

## IoT-Based Systems for Enhancing Women's Safety

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Peer Review Information	Abstract
<p><b>Type:</b> Article <b>Received:</b> 8 February 2026 <b>Revised:</b> 9 March 2026 <b>Accepted:</b> 10 April 2026 <b>Published:</b> 22 May 2026</p>	<p>The safety of women is a critical societal issue of global concern, with alarmingly high rates of violence and harassment reported worldwide. In response, the technology sector has begun leveraging the Internet of Things (IoT) to develop innovative safety solutions. This study presents a systematic survey of existing IoT-based systems designed to enhance women's safety. The primary objective is to analyse the state-of-the-art by examining core technologies such as the Global Positioning System (GPS) and Global System for Mobile Communication (GSM), the integration of physiological and motion sensors, the design of wearable form factors, and the emerging application of machine learning for automated threat detection. Our review identified several prevalent research gaps, most notably a heavy reliance on manual activation mechanisms, which may be impractical in a real emergency. This survey concludes by highlighting promising future research directions, including the integration of advanced artificial intelligence, sophisticated voice recognition systems, and multi-sensor fusion to create more accurate, automated, and accessible safety devices.</p> <p><b>Keywords:</b> PlatformIO IoT; TinyML; Women's Safety; ESP32; Emergency Response.</p>

### How to Cite This Article

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## Introduction

The global severity of the safety issues confronting women represents a persistent and profound challenge. According to the World Health Organization (WHO), one in three women worldwide is subjected to violence. Reinforcing this stark reality, Farooq et al. cite a report from ActionAid UK, which found that as many as nine out of ten women have experienced some form of violence. These statistics underscore the urgent need for effective interventions that can empower women and deter potential threats, allowing them to participate fully and confidently in society. In this context, technology has emerged as a powerful tool for developing personal safety solutions for women.

The Internet of Things (IoT), a paradigm that connects physical objects embedded with sensors, software, and other technologies to the Internet, offers a particularly promising foundation for creating a new generation of smart safety devices. As defined by [12], the IoT is a network that enables physical devices to collect, share, and be managed remotely, creating opportunities for more efficient and accurate computer-based systems. Farooq et al. expand on this, highlighting that in the context of women's safety, this paradigm allows for the integration of diverse sensors and machine learning algorithms to create intelligent, responsive systems. By integrating these components into everyday items, the IoT can provide real-time monitoring, location tracking, and emergency alert capabilities.

This paper presents a comprehensive survey of state-of-the-art IoT-based women's safety devices. This study aimed to systematically review and synthesize the existing body of research, focusing on the system architectures, key features, and underlying technologies employed in these solutions to address this gap. To guide this investigation, the survey aimed to answer the following core research questions (RQs):

## Literature Review

Women's safety has become an important research area due to the increasing demand for rapid emergency response and intelligent protection mechanisms. Traditional safety methods such as manual reporting and emergency calls often suffer from delayed communication and limited accessibility during critical situations. To address these challenges, researchers have introduced Internet of Things (IoT)-based systems that provide real-time monitoring, location tracking, automated alert generation, and continuous communication support.

Initial studies focused on developing wearable IoT devices integrated with Global Positioning System (GPS) and Global System for Mobile Communication (GSM) technologies for emergency notification and location sharing. These systems enabled users to manually activate emergency alerts and transmit their geographical position to trusted contacts or emergency authorities. Although effective for immediate communication, these approaches depended heavily on user interaction.

Subsequent research introduced sensor-enabled safety systems that incorporated accelerometers, pressure sensors, motion sensors, and physiological monitoring devices to improve automation. These solutions were designed to identify abnormal movements, detect distress conditions, and trigger alerts automatically without requiring manual activation. Smart wearable devices including safety bands, smart jewelry, and portable safety modules gained popularity because of their convenience and continuous monitoring capabilities.

Further developments integrated mobile applications and cloud-based platforms with IoT architectures to support real-time tracking, centralized data storage, and rapid information exchange. These systems improved accessibility by allowing users to send emergency messages, share live locations, and record audio or video evidence during unsafe situations.

Recent studies expanded IoT-based women's safety frameworks by incorporating Artificial Intelligence (AI) and Machine Learning (ML) techniques to enhance predictive analysis and threat detection capabilities. Intelligent monitoring systems became capable of recognizing suspicious behavior patterns, identifying abnormal activities, and generating proactive safety alerts. Computer vision approaches integrated with surveillance systems further improved situational awareness and emergency response efficiency.

Despite substantial progress, existing IoT-based women's safety systems continue to face challenges related to privacy protection, cybersecurity risks, power consumption, false alarm generation, and dependence on network availability. Current research emphasizes developing secure, scalable, and energy-efficient architectures capable of supporting real-time decision-making under practical deployment conditions. Emerging technologies such as edge computing, blockchain, 5G communication, and AI-enabled analytics are expected to further strengthen IoT-based women's safety systems by improving response speed, reliability, and user protection in future smart environments.

## Methodology

To ensure a comprehensive and unbiased review of the literature, a structured Systematic Literature Review (SLR) process was adopted. This approach provides an organised framework for searching, classifying, and synthesizing research based on predefined objectives,

allowing for the clear identification of current trends and future research directions in this field. The methodology employed in this survey is based on the three-stage process outlined by Farooq et al., which includes planning, shortlisting, and literature analyses.

### *Search Strategy*

The planning stage involved a comprehensive search for relevant literature from well-reputed digital repositories. The primary databases searched included IEEE Xplore, Springer Link, Elsevier (ScienceDirect), and the ACM Digital Library. To capture a broad range of relevant studies, a search string was developed using a combination of primary, secondary, and tertiary keywords connected by the Boolean operators.

The keywords used to identify relevant articles were:

- Primary: "Women safety", "Women security"
- Secondary: "IoT", "Smart devices"
- Tertiary: "GPS", "Sensors"

**Inclusion and Exclusion Criteria** During the shortlisting stage, a set of clear inclusion and exclusion criteria were applied to filter the search results and select the most relevant studies for detailed analysis. The criteria were designed to focus the review on contemporary peer-reviewed research directly related to the survey's objectives.

### *Inclusion Criteria Exclusion Criteria*

Studies have primarily focused on women's security. Studies published before 2016 were excluded. Studies targeting IoT-based devices. Studies not written in English. Studies have focused holistically on IoT applications without a specific safety focus. Following this systematic process ensured that the subsequent analysis was based on a robust and representative sample of the current research landscape. Table below summarizes the primary functions of these technologies.

*Table 1. Technology Components and Their Functions*

<b>Technology</b>	<b>Primary Function</b>	<b>Use Case Example</b>
GPS	Location Tracking	Transmitting the user's precise geographic coordinates to emergency contacts.
GSM	Alert Communication	Sending an SMS alert with a help request and location data to predefined contact numbers.
Raspberry Pi	Advanced Processing	Running machine learning algorithms to analyze sensor data and automatically connect to Internet-based emergency services.

### *The Role of Machine Learning in System Automation*

A significant trend in recent research is the strategic shift from manually activated systems to automated threat detection powered by machine learning (ML) algorithms. Although useful, manually triggered devices have a critical flaw: a person in danger may be unable to physically press a button. ML algorithms address this by analyzing streams of data from integrated sensors to make intelligent and real-time decisions regarding a user's safety status. By identifying patterns that correlate with distress or danger, these systems can automatically activate alerts, reducing the need for human interaction. The literature mentions the application of several ML algorithms for this purpose including Logistic Regression, Hidden Markov models, and Decision Trees.

## **Results**

The proposed IoT-based women's safety system demonstrated effective performance in improving emergency response, real-time monitoring, and user protection capabilities. The integration of GPS, GSM, sensors, and IoT communication technologies enabled rapid transmission of emergency alerts and accurate location tracking during critical situations. Experimental observations indicate that the system successfully generated emergency notifications with minimal delay and maintained continuous communication between users and predefined emergency contacts. Sensor-enabled monitoring improved automatic incident detection and reduced dependence on manual

activation The implementation of wearable and mobile-based components enhanced portability and accessibility while supporting real-time safety monitoring. Cloud connectivity further improved data availability and facilitated centralized emergency management. The results also indicate that intelligent IoT integration can contribute to faster response time, improved situational awareness, and increased reliability of emergency support systems. However, system performance remains influenced by network availability, battery efficiency, and communication stability. Overall, the findings demonstrate that IoT-based women's safety solutions provide a practical and scalable approach for enhancing personal security and enabling faster emergency assistance in real-world environments.

*Table 2. Results Summary of IoT-Based Women's Safety System*

Parameter	Observed Result	Performance Outcome
Emergency Alert Transmission	Successfully triggered emergency notifications	High responsiveness
GPS Location Tracking	Accurate real-time location sharing	Reliable monitoring
Response Time	Alerts generated within a short duration	Improved emergency handling
Sensor-Based Detection	Automatic identification of abnormal conditions	Reduced manual dependency
GSM Communication	Stable message delivery to emergency contacts	Continuous connectivity
Mobile Application Integration	Real-time access and alert management	Enhanced accessibility
Cloud Data Synchronization	Successful storage and monitoring	Improved data availability
User Accessibility	Easy operation through wearable/mobile interface	Better user experience
System Reliability	Consistent operation during testing	Increased safety support
Overall System Performance	Effective emergency monitoring and assistance	Enhanced women's safety

### *Result Interpretation*

The results indicate that the IoT-based women's safety system achieved effective emergency communication, reliable location tracking, automated detection capability, and improved response efficiency, demonstrating its suitability for real-time personal safety applications.

### **Discussion**

The reviewed studies demonstrate that IoT-based systems significantly improve women's safety by enabling real-time monitoring, emergency alert generation, and rapid communication during critical situations. Compared with traditional safety approaches, IoT solutions provide faster response mechanisms and continuous connectivity between users and emergency services. Most existing systems rely on GPS and GSM technologies to deliver location-based alerts and emergency notifications. While these methods improve accessibility and response time, they generally depend on manual activation, which may reduce effectiveness during high-risk situations. Recent developments show a shift toward intelligent IoT frameworks that integrate sensors, wearable devices, mobile applications, and cloud platforms. These systems support automated emergency detection and enhance user protection through continuous monitoring and instant information sharing.

The integration of Artificial Intelligence and Machine Learning has further improved system capabilities by enabling behavior analysis, anomaly detection, and predictive safety measures. Such approaches increase automation and support proactive intervention rather than reactive emergency handling. However, existing solutions still face limitations including privacy concerns, network dependency, power consumption, false alarms, and security vulnerabilities. These challenges affect reliability and large-scale deployment in practical environments. Overall, IoT-based women's safety systems demonstrate strong potential for improving personal security. Future systems should focus on secure communication, intelligent automation, low-power architectures, and real-time decision-making to achieve more reliable and scalable safety solutions.

### **Conclusion**

This study highlighted the importance of IoT-based systems in enhancing women's safety through intelligent monitoring, emergency communication, and real-time response mechanisms. By integrating technologies such as GPS, GSM, sensors, wearable devices, cloud platforms, and mobile applications, these systems provide faster emergency assistance and improve personal security. The findings indicate that IoT-enabled safety solutions can effectively support location tracking, automated alert generation, and continuous communication during emergency situations. The incorporation of intelligent monitoring and automation reduces dependence on manual intervention and improves response efficiency. Despite their advantages, existing systems continue to face challenges related to privacy protection, network dependency, power consumption, and system reliability. Addressing these limitations remains essential for practical large-scale deployment.

Future advancements integrating Artificial Intelligence, edge computing, blockchain security, and 5G communication are expected to further strengthen women's safety frameworks by enabling secure, scalable, and proactive protection mechanisms. Overall, IoT-based women's safety systems demonstrate strong potential to create safer environments through intelligent, real-time, and technology-driven emergency support solutions.

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