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Women Safety Night Patrolling Robot in IoT

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Abstract

This document explores the development and implementation of the "Women Safety Night Patrolling Robot in IoT," a cutting-edge solution designed to enhance the safety of women, particularly during nighttime. In light of increasing incidents of violence and harassment, this project leverages advanced technologies such as the Internet of Things (IoT), Raspberry Pi, cameras, and sensors to create an autonomous robotic system capable of patrolling designated areas. The robot is equipped to respond to sounds, providing real-time surveillance and transmitting critical information to a control center for immediate assistance in emergencies. By fostering a sense of security and independence, this initiative addresses the pressing societal challenges surrounding women's safety. Future enhancements may include the integration of artificial intelligence for improved threat detection, the expansion of the robotic network for comprehensive coverage, and adaptations for rural and underserved regions. Ultimately, this project represents a significant advancement towards creating a safer environment for women, empowering them to navigate public spaces confidently.

Keywords: *Women safety, Night patrolling robot, Internet of Things (IoT), Autonomous surveillance, Raspberry Pi, Real-time monitoring, Sound detection, Emergency response, Threat detection, Artificial intelligence (AI), Public safety,*

I. INTRODUCTION

Women's safety remains a pressing issue, with individuals often feeling unsafe outside their homes, particularly during nighttime. Instances of violence, harassment, and assault emphasize the urgency of innovative solutions. While societal attitudes take time to evolve, technology can bridge this gap by providing immediate support during emergencies. This document explores a safety device capable of addressing these issues, enabling women to feel more secure and independent. Since women are unable to leave their homes at any time, particularly at night, women's safety has become a significant concern in our nation. The main causes are fear of physical or sexual abuse or violence against them. Not only is harassment of women a problem outdoors, but it may also occur inside households. Despite the tremendous advancements in technology and the creation of new devices, women and girls continue to face challenges in the twenty-first century. They often strive to advance liberty despite differences in politics, religion, ethnicity, and culture. Although everyone in our society understands how important women's safety is, it is also everyone's responsibility to ensure that they are adequately safeguarded. In addition, our culture has to be set up in a way that makes women feel safe leaving the home, even when they are alone themselves. Because they are not as physically fit as males, women would benefit greatly from assistance in times of need. Robot Patrolling System with Vision Recognizing, defending, and searching for services to assist you in escaping dangerous circumstances is the finest method to lower your chances of being a victim of violent crime (robbery, sexual assault, rape, and domestic abuse).

By providing her current location and health status to her associates and control center via SMS and phone call, this device will protect a woman and provide assistance when she needs it, such as when she gets into trouble, gets separated from friends during a night out, or is being followed maliciously (sexual assault). In addition to offering police and family support, this gadget facilitates prompt access to medical assistance. Since women are not allowed to leave their homes at any time, particularly at night, women's safety has become a serious concern in our nation. The main causes

are fear of physical or sexual abuse or violence against them. Not only is harassment of women a problem outdoors, but it may also occur inside households. Recognizing, defending, and searching for services to assist you in escaping dangerous circumstances is the finest method to lower your chances of being a victim of violent crime (robbery, sexual assault, rape, and domestic abuse). By providing her current location and health status to her associates and control center via SMS and phone call, this device will protect a woman and provide assistance when she needs it, such as when she gets into trouble, gets separated from friends during a night out, or is being followed maliciously (sexual assault). In addition to offering police and family support, this gadget facilitates prompt access to medical assistance.

1.1 Autonomous Robotic System for the Security and Safety of Women

In many parts of the globe, women's safety is presently the top concern. In remote areas, there is still a dread of women. Women are adept at bringing dissimilar groups together for a shared objective. They usually work together across political, religious, cultural, and ethnic divides to advance peace. Everyone agrees that women's safety is crucial, but we also need to acknowledge that they need proper protection. In an emergency, a helping hand would be much appreciated since women lack the physical strength of males. Finding and contacting services that may help you escape dangerous circumstances is the best way to lower your risk of being a victim of violent crime (such as rape, sexual assault, robbery, or domestic violence). Whether it's an emergency or they get lost with friends on a night out and don't know how to go home, having these apps may reduce the danger and provide assistance when required. Although they are suitable for all women, a number of them were developed for students to reduce the risk of sexual assault on college campuses. Following the recent tragedy in Delhi that startled the country and raised awareness of the safety issues for our girls, people are getting ready to retaliate in a variety of ways. In India, women's standing has drastically evolved throughout the millennia.

In contemporary India, women still face social obstacles and are regularly the targets of violent crimes and abuse; a Thomson Reuters global survey found that India is the worst country for women among the G20 and the "fourth most dangerous country" for women worldwide. The time for women to change has already passed. Therefore, we propose a security patrolling robot that uses a Raspberry Pi. The main idea behind this project is a security robot designed especially to provide women safety and security so they never feel powerless in the face of such societal challenges. Cameras and sensors are used by the system to protect any area. A robot follows a preset path and starts to move in the direction of the sound when it hears it.

It can broadcast live video as well. This robot has a camera that can capture pictures, record them, and send them back to the control center. This technology can provide a real-time video signal to the control station. Securing the whole region is the aim here. The robot will initiate a line-following path in response to any sound, and it will continue to follow it until it runs into an obstacle. At that time, it will take a picture of the area and transmit it to the control room. It takes a Raspberry Pi connected to a camera to build an autonomous robotic system.

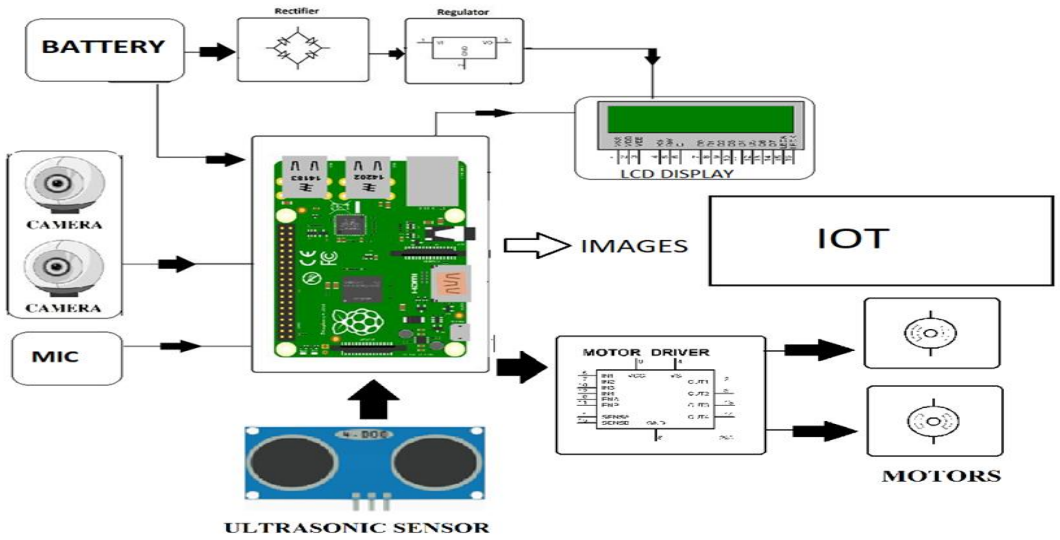

Figure 1. System Architecture of Women Safety Night Patrolling Robot

Table 1: Overview of Features and Objectives of the Women Safety Night Patrolling Robot in IoT

Feature	Description
Purpose	To enhance women's safety during nighttime and provide immediate support in emergencies.
Technology Used	IoT (Internet of Things), Raspberry Pi, cameras, and sensors.
Functionality	- Autonomous patrolling
	- Sound detection and response
	- Live video broadcasting
Emergency Support	Sends current location and health status to family and control center via SMS and call.
Target Users	Primarily women, especially those in vulnerable situations or areas.
Operational Mechanism	Follows a preset path and moves towards detected sounds, capturing images and sending them to control.
Real-time Monitoring	Provides a live video feed to the control center for immediate assessment and response.
Social Context	Addresses the pressing issue of women's safety in various cultural and societal contexts.
Goal	To create a safer environment for women, reducing the fear of violence and harassment.

II. LITERATURE REVIEW

Urvashi Gupta et.al (2022) This study Examined Crime against women (CAW) in India remains a pressing issue, with persistent levels of violence influenced by the country's dense population. This study analyzes NCRB data (2001–2020) for 27 states and 9 union territories. Using exploratory data analysis (EDA) and linear regression, it examines relationships between key factors and crime categories like rape, dowry deaths, kidnapping, and assault. EDA visualizes trends, while linear regression models dependencies. Adopting the CRISP-DM methodology ensures a structured and accurate approach to prediction. The proposed model preprocesses data, uncovers patterns, and achieves prediction accuracy of 72.29%, 92.15%, 83.30%, and 84.33% across four IPC categories. **Rajesh Kannan Megalingam et al. (2020)** propose a wearable technology to enhance women's safety, addressing their concerns about moving freely, especially during odd hours. The system, resembling a normal watch, is equipped with a button that women can press to activate it when they feel unsafe. Additionally, the system activates automatically through changes in sensor outputs. Once triggered, it tracks the user's location using GPS and sends an emergency email to a designated person for assistance. A screaming alarm, controlled by a real-time clock, further calls for help. Unlike previous solutions, this reliable system doesn't require a smartphone, ensuring accessibility and effectiveness. **Bhuvaneshwari Mehtre et al. (2019)** address the daily challenges faced by women and girls in ensuring their safety and dignity. They propose a compact IoT-based device incorporating a Raspberry Pi, heartbeat sensor, temperature sensor, GPS, panic button, and camera. The device can be activated by pressing a button or automatically when the user's temperature or heart rate exceeds a threshold. Upon activation, it captures the attacker's image using the Raspberry Pi camera, tracks the user's location, and sends the data via SMS to emergency contacts or police. Additionally, a voice-activated feature allows the user to trigger help by simply calling out.

Ashok K et al. (2023) highlight the issues women and girls face with abuse and harassment, not only in real life but also across social media platforms like Twitter, Facebook, and Instagram. The paper reviews women's safety on social media across Indian cities, emphasizing the need for better protections. Abusive tweets, posts, texts, and quotes targeting women are analyzed to understand the misuse of platforms and the lack of safety measures. It stresses the importance of strict actions against offenders. Women's shared experiences on social media provide insights into their feelings of insecurity, especially in public places, workplaces, and during harassment. **Shreya Chakraborty et al. (2019)** emphasize the need for enhanced safety measures for women, particularly when traveling alone at night. To address this, they propose the NAARI Safety Application, designed as a precautionary tool rather than only an emergency response system. The app allows users to scan a vehicle's QR code to retrieve details and track their current location using GPS. This information is then sent to the user's emergency contacts for added security. The app leverages the widespread use of smartphones, offering a proactive platform to prevent risks and ensure safety, aligning with the

principle of "protection is better than cure." **Janani S et al. (2024)** introduce a smart wearable device leveraging IBEACON technology to enhance women's safety. The device includes a BLE-Wi-Fi-supported Beacon module, an AI controller, and a MEMS accelerometer sensor to detect abnormalities. In emergencies, such as sexual harassment, the accelerometer detects abnormal motion based on a set threshold, automatically activating the system. It sends SMS and call alerts to predefined emergency contacts or authorities, continuously transmitting victim details to the beacon module. The module bypasses Wi-Fi password requirements, enabling real-time location tracking via a cloud server. A panic switch also triggers a buzzer to alert nearby people. This flexible and accurate framework effectively addresses women's safety concerns. **Muskan et al. (2018)** address the critical issue of women's safety, highlighting the limitations of existing devices that rely on fixed thresholds for temperature and heartbeat to trigger alarms. These systems fail to account for individual variations in physical patterns, leading to inaccuracies. The proposed solution involves a wearable safety device that customizes thresholds by learning an individual's temperature and pulse patterns using machine-learning algorithms. Data collected from sensors during non-danger conditions is used to train the model, improving accuracy in emergency detection. The device sends alerts and location information to multiple contacts and utilizes a ZigBee mesh network for communication in areas without internet connectivity, ensuring reliable operation in diverse scenarios.

Narasapuram Penchalaiah et al. (2021) emphasize the increasing harassment faced by women globally, which threatens empowerment and economic development. To address this, the study proposes an IoT-based system paired with an Android app to enhance women's safety. The system includes an emergency button that provides immediate assistance by monitoring the user's real-time location and notifying the nearest police station and volunteers. It also identifies the closest safe zones for the user. Designed for both online and offline functionality, the device can connect to authorities without internet access. Utilizing components like Arduino Uno, GPS, GSM, and Bluetooth, the system is cost-effective and user-friendly. **Sanila K et al. (2022)** propose a smart women's safety device that automates emergency alerts using pressure, pulse-rate, and gyroscope sensors to detect threats. It includes a manual push button but relies on automation during panic situations. The system uses GSM and GPS to send location alerts and attacker images to relatives and police. A shock module offers self-defense, while a cancel button prevents false alarms. This device addresses societal challenges and aims to enhance women's security effectively. **Mohamad Zikriya et al. (2018)** propose a wearable "Smart Gadget" to enhance women's safety amidst rising assaults and harassment in public spaces. The gadget integrates with smartphones and features motion-activated image capture, sending photos and the victim's location to an email for evidence. It also includes self-defense tools like an LED flash to disorient attackers and electric shock gloves to incapacitate them. Designed to work with or without internet, the device ensures protection in diverse scenarios, prioritizing self-defense and evidence collection to help women escape danger effectively. **Remya George et.al (2014)** an intelligent security system for women is described in this study. There is a lot of unethical physical harassment of women worldwide. The absence of an appropriate surveillance mechanism causes this to pick up speed. Our effort is an attempt to address this issue. In order to detect unsafe situations, the systems primarily consist of a monitoring device whose output is analyzed. When the system detects dangerous areas, it will notify the nearby control center and activate alarms positioned across the area to allow for outside assistance. This device may be installed in public areas where women are often attacked, such train stations, bus stops, walkways, and retail malls. We firmly think that our project will improve the lives of many people, and we want to see a future where people are brave and fearless.

Table 2 Studies on Women's Safety Systems: IoT, GPS, and Machine Learning Applications

Sr. No	Title of Paper	Authors	Methods Used & Limitations/Future Scope
1	Machine Learning Algorithms for Women's Safety	Sharma, N., Gupta, T.(2022)	Machine learning for real-time risk prediction. Limitations: Privacy issues; Future scope: Privacy improvements.
2	IoT-Based Smart Helmet for Safety of Women	Shetty, A., Narayan, P.(2021)	Wearable helmet with real-time tracking. Limitations: Connectivity issues; Future scope: Expanding to rural areas.
3	GPS-Based Women Safety System Using IoT	Saini, J., Dhawan, A. (2020)	GPS and IoT-based solution. Limitations: Lack of user feedback; Future scope: Feedback integration.

4	A Review on Women Safety Application	Patel, R., Trivedi, S. (2020)	Review of safety apps and wearables. Limitations: Lack of real-time monitoring; Future scope: AI integration.
5	Real-Time Women Safety Device with GSM and GPS	Jain, P., Agarwal, M. (2019)	Uses GSM, GPS for location tracking. Limitations: Network limitations; Future scope: Satellite communication.
8	Women Safety Device Design Using IoT	Kumar, A., Sharma, P. (2018)	IoT-based safety device with GPS tracking and emergency alert system. Limitations: Limited battery life; Future scope: Energy-efficient designs.
9	An Android App for Women's Safety Using GPS	Roy, D., Mehta, K.(2017)	Mobile app with GPS and messaging for location alerts. Limitations: Dependency on mobile networks; Future scope: Offline functionality.
10	Development of Women Security System Using IoT	Reddy, A., Rao, V.(2016)	Wearable device with IoT for continuous monitoring. Limitations: High costs; Future scope: Cost reduction.

Research Gap

The literature review highlights several advancements in women's safety technologies, yet notable research gaps persist. While various wearable devices and applications have been proposed, many solutions rely heavily on fixed thresholds for triggering alerts, which may not account for individual variations in physiological responses, leading to inaccuracies in emergency detection. Additionally, existing systems often require smartphone connectivity, limiting accessibility for users without such devices. Moreover, while some studies focus on real-time location tracking and emergency notifications, there is a lack of comprehensive integration of these technologies into a cohesive system that can operate effectively in both urban and rural settings, especially in areas with limited internet access.

Furthermore, the social context surrounding women's safety is often underexplored; many solutions do not adequately address the cultural and societal factors that contribute to women's vulnerability. Lastly, while the importance of real-time monitoring is emphasized, there is insufficient research on the psychological impact of these technologies on users, particularly regarding their feelings of empowerment versus dependency. Addressing these gaps could lead to more effective, inclusive, and user-friendly solutions for enhancing women's safety.

III. Methodology

The methodology for the Women Safety Night Patrolling Robot in IoT involves a systematic approach for ensuring effective safety monitoring in designated areas. The first step is to identify the safety needs in the target regions, analyzing the areas with the highest risk and determining the most effective routes for patrolling. Once the safety needs are identified, appropriate hardware components, such as night-vision cameras, sensors, GPS, and GSM modules, are selected for integration into the robot. These hardware components will ensure round-the-clock surveillance, location tracking, and communication for immediate assistance.

The software development phase involves programming the robot's patrol routes, detection algorithms, and alert systems. The detection system will be responsible for identifying potential threats in real time, while the alert system will notify the concerned authorities or users in case of emergencies. The system is then thoroughly tested by checking all components, including sensors and software, followed by field trials during nighttime conditions to assess performance in real-world scenarios. Once verified, the robot is deployed in designated safety zones, where it is used for continuous patrolling. Personnel are trained to operate the robot, ensuring proper functionality. maintenance involves periodic updates to both hardware and software to maintain optimal performance, address emerging issues, and improve efficiency.

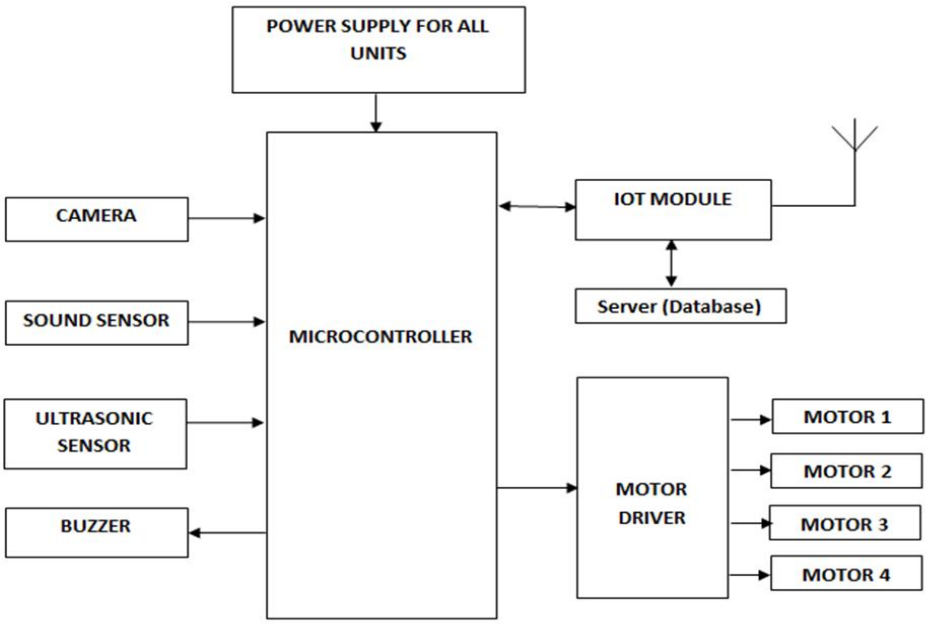

Figure 2. Block Diagram

This block diagram represents the architecture of a security robot system designed for women's safety. Diagram shows:

1. **Power Supply for All Units**: Provides the necessary power to all the components in the system.
2. **Microcontroller**: Serves as the central control unit, interfacing with various sensors, the IoT module, and motor drivers.
3. **Sensors**:
   - **Camera**: Captures live video and images of the surroundings.
   - **Sound Sensor**: Detects sound signals, such as screams or loud noises, which could indicate emergencies.
   - **Ultrasonic Sensor**: Detects obstacles to ensure smooth navigation.
   - **Buzzer**: Provides an audible alert in case of emergencies or threats.
4. **IoT Module**: Connects the system to the internet and communicates with a server (database) to store or retrieve data.
5. **Motor Driver**: Controls the movement of motors (Motor 1 to Motor 4) based on commands from the microcontroller, enabling the robot to navigate its environment.
6. **Server (Database)**: Stores data captured by the system and facilitates remote monitoring or analysis.

The system ensures efficient area monitoring and provides safety through real-time alerts and live video transmission.

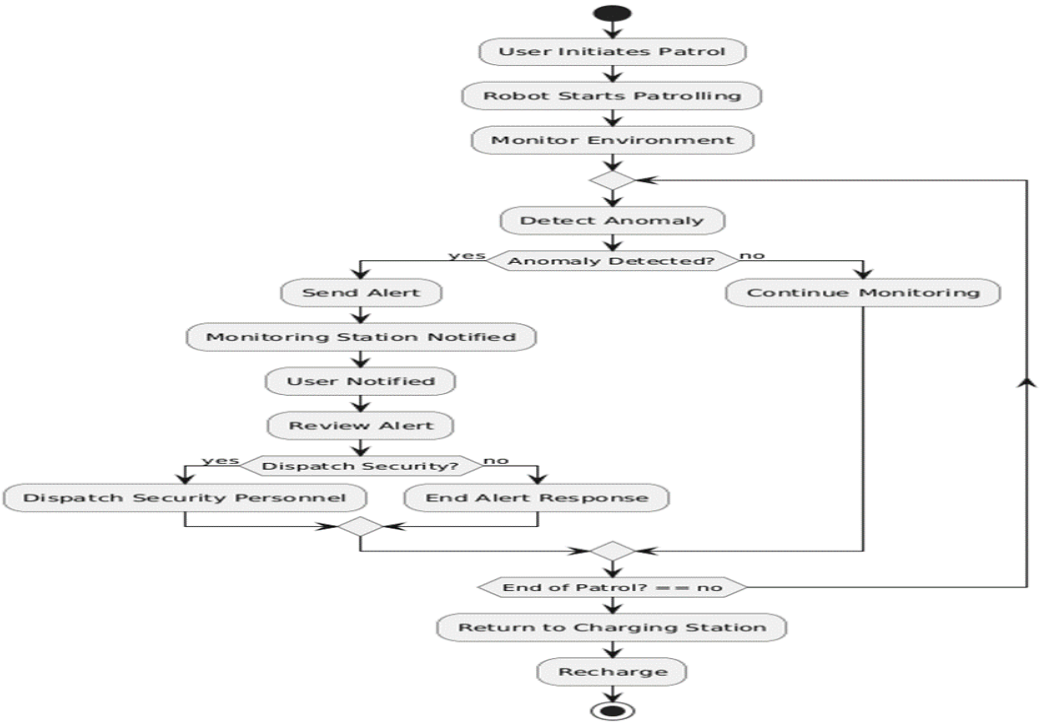

Figure 3. Workflow of Autonomous Security Robot for Patrolling and Anomaly Detection

The operating procedure of a security robot intended for patrolling and anomaly detection is described in this flowchart. When the user starts the patrol, the robot starts patrolling and keeping an eye on the surroundings, starting the procedure. The robot uses its integrated sensors and systems to continually check for abnormalities while on patrol. The robot alerts the user and the monitoring station whenever it notices an irregularity. To ascertain if further action is necessary, the warning is examined. Security officers are sent to the site if necessary. If not, the robot resumes its patrol when the alarm reaction is complete. The robot resumes its routine monitoring cycle if no abnormality is found. The robot assesses whether it has finished the work at hand at the conclusion of the patrol session. To ensure it is prepared for the next operating cycle, the robot returns to the charging station to refuel when the patrol is complete. This structured workflow ensures real-time monitoring, quick response to potential threats, and efficient energy management for the robot.

Table 3. Features and Technologies for Women's Safety and Emergency Assistance Systems.

Feature	Description	Purpose	Technology/Mechanism
Real-time Location Tracking	Allows for real-time tracking of an individual's location to ensure monitoring and assistance in unsafe situations.	Enhance safety by enabling location tracking.	GPS, IoT, mobile app.
Emergency Alert System	Notifies family members, friends, and authorities through SMS or a mobile app with the user's location and status in emergencies.	Provide quick alerts during distress.	SMS, app notifications, IoT-based triggers.
Health Monitoring Integration	Monitors heart rate and stress levels to trigger alerts in case of abnormal conditions or signs of distress.	Detect and respond to health-related emergencies.	Wearable sensors, IoT, health analytics.
User-friendly Interface	Simple and intuitive interface ensuring easy use, even in stressful situations.	Ensure usability for women across all demographics.	User-centered design, accessible interface.
Remote Control and Assistance	Allows remote monitoring and control through IoT devices for family members or authorities to assist or locate the user.	Facilitate support and assistance from remote locations.	IoT devices, real-time communication protocols.

Privacy and Data Security	Maintains user privacy and secures personal data through encryption and other measures.	Protect user information and ensure data confidentiality.	Data encryption, secure communication channels.

Challenges in Developing Effective Women's Safety Technologies: An Overview

- **Technological Limitations**: Many devices use fixed thresholds for monitoring, which may not account for individual variations, leading to inaccuracies. Connectivity issues in rural areas can also limit effectiveness.
- **User Accessibility**: Many solutions require smartphones, excluding users without access to such technology, particularly in lower socioeconomic groups.
- **Privacy Concerns**: Constant tracking raises privacy issues, making users wary of data misuse.
- **Cultural Factors**: Existing solutions often overlook the societal attitudes that contribute to women's vulnerability, impacting acceptance and effectiveness.
- **Integration Issues**: There is a lack of comprehensive systems that combine various safety features, leading to inefficiencies.
- **Psychological Impact**: The reliance on technology for safety can create feelings of dependency, which are often not addressed in current designs.

CONCLUSION

In conclusion, the "Women Safety Night Patrolling Robot in IoT" represents a significant advancement in addressing the pressing issue of women's safety, particularly during nighttime. The project leverages modern technology, including IoT, Raspberry Pi, cameras, and sensors, to create an autonomous robotic system that enhances security in vulnerable areas. By patrolling designated paths and responding to sound, the robot not only provides real-time surveillance but also transmits critical information to a control center, ensuring immediate assistance in emergencies. This innovative approach not only empowers women by providing them with a sense of security but also addresses the societal challenges they face, particularly in regions where violence and harassment are prevalent. The integration of emergency support features, such as location tracking and communication with family and authorities, further enhances the effectiveness of this solution. As societal attitudes evolve, the implementation of such technological solutions can play a crucial role in fostering a safer environment for women, enabling them to navigate public spaces with confidence. Ultimately, the development of the Women Safety Night Patrolling Robot is a step towards a future where women can feel secure and independent, free from the fear of violence and harassment.

FUTURE SCOPE

The future scope of the "Women Safety Night Patrolling Robot in IoT" is promising, with several avenues for enhancement and expansion. Firstly, integrating advanced artificial intelligence and machine learning algorithms could improve the robot's threat detection capabilities, allowing for more accurate identification of potential dangers. Additionally, expanding the system to include a network of robots could create a comprehensive surveillance grid in high-risk areas, enhancing overall safety.

Moreover, the technology could be adapted for use in rural and underserved regions, where women's safety concerns are often overlooked. Collaborations with local law enforcement and community organizations could facilitate better response times and resource allocation. Furthermore, incorporating user feedback mechanisms could lead to continuous improvements in the system's functionality and user experience. Finally, raising awareness and promoting the adoption of such technologies can contribute to a cultural shift towards prioritizing women's safety, ultimately fostering a more secure environment for all.

References

1. Monisha, D. G., Monisha, M., Pavithra, G., & Subhashini, R. (2016). Women safety device and application-FEMME. Indian Journal of Science and Technology, 9(10). https://doi.org/10.17485/ijst/2016/v9i10/88898
2. Zikriya, M., M G, P., Math, S. R., & Tankasali, S. (2017). SMART GADGET FOR WOMEN SAFETY USING IoT. 6(13), 1–5.
3. Sanila K, & NSS College of Engineering, Palakkad, Kerala, India. (2021). Wearable Device for Women Safety and Defence. International Journal of Advanced Research in Science, Communication and Technology, 2(2), 487–493. https://doi.org/10.48175/ijarsct-3337
4. N., P., M., S., C., V. K. R., D. V., P. K. R., & D., S. (2021). An IoT Based Smart Wearable Device for Women Safety. International Research Journal on Advanced Science Hub, 3(Special Issue ICITCA-2021 5S), 89–95. https://doi.org/10.47392/irjash.2021.145
5. Muskan, Khandelwal, T., Khandelwal, M., & Pandey, P. S. (2018). Women safety device designed using IoT and machine learning. Proceedings - 2018 IEEE SmartWorld, Ubiquitous Intelligence and Computing, Advanced and Trusted Computing, Scalable Computing and Communications, Cloud and Big Data Computing, Internet of People and Smart City Innovations, SmartWorld/UIC/ATC/ScalCom/CBDCom/IoP/SCI 2018, 1204–1210. https://doi.org/10.1109/SmartWorld.2018.00210
6. Muskan, Khandelwal, T., Khandelwal, M., & Pandey, P. (2018). Women Safety Device Designed Using IoT and Machine Learning. 1204–1210. https://doi.org/10.1109/SmartWorld.2018.00210
7. Hyndavi, V., Sai Nikhita, N., & Rakesh, S. (2020). Smart wearable device for women safety using IoT. Proceedings of the 5th International Conference on Communication and Electronics Systems, ICCES 2020, 03, 459–463. https://doi.org/10.1109/ICCES48766.2020.09138047
8. Chakraborty, S., Singh, D., & Biswal, A. K. (2021). NAARI: An Intelligent Android App for Women Safety. September, 625–637. https://doi.org/10.1007/978-981-33-4604-8_48
9. Ashok, K., Rajalakshmi, B., Chaitanya Reddy, K. S., Guggulla, G. P., & Santhosh Krishna, B. K. (2022). A Review on Women Safety in India using Machine Learning on Different Social Media Platform. 2nd IEEE International Conference on Advanced Technologies in Intelligent Control, Environment, Computing and Communication Engineering, ICATIECE 2022, September. https://doi.org/10.1109/ICATIECE56365.2022.10047377
10. Mehtre Prabhat Kumar, B. (2018). A Raspberry Pi-based Safety System for Women Security using IoT. International Journal of Science and Research, 9(7), 670–675. https://doi.org/10.21275/SR20706160008
11. Rajesh Kannan, M., Jyothsna, K., Aparna, T. S., Anjali, T., Meera, M., & Amrutha, S. D. (2020). IoT-based women security system. In Lecture Notes in Networks and Systems (Vol. 89, Issue November). Springer Singapore. https://doi.org/10.1007/978-981-15-0146-3_134
12. Gupta, U., & Sharma, R. (2023). Analysis of criminal spatial events in india using exploratory data analysis and regression. Computers and Electrical Engineering, 109, 108761. https://doi.org/https://doi.org/10.1016/j.compeleceng.2023.108761
13. S.NO. 1 Journal Name. (n.d.). 1, 2395.
14. Mahalakshmi, R., Kavitha, M., Gopi, B., & Kumar, S. M. (2023). Women Safety Night Patrolling IoT Robot. Proceedings - 5th International Conference on Smart Systems and Inventive Technology, ICSSIT 2023, 3(3), 544–549. https://doi.org/10.1109/ICSSIT55814.2023.10060955
15. Siciliano, B., & Khatib, O. (2016). Springer Handbook of Robotics. Springer.
16. K. A. M. Al-Sharif, I. S. Al-Shaibani, S. H. M. Ahmad, M. F. Abdurrahman, "Robotics in Security and Surveillance," International Journal of Engineering Research and Technology (IJERT), vol. 10, no. 3, 2021.
17. B. Siciliano, L. Sciavicco, L. Villani, and G. Oriolo, Robotics: Modeling, Planning and Control. Springer, 2009.
18. Szeliski, R. (2010). Computer Vision: Algorithms and Applications. Springer.
19. H. A. A. M. F. K. F. M. M. Amrith Raj R. B. Shafi, "Design and Implementation of a Surveillance Robot," International Journal of Recent Trends in Engineering & Research (IJRTER), vol. 5, no. 3, pp. 152-155, 2019.