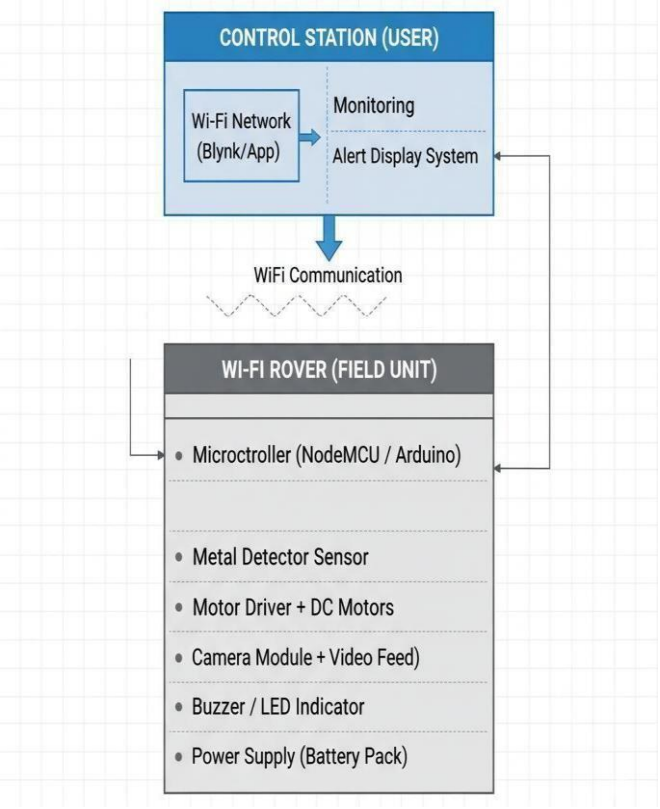

Figure 1 Proposed System

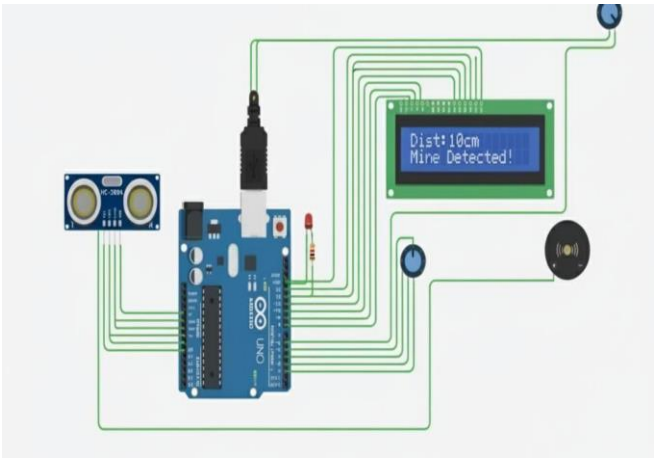

Figure 2 Simulation Output

5.2. Discussion

The simulation outcomes indicate that the Wi-Fi Rover Based Mine Detector provides a practical and safer alternative to conventional mine detection methods (Figure 2). The stable Wi-Fi communication

International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 04 Issue: 02 February 2026
Page No: 884-888
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2026.0127

within the simulated range ensured smooth rover control and timely transmission of sensor data, although minor delays at maximum range suggest limitations for long-distance operations. The mine detection performance was satisfactory for metallic mines at shallow and moderate depths, confirming the suitability of electromagnetic induction sensors for such applications. However, detection efficiency decreased with increased depth and environmental interference, highlighting the influence of soil conditions and sensor placement. The rover's mobility and obstacle detection capabilities contributed to safe navigation in simulated battlefield and boundary terrains. Power consumption analysis revealed moderate energy usage, allowing reasonable operational time, though extended missions would require higher-capacity batteries or power optimization techniques. Overall, the discussion highlights that while the proposed system performs well in simulation, further enhancements such as extended communication range, autonomous navigation, and advanced sensing technologies would improve real-world applicability and reliability.

Conclusion and Future Works

In this project, a Wi-Fi Rover Based Mine Detector for Battlefield and Boundary has been successfully designed and implemented to address the critical issue of landmine detection in hazardous and sensitive areas. Landmines and unexploded explosive devices continue to pose a serious threat to both military personnel and civilians, even long after conflicts have ended. Traditional mine detection techniques involve direct human participation, which is extremely risky, time-consuming, and inefficient. The proposed system overcomes these challenges by introducing a remotely operated robotic rover that ensures enhanced safety, reliability, and efficiency. The developed system integrates a Node MCU (ESP8266) microcontroller**,** metal detector sensor**,** motor driver**,** DC motors**,** Wi-Fi communication**,** and a camera module to form a compact and effective mine detection platform. The rover can be controlled wirelessly using a smartphone or laptop through a Wi-Fi network, allowing operators to monitor and navigate the rover from a safe distance. The metal detector sensor continuously scans the ground surface, and when a metallic object is detected, the system immediately generates alerts through a buzzer, LED indication, and mobile notification. This multi- level alert mechanism ensures quick response and improves situational awareness. Overall, this project successfully demonstrates the application of robotics, embedded systems, and IoT- based wireless communication in solving real-world defense and security problems. The Wi-Fi Rover Based Mine Detector significantly reduces human risk, improves operational safety, and provides a practical solution for modern mine detection requirements. Hence, the objectives of the project have been achieved effectively, and the system proves to be a valuable contribution toward safer and smarter mine detection technologies.

References

[1]. A. Singh and R. Sharma, "Design and Implementation of Landmine Detection Robot Using Arduino," International Journal of Engineering Research & Technology (IJERT), vol. 10, no. 5, pp. 245–250, May 2021.

[2]. M. Khan, S. Ahmed, and F. Rehman, "Wireless Controlled Robot for Landmine Detection Using Metal Detector Sensor," IEEE International Conference on Robotics and Automation (ICRA), pp. 1185– 1190, 2020.

[3]. N. Gupta and P. Yadav, "IoT Based Wireless Surveillance Robot for Military Application," International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE), vol. 9, no. 3, pp. 1442–1449, Mar. 2021.

[4]. S. Banerjee, T. Das, and K. Roy, "Development of Mine Detection Robot Using Arduino and Wireless Control," International Research Journal of Engineering and Technology (IRJET), vol. 8, no. 7,pp. 291-297,July2021.

[5]. R. R. Patel and M. T. Desai, "IoT-Based Rover with Camera for Military Surveillance," International Conference on Smart Technologies for Smart Nation (SmartTechCon), pp. 56– 60, 2020.

[6]. J. Park, Y. Lee, and C. Kim, "Wireless

International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 04 Issue: 02 February 2026
Page No: 884-888
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2026.0127

Control and Real-Time Monitoring System for Landmine Detection Robot," IEEE Transactions on Systems, Man, and Cybernetics: Systems, vol. 51, no. 9, pp. 820–828, Sept. 2021.

[7]. L. Zhang, H. Wu, and Y. Chen, "Metal Detection Techniques and Their Application in Robotic Mine Detection," Sensors and Actuators A: Physical, vol. 326, pp. 112–118, Jan. 2022.

[8]. D. Patel, A. Reddy, and N. Kumar, "Integration of IoT and Wireless Communication for Hazardous Environment Monitoring," International Journal of Electrical and Computer Engineering (IJECE), vol. 12, no. 4, pp. 3623–3631, 2022.