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IoT Based Women Safety Patrolling Robot Using Raspberry Pi

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Abstract: This work presents an IoT-based women safety patrolling robot Using Raspberry Pi designed to improve surveillance and emergency response in sensitive environments. The system uses a Raspberry Pi as the central controller to manage sensors, camera modules, and communication units. It operates in both autonomous and manual modes. In autonomous mode, the robot patrols the area, detects obstacles, and identifies suspicious sounds using a microphone. Once abnormal sound is detected, the robot moves toward the source, captures images, records audio, and determines its location using GPS. The collected information is transmitted instantly to users through a Telegram based alert system. In manual mode, the robot can be remotely controlled for targeted monitoring. This model proved to be robust and trustworthy in practical scenarios in real-time surveillance and rapid communication

Keywords: IoT, Raspberry Pi, Women Safety, Patrolling Robot, GPS Tracking.

I.INTRODUCTION

Recent safety challenges in public environments have increased the demand for intelligent monitoring systems capable of providing quick assistance during emergencies. Conventional security methods such as human surveillance and fixed cameras depend on continuous attention and may fail to respond promptly to unexpected incidents. Hence, there is a need for automated systems that can continuously monitor surroundings and react instantly to abnormal events.

Advancements in robotics, embedded systems, and the Internet of Things (IoT) have enabled the development of smart safety solutions. IoT allows devices and sensors to communicate through networks for real-time monitoring and remote access. Robotic platforms enhance surveillance by providing mobility and wider area coverage. The integration of IoT and robotics enables intelligent, flexible, and fast-responding systems.

The proposed Women Safety Patrolling Robot based on Raspberry Pi acts as an automated surveillance unit to improve situational awareness and response time. The Raspberry Pi serves as the central controller for sensors, camera modules, navigation, and communication systems, enabling continuous monitoring and efficient data processing.

The system operates in both autonomous and manual modes. In autonomous mode, the robot patrols a defined area, detects obstacles and unusual sounds using a microphone module, and moves toward the source. It then captures images, records audio, and obtains location data using GPS. All information is sent to a Telegram group via IoT for real-time alerts. In manual mode, the robot can be remotely controlled for targeted monitoring when required.

II. LITERATURE REVIEW

Recent research in IoT-based surveillance systems has led to significant improvements in mobile safety robots by integrating sensors, wireless communication, and robotic navigation. Several existing systems, such as IoT-based women safety patrolling robots and ESP32-based surveillance robots, have focused on motion detection, GPS tracking, and real-time alert transmission. However, many of these systems still rely on basic sensing techniques and lack advanced features such as intelligent sound recognition and accurate threat classification [1,2].

Some studies have introduced AI-based and autonomous surveillance robots with features like night vision, GSM alerts, and wireless communication for improved monitoring. While these systems enhance response and communication capabilities, they often do not include detailed audio analysis to identify distress signals or differentiate between normal and abnormal sounds. Additionally, some models face limitations due to network dependency and reduced reliability in low-connectivity environments [3,4,7].

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Other research has explored Raspberry Pi-based robots and IoT-enabled wearable safety devices for security applications. These systems provide useful features such as video monitoring, emergency alerts, and location sharing. However, they are often limited in terms of environmental awareness, large-area surveillance, intelligent decision-making, and real-time automated threat detection. Overall, existing solutions highlight the need for more advanced, integrated systems with improved sound recognition, faster response, and reliable IoT-based communication [5,6,8–11].

III. METHODOLOGY

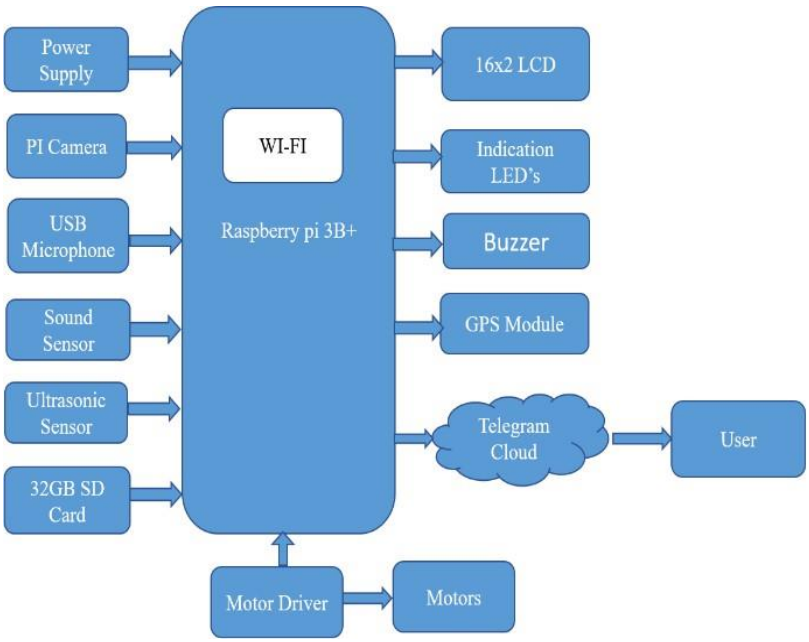

Fig.1: Block Diagram of Proposed Method

The proposed IoT-Based Women Safety Patrolling Robot is built using integrated sensing, processing, and communication modules to enable real-time monitoring and emergency response. The Raspberry Pi acts as the central controller that processes sensor data and coordinates all system operations efficiently [3], [9], [10].

The Pi camera module is used for real-time video surveillance to monitor surroundings and detect suspicious activities [1], [5], [11], while the ultrasonic sensor helps in obstacle detection and safe navigation by preventing collisions during movement [2], [4], [7]. A USB microphone is included to detect abnormal or suspicious sounds and trigger appropriate system responses [3], [6].

The motor driver (L298N) controls the DC motors, enabling movement of the robot in different directions for patrolling tasks [4], [9]. The GPS module provides real-time location tracking and The system supports IoT connectivity through the build in Wi-Fi module**,** enabling remote monitoring and control via internet-based applications **[**1], [12]**.** A battery-based power supply ensures continuous operation of all components. Overall, the

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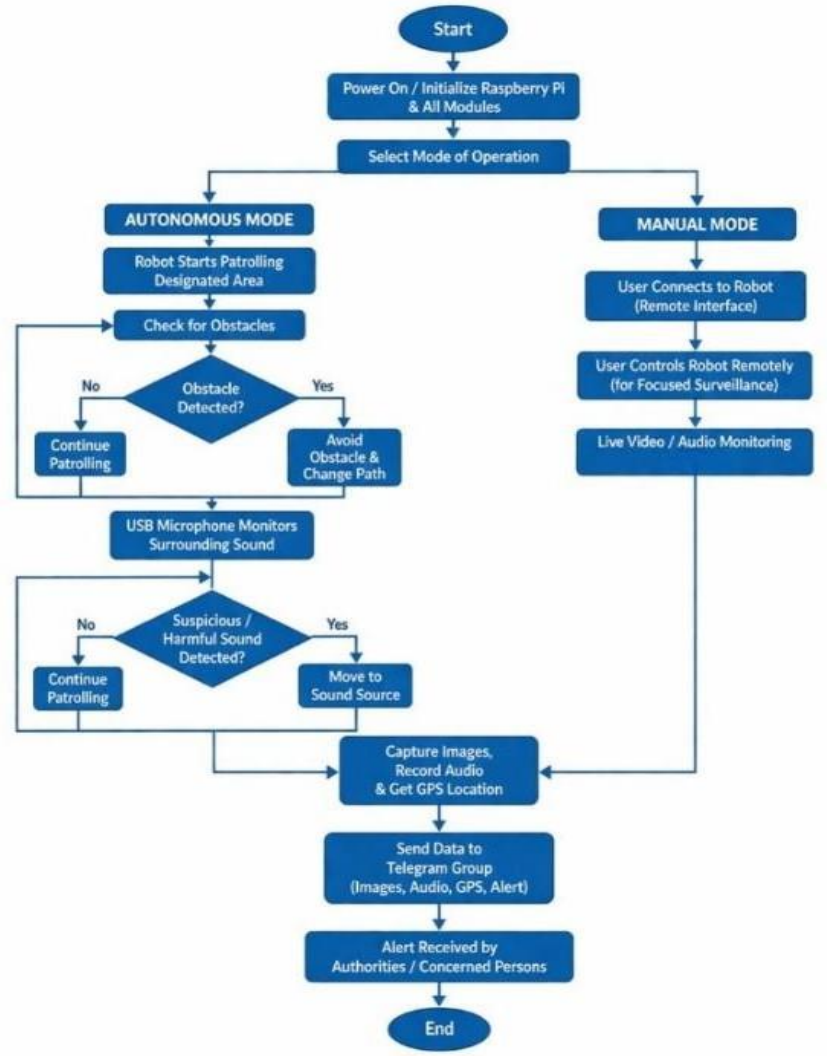

Fig.2: Work Flow of the Proposed Method

Integration of these modules enables efficient surveillance, mobility, and emergency communication for enhanced safety applications [1]–[12].

IV. IMPLEMENTATION

The proposed IoT-Based Women Safety Patrolling Robot using Raspberry Pi was implemented using a wheeled robotic platform integrated with sensing and communication modules. The system consists of a Raspberry Pi controller, motor driver module, ultrasonic sensor, GPS module, DC motors, and a rechargeable battery pack. The Raspberry Pi acts as the main control unit that manages the movement of the robot and processes sensor data.

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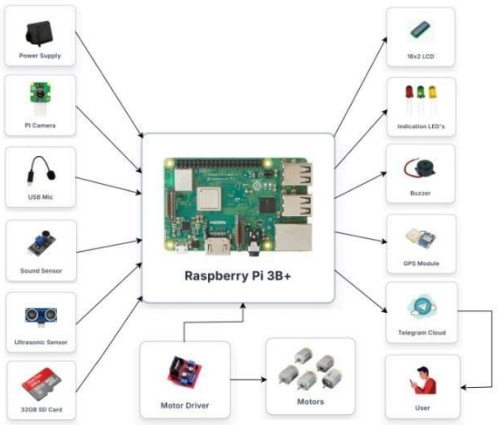

Fig.3: Components Integration

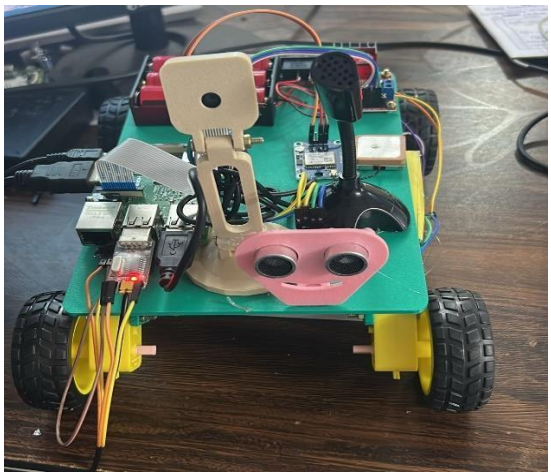

Fig.4: Hardware Implementation of Proposed method

When an obstacle is detected within a certain distance, the robot automatically changes direction to avoid collision A GPS module is used to track the real-time location of the robot during patrolling. The location data can be transmitted to the user through an IoT platform for monitoring purposes. When the system is powered ON, all components initialize, and the robot begins patrolling while continuously monitoring obstacles and updating location information.

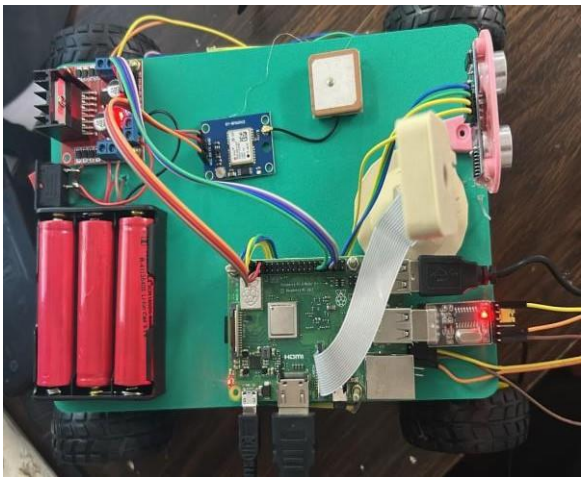

Fig.5: Top View of Proposed Method

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The implemented prototype successfully demonstrates autonomous movement, obstacle detection, and location tracking, making it suitable for safety and surveillance applications.

4.1 Results & Analysis

The implemented IoT-Based Women Safety Patrolling Robot successfully demonstrated real-time monitoring and alert capabilities. During testing, the robot was able to detect suspicious sounds using the microphone module and respond accordingly. Upon detection, the system automatically transmitted an alert message through the Telegram application, which included the GPS location coordinates of the robot along with an audio voice message of the detected sound.

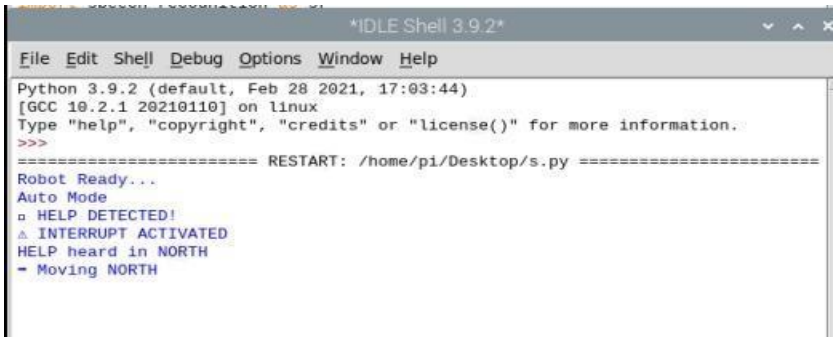

Fig.6: Robot Initialization

The GPS module accurately provided real-time latitude and longitude values, enabling the user to track the exact position of the robot remotely. The audio transmission feature allowed the user to listen to surrounding sounds, improving situational awareness during emergency conditions. Additionally, the robot successfully avoided obstacles using the ultrasonic sensor and navigated towards the detected sound source.

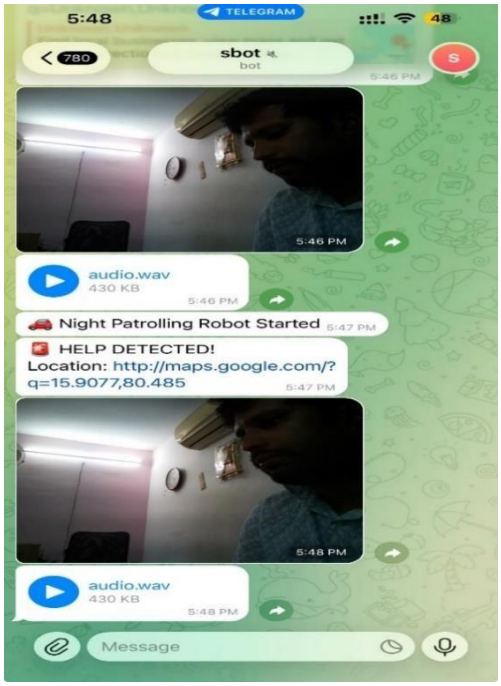

Fig.7: Alert Message to Telegram

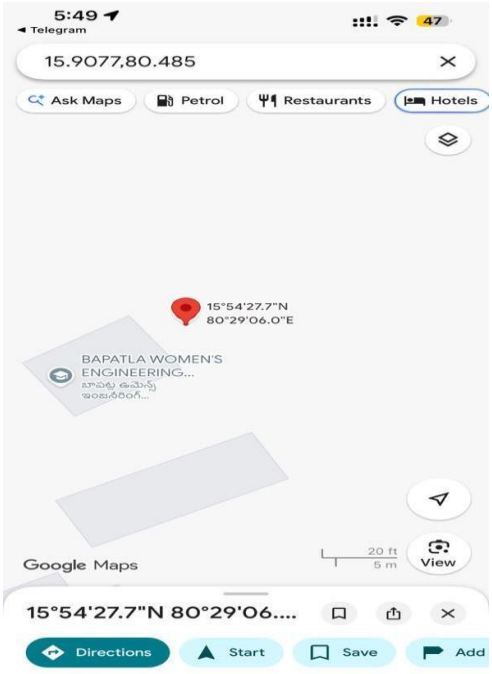

Fig.8: Location Tracking Results

Overall, the system demonstrated reliable performance in sound detection, location tracking, obstacle avoidance, and real-time communication. The integration of Telegram-based alerts enhanced the effectiveness of the safety system by enabling quick response and remote monitoring

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V. CONCLUSION

The proposed IoT-based Women Safety Patrolling Robot using Raspberry Pi was successfully designed to improve safety and monitoring in sensitive areas. It integrates obstacle detection, sound detection, GPS tracking, and real-time communication through Telegram.

The robot operates in both autonomous and manual modes, enabling automatic patrolling as well as remote control. During testing, it effectively avoided obstacles, detected suspicious sounds, moved toward the source, and transmitted GPS location, images, and audio alerts to the user.

Overall, the system demonstrated reliable real-time performance and timely alert generation, making it a cost-effective solution for women safety and night patrolling applications.

VI. FUTURE SCOPE

Future improvements can focus on enhancing the intelligence and efficiency of the proposed system. Artificial intelligence and machine learning techniques may be applied to support automatic detection of suspicious activities and human presence. Additional hardware such as night vision or thermal sensors can improve performance in low-light conditions. The use of facial recognition technology may enable identification of individuals in real time. Power management can be improved through wireless charging or solar-based energy systems to extend operating time. Future versions may also include multiple coordinated robots, mobile application support, and cloud-based storage to enable large-area surveillance and advanced remote monitoring.

VII. ACKNOWLEDGMENT

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