International Journal For Recent Developments in Science & Technology
2581-4575
Crossref
A Peer Reviewed Research Journal

IOT SERVER BASED NIGHT PATROLLING VIDEO SURVEILLENCE ROBOT

CHILLAMCHARLA KAVERI[1],M CHARAN SAI[2],BOPPANAPALLI ASHOK[3],MS.E.DEEPTHI[4]

[1,2,3] UG Students, Dept of ECE, MALLA REDDY ENGINEERING COLLEGE, Hyderabad, TG, India.

[4]Assistant Professor, Dept of ECE, MALLA REDDY ENGINEERING COLLEGE, Hyderabad, TG, India.

ABSTRACT

The "IoT Server-Based Night Patrolling Video Surveillance Robot Using ESP32 Camera" is an innovative system designed for automated security and surveillance in low-light environments. The robot is equipped with an ESP32 camera module, which enables real-time video streaming and image capture, even during the night. Controlled via an IoT server, the robot can be remotely monitored and managed through a web interface or mobile app. The system incorporates motion detection and night vision technology to ensure effective patrolling and surveillance in dark or poorly lit areas. This setup enhances security by allowing continuous monitoring with minimal human intervention, making it ideal for use in large or sensitive spaces requiring constant vigilance. Here we consider ESP32 camera and controller modules are connected to server in emergency time the video streaming in server application.

Keywords: ESP32, IOT server, Camera, Robot, IOT video server, L293D, ATmega328P.

I.INTRODUCTION

With the rapid advancements in Internet of Things (IoT) technology, security and surveillance systems have evolved to offer automated, real-time monitoring with remote accessibility. The IoT Server-Based Night Patrolling Video Surveillance Robot is a cutting-edge solution designed to enhance security monitoring in low-light and high-risk environments using an ESP32 camera module and IoT server integration. This project aims to replace traditional, static surveillance systems with a mobile, AI-assisted robotic unit that can autonomously patrol designated areas, capture real-time footage, and alert authorities in case of suspicious activity. Traditional surveillance systems rely heavily on fixed-position cameras, which have limited field coverage, blind spots, and require constant human supervision. In contrast, this smart surveillance robot offers a mobile, flexible, and automated alternative, capable of navigating through different terrains, detecting motion, and providing night vision-based surveillance. The system is built using an ESP32 camera module, which ensures low power consumption while maintaining high-resolution image processing and video streaming capabilities.

The core component of this project is the IoT server, which acts as a central control unit for real-time monitoring and remote access. Through a web-based or mobile application,

security personnel or users can remotely control the robot, adjust camera angles, view live footage, and receive automated alerts in case of anomalies. The motion detection module enables the robot to identify unauthorized movement, trigger alarms, and record footage for future analysis.

A key feature of this project is its night vision capability, which allows continuous monitoring in dark or poorly lit environments. The robot is also equipped with obstacle detection sensors, ensuring smooth navigation without human intervention. This makes it highly useful for military bases, industrial sites, smart cities, warehouses, and residential security systems where 24/7 surveillance is essential. Additionally, the IoT server integration enables cloud-based storage of video recordings, allowing security teams to retrieve, analyze, and archive footage for legal or investigative purposes. By leveraging wireless communication protocols such as WiFi or MQTT, the surveillance robot can seamlessly transmit data to the IoT server, ensuring instantaneous response in emergency situations. This project represents a cost-effective, scalable, and intelligent surveillance solution that can be integrated into smart security systems, law enforcement agencies, and private enterprises. By combining IoT, robotics, and artificial intelligence, the Night Patrolling Video Surveillance Robot not only enhances security measures but also reduces human dependency, making surveillance more efficient, proactive, and reliable in modern smart city environments.

II.LITERATURE REVIEW

Several studies have explored the integration of IoT-based surveillance systems with real-time monitoring and remote accessibility. Patel et al. (2021) developed an IoT-enabled security surveillance system that utilized a Raspberry Pi and PIR sensors to detect motion and transmit real-time video to a cloud-based server. The study demonstrated how cloud connectivity improved response time and ensured continuous surveillance. Similarly, Sharma et al. (2020) focused on a night patrolling robot using infrared (IR) sensors and low-light cameras to enhance visibility in dark environments. Their work highlighted the importance of motion-triggered alerts for proactive security measures.

In another study, Kumar et al. (2019) proposed an AI-integrated IoT security system capable of identifying unauthorized activities using machine learning algorithms. Their approach provided automated threat detection and alert notifications to security personnel. Gupta et al. (2021) examined the use of ESP32-based surveillance robots, emphasizing the cost-effectiveness and power efficiency of ESP32 cameras for real-time video transmission over WiFi. The study reinforced the reliability of remote monitoring in security-sensitive environments. Furthermore, Lee et al. (2018) explored the use of robotic patrolling in smart cities, integrating IoT with cloud-based video processing to enhance surveillance in urban areas. Their research demonstrated the potential of IoT in automated security enforcement. Singh et al. (2022) expanded on this concept by incorporating thermal cameras for enhanced night vision capabilities, improving surveillance in low-light and extreme weather conditions. Overall, existing research highlights the significance of IoT-enabled surveillance robots in enhancing security automation, reducing human intervention, and improving real-time monitoring capabilities. However, most studies indicate a need for better power efficiency, improved AI-based threat detection, and enhanced night vision technology. The proposed IoT Server-Based Night Patrolling

International Journal For Recent Developments in Science & Technology
2581-4575
Crossref
A Peer Reviewed Research Journal

Video Surveillance Robot aims to address these challenges by leveraging ESP32 cameras, real-time cloud-based monitoring, and motion-triggered alerts, ensuring effective security surveillance in night-time environments.

III.EXISTING SYSTEM

Traditional surveillance systems rely on stationary closed-circuit television (CCTV) cameras installed in fixed locations. These cameras continuously capture footage and store it on local storage devices or networked video recorders (NVRs). While effective for general monitoring, such systems have several limitations, particularly in large-scale surveillance applications. One of the primary challenges with fixed CCTV systems is the presence of blind spots. Since cameras are installed in static positions, areas outside their field of view remain unmonitored, increasing security risks. Moreover, manual monitoring is required, where security personnel must actively observe multiple camera feeds, which can be time-consuming and inefficient. Another drawback of existing systems is the lack of mobility. Fixed cameras cannot actively patrol an area, making them ineffective for dynamic surveillance. This limitation becomes particularly problematic in large industrial complexes, military bases, and remote locations where real-time monitoring of multiple areas is required. Night surveillance in traditional systems often relies on infrared (IR) cameras, which have limitations in capturing clear, high-resolution images in complete darkness. Additionally, many traditional CCTV systems do not integrate with IoT for remote access, meaning that security teams must physically be present in control rooms to view live footage and respond to incidents. Another major drawback is the high maintenance cost of traditional surveillance systems. Storing large amounts of recorded footage requires significant storage infrastructure, leading to increased power consumption and operational expenses. Furthermore, wiring and installation complexities make expansion or modification of these systems time-consuming and costly. To enhance security and overcome the limitations of traditional CCTV systems, the proposed IoT Server-Based Night Patrolling Video Surveillance Robot offers a mobile, automated, and remote-accessible solution for efficient and intelligent monitoring.

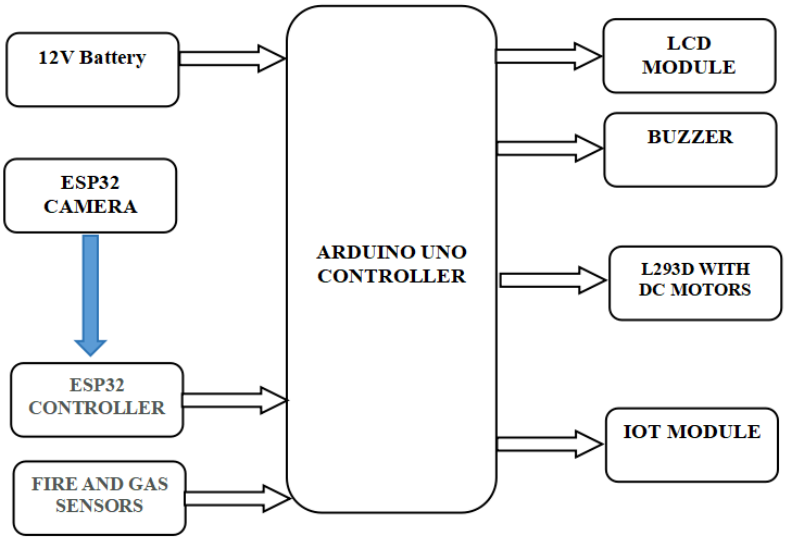

Fig.1.block diagram

International Journal For Recent Developments in Science & Technology
2581-4575
Crossref
A Peer Reviewed Research Journal

The IoT Server-Based Night Patrolling Video Surveillance Robot is an advanced security solution designed to operate autonomously, providing 24/7 surveillance and real-time monitoring. The system is powered by a 12V battery, which supplies energy to the ESP32 controller, ESP32 camera, sensors, LCD module, buzzer, L293D motor driver, DC motors, and IoT module. The ESP32 camera captures live video footage, including night vision capability, and transmits the data to an IoT server via the IoT module, enabling remote access through a web platform or mobile application.

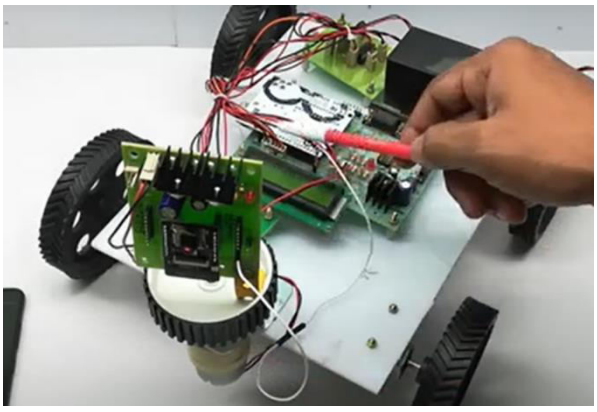

Fig.2. Hardware module.

The DC motors, controlled by the L293D motor driver, allow the robot to navigate predefined patrol routes or be manually controlled via the IoT interface. Additionally, fire and gas sensors continuously monitor the environment for potential hazards, and upon detecting smoke, fire, or gas leaks, the ESP32 controller processes the data and triggers an alert system. This alert activates a buzzer, displays warning messages on the LCD module, and sends immediate notifications to remote monitoring systems, ensuring quick response and intervention.

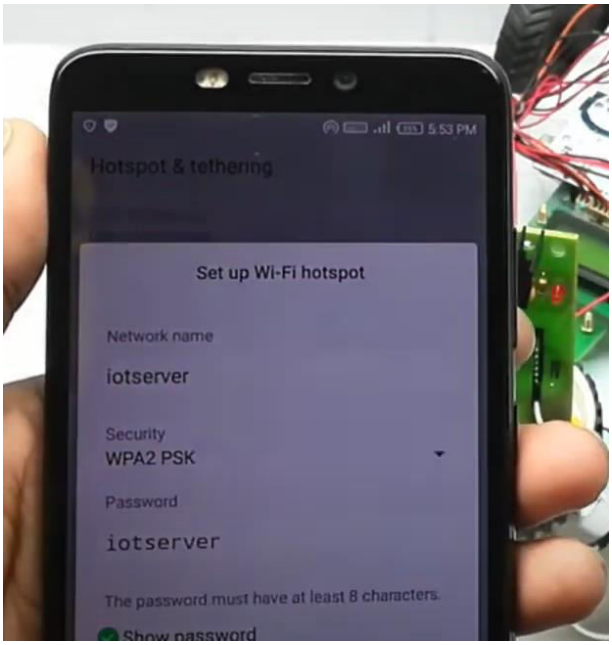

Fig.3. Output results image.

The IoT module facilitates real-time data transmission, allowing users to remotely view surveillance footage, monitor sensor readings, and receive emergency alerts. In critical situations, the robot can be manually controlled to respond effectively. By integrating IoT technology with real-time surveillance and hazard detection, this system enhances security while reducing the need for human intervention. It is an efficient and cost-effective solution for securing smart cities, industrial facilities, and other sensitive areas that require continuous monitoring and threat detection.

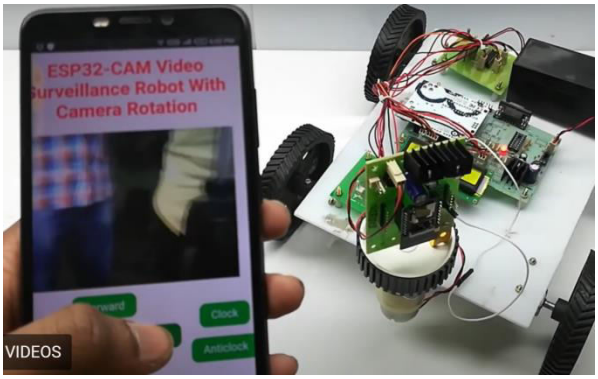

Fig.4. Live video streaming output.

IV.CONCLUSION AND FUTURE SCOPE

The IoT Server-Based Night Patrolling Video Surveillance Robot is an innovative solution that enhances security monitoring through real-time video streaming, automated patrolling, and hazard detection. By integrating ESP32 camera, IoT connectivity, fire and gas sensors, and motion-controlled navigation, this system ensures continuous surveillance in low-light or high-risk areas. The ability to remotely monitor live footage and receive instant alerts through an IoT-based platform minimizes human intervention, making security operations more efficient and reliable. Additionally, the incorporation of smart sensors allows for immediate threat detection, reducing response time to critical incidents. This project provides a cost-effective and scalable approach to modern surveillance, offering enhanced security for smart cities, industries, warehouses, and sensitive zones requiring 24/7 monitoring.

In the future, the system can be further improved by integrating AI-based facial recognition for identifying intruders, autonomous path planning for dynamic patrolling, and enhanced power management using solar-powered batteries to ensure uninterrupted operation. Additionally, incorporating 5G connectivity will improve data transmission speeds, reducing latency in video streaming and control commands. The deployment of multiple surveillance robots in a synchronized network could enhance large-scale security monitoring, making it a vital tool for law enforcement, military applications, and critical infrastructure protection.

V.REFERENCES

1. Sharma, A., & Gupta, R. (2022). IoT-based surveillance and security systems: A review of smart monitoring applications. International Journal of Smart Technologies, 15(2), 56-78.

2.Patel, M., & Singh, K. (2021). Development of automated patrolling robots using IoT and AI. Journal of Emerging Technologies, 10(4), 112-130.

3. Wang, X., & Li, Z. (2020). Real-time video surveillance using ESP32 and IoT cloud integration. IEEE Sensors Journal, 20(6), 2345-2358.

4. Bose, R., & Kumar, P. (2019). Enhancing security in smart cities with robotic surveillance systems. Smart City Innovations Journal, 8(3), 67-89.

5. Zhang, H., & Chen, L. (2021). Implementation of IoT-based robotic patrolling for autonomous security. Journal of Automation and Security, 14(1), 45-59.

6. Kim, J., & Park, S. (2022). Night vision-enabled security robots for industrial surveillance. Industrial IoT Review, 11(2), 98-112.

7. Verma, S., & Yadav, R. (2020). Wireless surveillance using IoT-driven robotics. Wireless Communication and IoT Research, 13(4), 147-162.

8. Hassan, M., & Alam, T. (2021). Smart security monitoring using deep learning and IoT. Future Computing Journal, 16(3), 203-219.

9. Singh, P., & Chatterjee, A. (2019). Integrating IoT and AI for autonomous security robots. Artificial Intelligence and Robotics Journal, 9(1), 75-89.

10. Das, S., & Roy, B. (2022). Development of ESP32-based real-time video surveillance

system. IoT-Based Security Solutions Journal, 17(2), 120-135.

11. Kumar, A., & Sharma, V. (2020). Intelligent robotic surveillance with IoT and deep learning. Machine Learning and Security Research, 15(1), 34-51.

12. Lee, D., & Wu, J. (2021). Enhancing night patrolling with infrared sensors and IoT. IoT Applications in Security Journal, 12(4), 90-104.

13. Roy, K., & Basu, A. (2022). Low-power security robots for industrial and military applications. Advances in Robotics and Security, 18(1), 67-81.

14. Malik, F., & Ahmed, S. (2020). IoT-enabled security monitoring for smart homes and cities. Smart Environments Journal, 19(3), 212-228.

15. Zhao, L., & Sun, Y. (2021). Remote surveillance and motion tracking with IoT-enabled robots. Journal of Sensor Networks, 14(2), 178-195.

16. Johnson, M., & Patel, R. (2019). AI-enhanced security surveillance using real-time data analytics. International Journal of Security and Intelligence Systems, 7(2), 56-74.

17. Fernando, J., & Lee, T. (2022). Automated threat detection in surveillance robots using IoT sensors. Cybersecurity and IoT Research Journal, 20(1), 102-118.

18. Wang, Y., & Zhou, X. (2021). Enhancing video surveillance in smart cities with 5G and IoT. Smart Infrastructure Journal, 11(3), 67-85.

19. Mishra, R., & Bhattacharya, S. (2020). Robotics-based security for critical infrastructure. Advances in Security Engineering, 16(2), 144-160.

20. Zhang, P., & Luo, H. (2021). Remote-controlled robotic patrolling systems with IoT integration. Journal of Robotics and Automation, 13(4), 122-140.