

Night Patrol Robot

IoT Autonomous Surveillance System

1. Abstract This project presents the development of an IoT-enabled Night Patrol Robot designed for autonomous night-time surveillance and remote monitoring. The system integrates an Arduino Uno R32 to control the chassis and drive motors, while an ESP32 handles sensor data acquisition, remote control interfaces, and real-time data communication. Key features include obstacle avoidance, motion detection, environmental monitoring, and live remote access via both app and web interfaces.

2. Introduction Security surveillance is a growing necessity in residential, industrial, and institutional setups. The Night Patrol Robot is designed to autonomously patrol a predefined area, detect motion, sense environmental parameters, and stream real-time data and alerts. This project emphasizes the integration of sensors and IoT communication to reduce the need for manual surveillance.

3. Objectives

- To design and build a mobile robot capable of autonomous patrolling.
- To implement real-time environmental monitoring (temperature, humidity).
- To detect motion and suspicious sounds.
- To stream data and alerts to users via a web interface and mobile app.

4. Components Used

- Arduino Uno R3 with Motor Driver (for motor control)
- ESP32 Dev Module (for sensor and IoT interface)
- HC-SR501 PIR Motion Sensor

- DHT11 Temperature and Humidity Sensor
- HC-05 Bluetooth Module
- 2x DC Motors and Wheels
- Chassis
- Rechargeable Battery Pack

5. System Architecture

- Arduino Uno R3 handles the mobility.
- ESP32 is connected to PIR, DHT11.
- Sensor data is processed and sent over Wi-Fi via ESP32 to a web dashboard.
- Bluetooth module HC-05 is used for basic app-based remote control.

6. Software Implementation

- Arduino IDE used for programming Arduino Uno and ESP32.
- HTML and JavaScript used for the web dashboard.
- Wi-Fi communication enables remote access to sensor data.

7. Web Interface Features

- Displays real-time temperature and humidity readings.
- Alerts on motion detection via PIR.

8. Mobile App Features

- Bluetooth-based control of the robot.
- Manual Control
- Voice Control
- Real-time environmental data display.
- Emergency stop and alert trigger functionality.

9. Results and Testing

- Robot successfully patrolled predefined paths and avoided obstacles.
- Sensor data accurately displayed on both web and mobile interfaces.
- Motion detection and sound alerts worked as expected during night testing.
- Real-time response via web interface was stable under Wi-Fi range.

10. Conclusion and Future Work The Night Patrol Robot provides a cost-effective and functional prototype for smart surveillance using IoT technologies. Future improvements could include night vision cameras, GSM module for broader network access, and AI-based object recognition. Further miniaturization and enclosure design would improve deployment readiness.

Appendix

- Circuit diagrams
- Source code snapshots
- App interface screenshots
- Web dashboard snapshots