IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, March 2026
Impact Factor: 8.2

Military Surveillance Robot with Image Processing

Asst. Prof. Mahendrasing A.Gurunasingani[*], Ms. Shravani Dinesh Vijapure[1] ,
Ms. Mayuri Rajendra Chandure[2], Ms.Tejaswini Chandu Warghat[3], Ms. Sakshi Gajanan Gandhe[4],
Mr. Amit PrabhakarKale[5] , Mr. Aves Baig Wazir Baig[6]
Guide, Department of Electrical Engineering
Students, Final Year Department of Electrical Engineering
R.V. Parankar College of Engineering and Technology, Arvi, Maharashtra, India
mahendra141286@rediffmail.com, ijapureshravani@gmail.com , mayurichandure413@gmail.com,
varghtsavita@gmail.com ,gandhesakshi4@gmail.com ,kaleamit578@gmail.com ,avesbaig980@gmail.com

Abstract: *Ensuring security in hostile and high-risk environments is a critical requirement in modern military operations. Traditional surveillance approaches often depend on human patrol teams or stationary monitoring equipment, which can expose personnel to dangerous conditions and limit the effectiveness of surveillance coverage. Advances in robotics, embedded electronics, and computer vision have enabled the development of intelligent robotic platforms capable of performing monitoring tasks remotely.*

This study presents the design and development of a mobile military surveillance robot integrated with image processing capabilities. The proposed robotic system is designed to perform real-time monitoring of sensitive areas, detect suspicious movements, and identify possible landmines in hazardous zones. A camera mounted on the robotic platform captures live video from the surrounding environment and transmits the data to a remote monitoring station using wireless communication. Image processing techniques are applied to analyze the captured video frames for detecting objects, movement patterns, and unusual activities.

By integrating mobility, sensing technologies, and automated visual analysis, the system improves situational awareness in dangerous environments while minimizing the need for direct human involvement. The proposed solution offers an effective and reliable technological approach for surveillance tasks in modern defense applications.

Keywords: Military Surveillance, Image Processing, Mobile Robot, Landmine Detection, Wireless Communication, Security Systems

I. INTRODUCTION

Surveillance is an essential component of modern military strategy. Monitoring sensitive locations, protecting national borders, and collecting intelligence about enemy activities are important tasks that help ensure national security. Conventional surveillance methods typically rely on human patrol units or fixed surveillance systems such as cameras and watchtowers. Although these methods can provide useful information, they also expose soldiers to potential threats, especially in areas containing hidden explosives or hostile activity.

Recent developments in robotics technology have made it possible to deploy unmanned systems for surveillance and monitoring tasks. These robotic platforms can operate in environments that may be unsafe for human personnel. By integrating cameras, sensors, and communication technologies, robots can collect real-time information and transmit it to remote operators for analysis.

One of the major challenges in military surveillance is operating in unpredictable and difficult terrain. Surveillance missions may occur in deserts, forests, mountainous regions, or urban environments. Therefore, robotic systems used for surveillance must be capable of moving across uneven surfaces while maintaining stable communication with the control station.

DOI: 10.48175/IJARSCT-31588

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, March 2026
Impact Factor: 8.2

Another major concern in conflict zones is the presence of concealed explosive devices such as landmines. Landmines are often buried underground and can remain undetected for long periods, posing serious risks to soldiers and civilians. Early detection of such hazards can significantly reduce casualties and improve operational safety.

The integration of image processing techniques further enhances the capability of surveillance robots. Computer vision algorithms enable automated analysis of visual data captured by cameras. These techniques can be used to detect moving objects, recognize unusual patterns, and identify suspicious activities in monitored areas. As a result, image processing reduces the workload of human operators and improves the efficiency of surveillance systems.

The development of a mobile surveillance robot equipped with image processing and sensor technologies provides a practical approach to addressing these challenges. By combining robotics, sensing devices, and wireless communication, the system can monitor hazardous environments remotely while reducing risks to human personnel.

II. LITERATURE REVIEW

Several research studies have explored the use of robotic platforms for surveillance and security purposes. Mobile robots equipped with cameras and wireless communication systems are widely used to monitor restricted zones and transmit real-time visual information to remote control centers. These systems help improve situational awareness and reduce the need for continuous human patrols.

Researchers have also investigated the integration of different sensors in robotic systems to improve navigation and environmental awareness. Sensors such as ultrasonic sensors, infrared sensors, and metal detectors are commonly used for obstacle detection and object identification. In military applications, metal detectors can assist in identifying buried metallic objects that may indicate the presence of landmines or explosive materials.

Computer vision technology has significantly improved the capabilities of modern surveillance systems. Techniques such as motion detection, object recognition, and pattern analysis allow automated monitoring of large areas. These methods enable surveillance systems to detect suspicious behavior more efficiently and provide faster responses to potential threats.

Despite the progress made in surveillance robotics, several challenges still remain. Issues such as limited battery capacity, communication reliability, and processing speed can affect the performance of robotic surveillance systems. In addition, many existing systems lack integrated mechanisms for detecting hidden threats such as buried explosives. Therefore, continued research is required to develop more advanced and efficient surveillance robots capable of operating effectively in complex environments.

III. METHODOLOGY

The proposed system focuses on designing and implementing a mobile robotic platform capable of performing surveillance and detecting potential threats using image processing and sensor technologies.

3.1 System Design

The robot is built as a wheeled mobile platform powered by DC motors. A microcontroller or single-board computer such as Arduino or Raspberry Pi controls the overall operation of the robot. Various sensors, a camera module, and wireless communication components are integrated into the system to enable navigation, monitoring, and data transmission.

3.2 Image Acquisition

A camera module is installed on the robot to capture real-time images and video from the surrounding environment. The captured video frames are transmitted to the processing unit where they are analyzed for detecting objects and movements.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, March 2026
Impact Factor: 8.2

3.3 Image Processing

Computer vision techniques are us
ed to analyze the captured video data. Image processing algorithms implemented using libraries such as OpenCV are used to identify moving objects, detect patterns, and highlight unusual activities within the monitored environment.

3.4 Landmine Detection

To detect potential landmines, a metal detection sensor is integrated into the robotic platform. The sensor continuously scans the ground surface for metallic objects. When a metal object exceeding the predefined threshold is detected, the system generates an alert signal indicating the possible presence of a landmine.

3.5 Wireless Communication

The robot communicates with a remote control station using wireless technologies such as Wi-Fi or Bluetooth. This communication link allows the transmission of live video streams as well as control commands from the operator.

3.6 Remote Monitoring

The control station receives real-time visual and sensor data from the robot. Operators can monitor the environment through a display interface and control the robot's movement remotely while receiving alerts related to detected threats.

IV. PROPOSED SYSTEM

The proposed surveillance robot is designed to operate in environments that may be unsafe for direct human access. The system integrates mobility, sensing technologies, and visual monitoring capabilities to observe surroundings and transmit information to a remote controlcenter.

The robot performs several important functions, including:

- Monitoring restricted or hazardous areas
- Providing real-time video surveillance
- Detecting potential landmines using metal detection sensors
- Identifying suspicious movements through image processing techniques
- Allowing remote navigation and control by an operator

By combining these functions into a single robotic platform, the system improves situational awareness and enhances the safety of military personnel.

V. SYSTEM ARCHITECTURE

The system architecture consists of three major modules.

Surveillance Module

This module is responsible for capturing visual data using the onboard camera and transmitting the video stream to the monitoring station.

Detection Module

The detection module processes information from sensors and image processing algorithms to identify obstacles, metallic objects, or unusual movements within the environment.

Control Module

The control module manages the movement of the robot using commands received from the operator through the wireless communication channel. It also coordinates the operation of sensors, motors, and processing units.

VI. HARDWARE COMPONENTS

The proposed surveillance robot consists of the following hardware components:

- Processing Unit: Arduino or Raspberry Pi used for system control and data processing

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, March 2026
Impact Factor: 8.2

- Camera Module: Used for capturing real-time video of the environment
- Metal Detector Sensor: Used for detecting metallic objects beneath the ground surface
- Ultrasonic Sensor: Used for obstacle detection and distance measurement
- Motor Driver (L298N): Used to control the movement of DC motors
- DC Motors and Wheels: Provide mobility for the robotic platform
- Wireless Communication Module: Enables data transmission between the robot and control station
- Rechargeable Battery: Supplies electrical power to the system

VII. WORKING OF THE SYSTEM

The operation of the system begins when the robot is powered on and connected to the remote monitoring station. The onboard camera continuously captures video of the surrounding environment and sends the visual data to the control station through the wireless communication module.

At the same time, the metal detection sensor scans the ground surface while the robot moves. If the sensor detects a metallic object that may indicate the presence of a landmine, an alert message is sent to the operator.

The operator can remotely control the robot's movement through wireless commands. This allows the robot to explore hazardous areas while continuously transmitting surveillance data and sensor readings. As a result, monitoring operations can be performed safely without exposing soldiers to direct risk.

VIII. RESULTS AND DISCUSSION

The developed robotic system successfully demonstrates the ability to perform real-time monitoring and transmit live video data to a remote control station. The integration of image processing algorithms enables the system to detect motion and identify objects within the monitored area.

The metal detection mechanism improves operational safety by identifying possible landmines before human personnel enter the location. Wireless communication ensures continuous data exchange between the robot and the operator.

Experimental testing indicates that the system can effectively support surveillance tasks in hazardous environments while reducing potential risks to human personnel.

IX. CONCLUSION

This research presented the design and implementation of a mobile military surveillance robot integrated with image processing technology. The system combines robotics, sensing devices, and wireless communication to enable remote monitoring and threat detection.

The robot is capable of capturing real-time video, analyzing visual information, detecting metallic objects that may indicate landmines, and sending alerts to operators. By minimizing the need for human presence in dangerous environments, the proposed system improves safety and operational efficiency in military surveillance applications.

Robotic surveillance platforms such as the one proposed in this study represent an important advancement in defense technology and have the potential to play a significant role in future security operations.

Future Scope

- Several improvements can be implemented in future versions of the system:
- Integration of artificial intelligence for advanced object recognition
- Implementation of GPS for location tracking and navigation
- Use of thermal and night-vision cameras for low-light surveillance
- Autonomous navigation using machine learning algorithms
- Integration with aerial drones for combined ground and aerial monitoring

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, March 2026
Impact Factor: 8.2

REFERENCES

[1]. J. Siegwart, I. Nourbakhsh, and D. Scaramuzza, *Introduction to Autonomous Mobile Robots*, MIT Press, 2011.
[2]. R. Szeliski, *Computer Vision: Algorithms and Applications*, Springer, 2010.
[3]. G. Bradski and A. Kaehler, *Learning OpenCV: Computer Vision with the OpenCV Library*, O'Reilly Media, 2008.
[4]. B. Siciliano and O. Khatib, *Springer Handbook of Robotics*, Springer, 2016.
[5]. M. F. Hossain and M. A. Rahman, "Design and Implementation of Wireless Surveillance Robot for Security Applications," *International Journal of Robotics Research*, vol. 8, no. 3, pp. 45–52, 2019.
[6]. S. Thrun, W. Burgard, and D. Fox, *Probabilistic Robotics*, MIT Press, 2005.