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IOT BASED NIGHT PATROLLING ROBOT

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ABSTRACT

Security and surveillance play a vital role in ensuring safety in residential, commercial, and restricted areas, especially during night hours when human supervision is limited. Manual patrolling is labor-intensive, prone to fatigue, and can be inconsistent. To overcome these challenges, an **IoT-based Night Patrolling Robot** is proposed, which autonomously monitors its surroundings, detects movement, captures images or video, and sends real-time alerts to a remote user through an IoT platform. The robot is equipped with sensors such as PIR (Passive Infrared), ultrasonic sensors for obstacle detection, and a night-vision camera for visual surveillance. Data captured by the robot is transmitted to a cloud server via Wi-Fi for monitoring and control. The integration of IoT enables remote access, live streaming, and immediate notifications, enhancing security efficiency and reliability.

Keywords: IoT, Night Patrolling Robot, Surveillance, Security Automation, PIR Sensor, Ultrasonic Sensor, Raspberry Pi, ESP32, Remote Monitoring, Real-Time Alert System.

I. INTRODUCTION

The rise in security concerns has led to an increased need for efficient surveillance systems capable of operating continuously, especially at night. Traditional security measures rely heavily on human guards, who may suffer from fatigue or overlook incidents due to limited visibility and attention span. These challenges make manual patrolling inefficient and expensive in the long run.

With advancements in robotics and IoT technologies, automated patrolling systems are becoming viable alternatives. A night patrolling robot integrates sensors, cameras, and communication modules to detect motion, obstacles, and intrusions, while IoT connectivity enables remote control and monitoring through the internet.

The primary objective of this project is to design and develop an IoT-based robot capable of **autonomous night patrol**. The robot navigates its path, detects obstacles, captures visual data using a night-vision camera, and transmits the information to the user’s device via an IoT platform. This innovation reduces human intervention, enhances safety, and provides continuous real-time surveillance.

II. LITERATURE SURVEY

1. **Dr. N. Ramesh – “IoT-Enabled Robotic Surveillance System”**

Dr. Ramesh developed a robotic surveillance framework that combined IoT and automation to enhance area monitoring. The system used sensors and Wi-Fi modules to transmit real-time data to a control center.
His design showed that robots could efficiently replace human guards in repetitive security tasks, operating without fatigue.
The study established the practicality of using IoT for remote control, video streaming, and data storage, which forms the basis for modern patrolling robots.

2. **Prof. J. Verma – “Autonomous Robots for Security Surveillance”**

Prof. Verma focused on creating autonomous robots equipped with motion and obstacle detection capabilities. The robots navigated predefined routes using ultrasonic sensors and microcontrollers.

The study highlighted that integrating multiple sensors reduced collision rates and improved

patrol coverage.
His work influenced the proposed system by showing how autonomous navigation can be combined with IoT monitoring for real-time control and updates.

3. **Dr. A. Singh – "Smart Security Systems Using IoT and Embedded Platforms"**

Dr. Singh presented a design that utilized embedded platforms such as Raspberry Pi for IoT-based security management. The system was capable of streaming video feeds and sending alerts when motion was detected. This research demonstrated the effectiveness of IoT in remote surveillance and alert systems. It provided the groundwork for integrating live camera feeds and cloud-based notifications in robotic patrolling applications.

4. **Dr. P. R. Mehta – "Night Vision Technology in Robotic Monitoring"**

Dr. Mehta's research focused on implementing infrared and night-vision sensors in mobile robots for low-light conditions.
The robot could detect movement even in complete darkness, allowing uninterrupted surveillance during night operations.
His contribution supports the present project by emphasizing the importance of infrared imaging and low-light cameras in security robotics.

5. **Prof. S. L. Thomas – "Wireless Control and IoT Integration in Mobile Robots"**

Prof. Thomas designed a wireless IoT control system using ESP32 modules for robot communication and data transfer.
The research illustrated how cloud platforms can enhance robot autonomy by enabling user interaction from anywhere.
This concept is applied in the proposed system, where the robot can be remotely controlled, monitored, and alerted through IoT dashboards and mobile apps.

III. EXISTING SYSTEM

Conventional surveillance systems use fixed cameras and human security personnel for monitoring. These systems are limited by the range of coverage, blind spots, and reliance on manual supervision. Guards may fail to detect certain incidents, and static cameras cannot adapt to new positions or threats. Moreover, traditional CCTV systems often lack remote accessibility and real-time alert features.

IV. PROPOSED SYSTEM

The proposed system introduces an **IoT-based autonomous night patrolling robot** equipped with sensors and cameras to perform intelligent monitoring. The robot uses ultrasonic sensors to avoid obstacles, a PIR sensor to detect human motion, and a night-vision camera to capture live visuals. A **Raspberry Pi or ESP32** acts as the main controller, processing data from sensors and transmitting information to a cloud platform such as **ThingSpeak**, **Firebase**, or **Blynk**. Users can monitor the area in real time via a web or mobile interface, receive alerts when motion is detected, and even manually control the robot remotely.

V. SYSTEM ARCHITECTURE

- **Ultrasonic Sensor:** Detects obstacles and ensures collision-free navigation.
- **PIR Sensor (Passive Infrared Sensor):** Detects human or animal motion, which helps identify intruders.
- **LDR Sensor (Light Dependent Resistor):** Monitors light intensity for night conditions. It can automatically activate LEDs or night vision cameras in low light.
- **Temperature or Smoke Sensor (Optional):** Detects abnormal environmental conditions, such as fire or overheating.

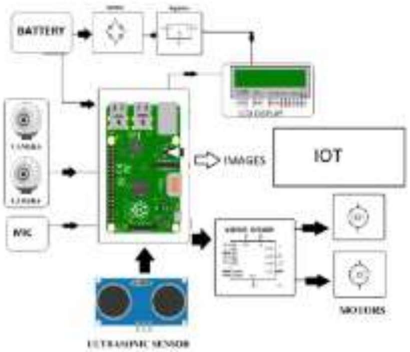

Fig.5.1: Architecture of proposed model

NODE MCU:

NodeMCU is a low-cost open source IoT platform. It initially included firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which was based on the ESP-12 module.[6][7] Later, support for the ESP32 32-bit MCU was added

OVERVIEW:

NodeMCU is an open source firmware for which open source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit).[8]. The term "NodeMCU" strictly speaking refers to the firmware rather than the associated development kits.[citation needed]

Both the firmware and prototyping board designs are open source.

The firmware uses the Lua scripting language. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson[10] and SPIFFS.[11] Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented.

The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially was based on the ESP-12 module of the ESP8266, which is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core, widely used in IoT applications

VI. IMPLEMENTATION

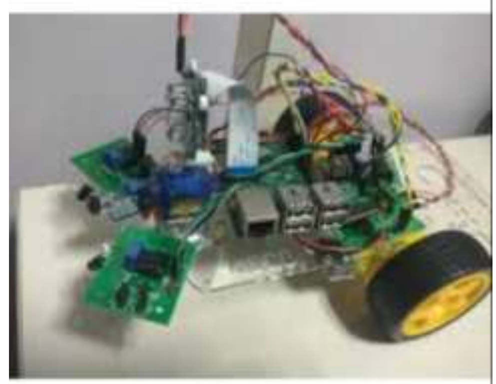

Fig. 6.1: Working prototype of proposed system

The implementation involves integrating hardware, software, and communication components to create an operational prototype. The robot chassis carries components such as **Raspberry Pi**, **PIR sensor**, **ultrasonic sensors**, **motor driver (L298N)**, **night-vision camera**, and **DC motors** for mobility. The Raspberry Pi acts as the main controller, executing Python scripts to control the motors, read sensor data, and stream camera footage. When the PIR sensor detects motion, the robot captures an image or initiates video recording and uploads it to the cloud server. Ultrasonic sensors continuously scan the surroundings to avoid obstacles during navigation.

From fig. 6.1 the IoT component is implemented using Wi-Fi connectivity, enabling real-time communication with a cloud platform such as **Blynk** or **ThingSpeak**. The user interface allows live video viewing, robot control, and instant notifications through a web dashboard or mobile app. The power supply is provided by rechargeable batteries to ensure mobility during night patrol. The system is tested under various lighting and environmental conditions to validate sensor accuracy, mobility, and data transmission reliability.

VII. CONCLUSION

The **IoT-Based Night Patrolling Robot** provides a reliable and efficient solution for autonomous surveillance, especially in low-light environments. By integrating IoT communication, sensor networks, and camera modules, the robot offers real-time monitoring, motion detection, and alert capabilities. It reduces dependency on human guards, ensures round-the-clock security, and allows remote supervision through cloud connectivity. The project demonstrates how robotics and IoT can collaborate to create cost-effective and intelligent security systems.

VIII. FUTURE SCOPE

In the future, the robot can be enhanced with **AI-based object recognition** to differentiate between humans, animals, and vehicles. Integration of **GPS modules** can allow autonomous navigation over larger areas, while **solar power systems** can increase operational time and sustainability. Adding **voice communication** and **edge computing** capabilities will enable the robot to respond dynamically to security threats without human intervention, making it suitable for deployment in industrial zones, campuses, and military applications.

IX. REFERENCES

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