International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 12 | Dec - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Safebot-Intelligent Patrol System for Realtime Safety Monitoring

[I]Vibhavi R N, [2]Matlamadugu Chandana, [3]Mythri G, [4]Mamatha R, [5]Manasa P

[I]Assist. Professor, Dept. of CSE, City Engineering College, Bengaluru-560062
[2]1-JG Student, Dept. of CSE, City Engineering College, Bengaluru-560062
[3]UG Student, Dept. of CSE, City Engineering College, Bengaluru-560062
[4]1-JG Student, Dept. of CSE, City Engineering College, Bengaluru-560062
[5]UG Student, Dept. of CSE, City Engineering College, Bengaluru-560062

Abstract

Public safety in urban and semi-urban environments continues to face significant challenges due to limited surveillance coverage, slow emergency response, and inefficient monitoring mechanisms. Existing security systems largely rely on fixed cameras and manual supervision, which often delay the detection of suspicious activities or potential threats. To overcome these limitations, this paper presents SafeBot, an autonomous patrol robot designed to deliver intelligent, real-time safety monitoring. SafeBot integrates Artificial Intelligence (Al), Internet of Things (IOT) technology, GPS-based location tracking, and sensor-driven navigation to enhance situational awareness and responsiveness. The system employs deep learning—based emotion recognition models capable of identifying emotional states such as fear, stress, and distress, enabling early recognition of emergency situations. Accurate location tracking is achieved through GPS modules, while 10T connectivity facilitates automatic email alerts to relevant authorities during critical events. Obstacle detection sensors support safe and autonomous navigation, and solar-powered components ensure continuous and energy-efficient operation. The proposed system demonstrates improved response time, enhanced monitoring capability, and reliable performance across various environments, including educational campuses, office premises, and public spaces.

INTRODUCTION

Conventional surveillance systems depend heavily on human supervision and static camera installations, which significantly limit real-time threat detection and do not support intelligent or predictive analysis. These constraints often result in delayed emergency responses and leave critical safety gaps, particularly in isolated or low-visibility areas during nighttime. With recent advancements in Artificial Intelligence, Internet of Things (IOT), robotics, and embedded systems, there is a growing opportunity to develop autonomous monitoring solutions capable of analysing human behaviour, identifying potential vulnerabilities, and responding promptly through automated alert mechanisms. In this context, SafeBot is proposed as a smart, self-navigating patrol robot equipped with an integrated sensing, processing, and communication framework. The system continuously monitors its surroundings, interprets emotional cues from individuals, detects abnormal or suspicious activities, and immediately notifies concerned authorities. By combining intelligent perception with autonomous mobility and real-time communication, this project aims to deliver a more responsive, efficient, and reliable safety monitoring solution compared to traditional surveillance infrastructures.

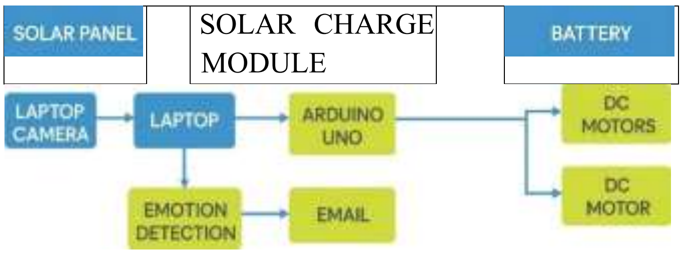

Fig 1: Block Diagram

LITERATURE SURVEY

Ramesh & lyer [1] presented an IoT-based autonomous patrol robot capable of monitoring public spaces for potential security threats. Their work underlined the importance of mobile surveillance combined with multisensory inputs.

Sharma and Gupta [2] presented an Al—IoT—based security system that makes use of machine-learning algorithms to improve recognition accuracy during real-time monitoring. Studies on emotion-recognition systems indicate that Convolutional Neural Networks (CNNs) significantly improve facial-expression classification accuracy. The FER2013 dataset has been widely used for training such models. Research on GPS-integrated emergency alert systems highlights the importance of instant communication through 10T platforms. Solar-powered embedded systems have also been explored for autonomous operations, supporting continuous monitoring without an external electrical supply. These studies collectively support the development of SafeBot as an integrated safetyenhancement system combining emotion analysis, autonomous navigation, and real-time alerting capabilities.

PROPOSED SYSTEM

The proposed system features an autonomous mobile robot equipped with a camera, sensors, a GPS module, a microcontroller and IOT components. A deep learning CNN model processes emotions to identify fear-like indicators. When abnormal behaviour is detected, GPS will obtain the coordination with the robot and transmit an automated email
Notification to authorities. Solar panels recharge the internal battery to ensure continuous operations

METHODOLOGY

A. Emotion Detection Using CNN A camera continuously captures facial images, which are processed using OpenCV for feature extraction. A CNN-based deep learning model classifies emotions such as fear, anger, stress, or happiness.
The model is trained using Python libraries such as TensorFlow and Keras.

B. Obstacle Detection Ultrasonic and infrared sores are used to measure object distance and detect obstacles in the robot's path. These sensors help maintain safe navigation during autonomous movement.

c. GPS Tracking and Email Alerts A NEO-6M GPS module provides location coordinates in real time. If the system identifies a high-risk emotional state, an automated email containing the exact location is sent to authorities using SMTP.

D. Solar-Powered Operation A solar panel charges the battery during daylight, enabling extended usage. Energy stored is used during nighttime, reducing dependency on external power sources.

E. Embedded Control An Arduino controller coordinates sensor data, triggers actuators, controls motors using the L293D driver, and ensures smooth navigation.

SYSTEM ARCHITECTURE

The SafeBot architecture integrates sensing hardware, processing units, power systems, and software modules into a unified platform. The hardware layer consists of a high-resolution camera, a GPS unit, ultrasonic sensors, IR sensors, DC motors, and a solar-powered battery. The software layer performs real-time video processing, face detection, emotion classification, and alert generation. A Python-based GUI built with Tkinter/PyQt displays live video feed, GPS location, and robot status. 10T connectivity enables cloud interaction, data logging, and automated notifications. A hybrid energy system ensures continuous operation, while structured sensor fusion and motor-control algorithms support stable autonomous movement across uneven terrains. This architecture enhances reliability, mobility, and intelligent responsiveness.

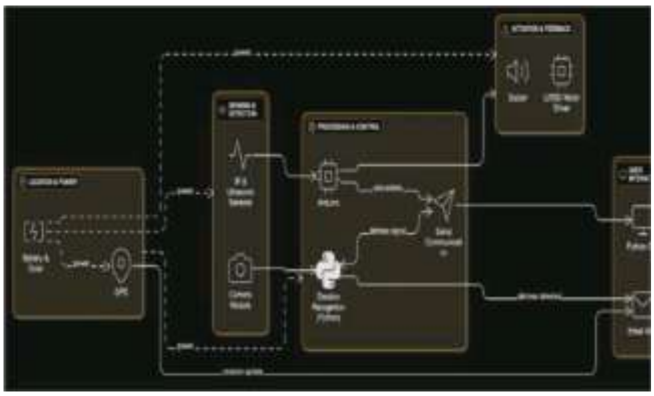

Fig 2: System Architecture

RESULTS AND DISCUSSION

SafeBot demonstrated reliable real-time monitoring during testing. The emotion-recognition model achieved an accuracy of approximately 81—92%, enabling early detection of distress signals. GPS-based alerts showed a delay of only 3—4 seconds, ensuring quick communication with authorities. Autonomous navigation tests confirmed stable movement across different environments, with accurate obstacle detection provided by ultrasonic and IR sensors.

Solar charging supported 6—8 hours of continuous operation, making the system scalable for long-term field use. The integration of sensors, Al analytics, and automated alerts significantly improved monitoring efficiency and reduced dependence on manual surveillance. These results show that SafeBot can act as a proactive safety management solution.

= M Gmail q Such

Fig 5: Result Seen through Email

CONCLUSION

The SafeBot system successfully integrates Al, IOT, robotics, and renewable energy technologies to create an intelligent safety-monitoring solution. Its ability to detect emotional cues, navigate autonomously, and transmit real-time location alerts ensures a quick response to potential threats. Results indicate improved detection accuracy, energy efficiency, and operational reliability. Future enhancements may include mobile app integration, advanced deep learning models, cloud analytics, and multirobot coordination for scalable safety monitoring.

ACKNOWLEDGMENTS

We express our sincere thanks to our guide and faculty members for their continuous support and technical guidance throughout this project. We also acknowledge the Department of Computer Science and Engineering for providing laboratory facilities and hardware components needed for system development. Our gratitude extends to the institution for enabling a productive research environment that contributed to the successful completion of this work.

REFERENCE

[1] Ramesh, K., & lyer, V. (2022). 10T-Based Smart Patrol Robots for Public Safety. International Journal of Embedded Systems, 14(3), 56—64. https://www.riverpublishers.com/journal.php?j=JES

[2] Sharma, N., & Gupta, P. (2023). Integration of Al and IoTfor Smart Surveillance. IEEE Transactions on Automation Science and Engineering, 20(2), 234 _ 245. https://ieeexplore.ieee.org/

[3] Arduino. (2024). Arduino Uno Technical Reference Manual. https://docs.arduino.cc/hardware/uno-rev3

[4] OpenCV Team. (2023). OpenCV Python Tutorials. https://docs.opencv.org/

[5] TensorFlow Developers. (2023). TensorFlow Keras API Documentation. https://www.tensorflow.org/api_docs/python/tf/keras

[6] Ubiox. (2022). NEO-6M GPS Module Datasheet. https://www.u-blox.com/en/product/neo-6series

[7] Python Software Foundation. (2023). Python smtplib Documentation. https://docs.python.org/3/library/smtplib.html

[8] Texas Instruments. (2021). L293D Motor Driver IC Datasheet. https://www.ti.com/product/L293D

[9] FER2013 Dataset. (2013). Facial Expression Recognition Dataset. https://www.kaggle.com/datasets/msambare/fer2013