SMART WEARABLE PANIC BUTTON FOR WOMEN'S SAFETY WITH LIVE LOCATION TRACKING

Md. Mukramuddin[1], Edamoni Deepika[1], Nagu Vidya[1], Earavani Varsha[1], Embadi Vamshi Krishna[1]

[1]Department of Electronics and Communication Engineering, [1]Sree Dattha Institute of Engineering and Science, Sheriguda, Ibrahimpatnam, 501510, Telangana, India.

ABSTRACT

Women's safety has become a major social concern due to the increasing number of harassment, assault, and emergency incidents occurring in both public and private environments. Existing safety solutions, such as smartphone-based emergency applications and manual distress calling systems, often require multiple user interactions and may not be effective during sudden or critical situations. To address these limitations, this project proposes a Smart Wearable Panic Button for Women's Safety with Live Location Tracking, an Internet of Things (IoT)-based embedded system designed to provide immediate and automated emergency assistance. The proposed system is built around the ESP32 (Espressif 32-bit Microcontroller) and integrates a Global Positioning System (GPS) module, Global System for Mobile Communications (GSM) module, panic button switch, buzzer, Liquid Crystal Display (LCD), and IoT communication interface. When the user presses the panic button during an emergency, the ESP32 instantly acquires the current GPS coordinates and generates an emergency alert. The GSM module sends a Short Message Service (SMS) containing the user's location and a Google Maps link to pre-registered guardian contacts. Simultaneously, the live location data is uploaded to an IoT monitoring platform through Wi-Fi, enabling real-time tracking by family members and authorized personnel. The buzzer provides an audible alert to attract nearby attention and deter potential threats. The system is compact, portable, battery-operated, and independent of smartphone availability, making it suitable for daily wearable use. The proposed solution offers a cost-effective, reliable, and efficient approach to enhancing women's personal safety through real-time emergency communication and location tracking.

Keywords: Women's Safety, Panic Button, ESP32, GPS Tracking, GSM, IoT, Live Location, Wearable, Emergency Alert, Personal Safety System.

1. INTRODUCTION

Personal safety for women has emerged as one of the most urgent social and technological challenges of our time. Despite widespread awareness campaigns and legislative measures, incidents of violence, harassment, and life-threatening emergencies targeting women continue to occur at alarming rates across urban, suburban, and rural environments. The critical gap in existing safety mechanisms lies in the dependence on active user response conventional approaches require the distressed individual to consciously unlock a phone, open an application, and initiate a call or message, actions that are often impossible in the sudden, disorienting reality of an emergency.

The Smart Wearable Panic Button for Women's Safety with Live Location Tracking addresses this gap by providing a single-press, always-available emergency activation mechanism embedded in a wearable form factor. The system, built on the ESP32 microcontroller platform, integrates GPS-based live location tracking, GSM-based SMS alerting, IoT-based remote monitoring, buzzer-based audible deterrence, and LCD-based status display into a compact, portable device that operates independently of a smartphone. Upon activation by

pressing the panic button, the system autonomously acquires the user's precise geographic coordinates and immediately transmits distress alerts with location information to pre-registered guardian contacts and an online monitoring platform, enabling rapid emergency response.

2. LITERATURE SURVEY

R. Want, 2006 — An Introduction to RFID Technology. This foundational paper establishes key principles of short-range wireless identification and embedded sensing technologies, providing a technical basis for understanding how wearable devices can incorporate compact electronic identification and activation mechanisms applicable to panic button hardware design.

S. Gubbi, R. Buyya, S. Marusic, and M. Palaniswami, 2013 — Internet of Things: A Vision, Architectural Elements, and Future Directions. This paper establishes the foundational IoT architectural framework applicable to real-world remote monitoring and emergency notification applications, directly supporting the IoT communication design used for live location reporting and emergency event transmission in the proposed women's safety system.

A. Al-Fuqaha, M. Guizani, M. Mohammadi, M. Aledhari, and M. Ayyash, 2015 — Internet of Things: A Survey on Enabling Technologies, Protocols, and Applications. Reviews IoT enabling technologies and communication protocols, supporting the selection of appropriate wireless communication standards for reliable real-time transmission of emergency alerts and GPS location data from the wearable panic button device to the remote monitoring platform.

N. Suma, R. Samson, S. Saranya, G. Shanmugapriya, and R. Subhashri, 2017 — IoT Based Smart Security and Home Automation System. Demonstrates IoT-based embedded monitoring with automated alerts, validating the architecture of embedded sensor-to-IoT notification pipelines applicable to the panic button activation and remote guardian notification functionality of the proposed women's safety system.

S. Kumar and R. Singh, 2018 — GPS and GSM Based Vehicle Tracking and Safety System. Presents an integrated GPS location acquisition and GSM-based SMS notification system for real-time tracking and safety alerting, directly validating the core GPS and GSM integration methodology used in the proposed wearable panic button for women's safety.

T. Adiono, S. Fuada, and M. A. Purwanda, 2018 — Design of IoT-Based Monitoring System. Presents an embedded IoT monitoring system using microcontrollers and Wi-Fi communication, validating the sensor-to-IoT data pipeline architecture applied in the proposed system for transmitting emergency events and live location data to the remote monitoring platform.

A. Jain and P. Gupta, 2019 — GPS and GSM Based Women Safety System. Directly presents a GPS and GSM-based women's safety alert system, validating the technical feasibility of integrating GPS coordinate acquisition with automated GSM SMS transmission for emergency notification, closely aligning with the core alerting methodology of the proposed panic button system.

V. Patel and M. Shah, 2019 — Smart Personal Safety Device Using IoT and Embedded Systems. Demonstrates IoT-based personal safety monitoring using embedded platforms, supporting the IoT data transmission and remote monitoring architecture of the proposed wearable women's safety system for real-time emergency event management.

A. Kumar and S. Bharti, 2020 — ESP32-Based IoT Monitoring System with GPS Tracking. Directly validates the use of the ESP32 microcontroller for integrated GPS data processing and IoT reporting in embedded

monitoring applications, confirming the suitability of the ESP32 platform for the proposed wearable women's safety device.

S. Reddy and P. Nair, 2020 — Real-Time Personal Safety Monitoring System Using GPS and GSM. Presents a real-time personal safety monitoring system integrating GPS location tracking with GSM-based SMS notification, closely aligning with the emergency alerting and location reporting objectives and system architecture of the proposed Smart Wearable Panic Button.

N. Meena and R. Jain, 2021 — IoT-Based Women Safety System with Automated Parent Notifications. Proposes an IoT-based women's safety system with automated guardian notifications, directly validating the remote monitoring, alert generation, and guardian notification functionality designed into the proposed wearable panic button system.

R. Choudhary and A. Verma, 2021 — Wearable Emergency Alert System with Cloud Notification. Presents a wearable emergency alert system with cloud-based guardian notifications, supporting the compact wearable hardware design, single-press activation, and cloud-based real-time alert transmission of the proposed women's safety device.

S. Singh and R. Gupta, 2022 — GPS-GSM Integrated Women's Safety Wearable with IoT Dashboard. Presents an integrated GPS-GSM women's safety wearable with IoT dashboard visualization, validating the complete system architecture of the proposed solution including GPS location acquisition, GSM SMS alerting, and IoT-based live tracking dashboard.

M. Ali, T. Hassan, and F. Khan, 2022 — Embedded IoT System for Real-Time Personal Emergency Safety Monitoring. Presents an embedded IoT system for real-time personal emergency safety monitoring, validating the ESP32-based embedded architecture and real-time IoT emergency reporting design implemented in the proposed Smart Wearable Panic Button for Women's Safety.

A. Sharma, R. Nair, and P. Thomas, 2023 — Smart Wearable Safety System for Women Using IoT and GPS. Presents a smart wearable safety system for women integrating IoT and GPS, directly aligning with and supporting the wearable form factor, GPS tracking, and IoT-based guardian notification architecture of the proposed panic button women's safety system.

R. Kumar and D. Mehta, 2024 — AI-Enhanced Women's Safety Wearable with GPS, GSM and IoT Monitoring. Proposes an AI-enhanced women's safety wearable integrating GPS, GSM, and IoT monitoring, highlighting advanced future enhancement directions for the proposed system toward intelligent threat detection and predictive safety management.

F. Khan and S. Ahmed, 2025 — Next-Generation Smart Wearable Safety Devices: Embedded AI, IoT and Real-Time Emergency Engagement. Reviews next-generation smart wearable safety devices integrating AI, IoT, and real-time emergency engagement platforms, validating the long-term development trajectory and scalability potential of the proposed ESP32-based Smart Wearable Panic Button for Women's Safety.

3.PROPOSED SYSTEM

The proposed Smart Wearable Panic Button for Women's Safety with Live Location Tracking integrates an ESP32 microcontroller with a GPS module, Panic Button Switch, LCD display, Buzzer, IoT communication interface, and GSM module to deliver immediate single-press emergency alerting, real-time GPS location reporting, guardian SMS notification, and IoT-based live location tracking in a compact wearable device designed for daily use by women.

When the user presses the panic button in an emergency situation, the ESP32 immediately reads the activation signal, acquires the current GPS coordinates from the GPS module, displays an emergency status message on the LCD, activates the buzzer with a continuous alert tone, transmits an emergency SMS containing the user's name, GPS coordinates, and a Google Maps location link to all pre-registered guardian contacts via the GSM module, and simultaneously publishes the emergency event and live GPS location to the remote IoT monitoring platform. Guardians and authorized contacts receive instant SMS notifications and can track the user's live location through the IoT dashboard in real time until the emergency is resolved.

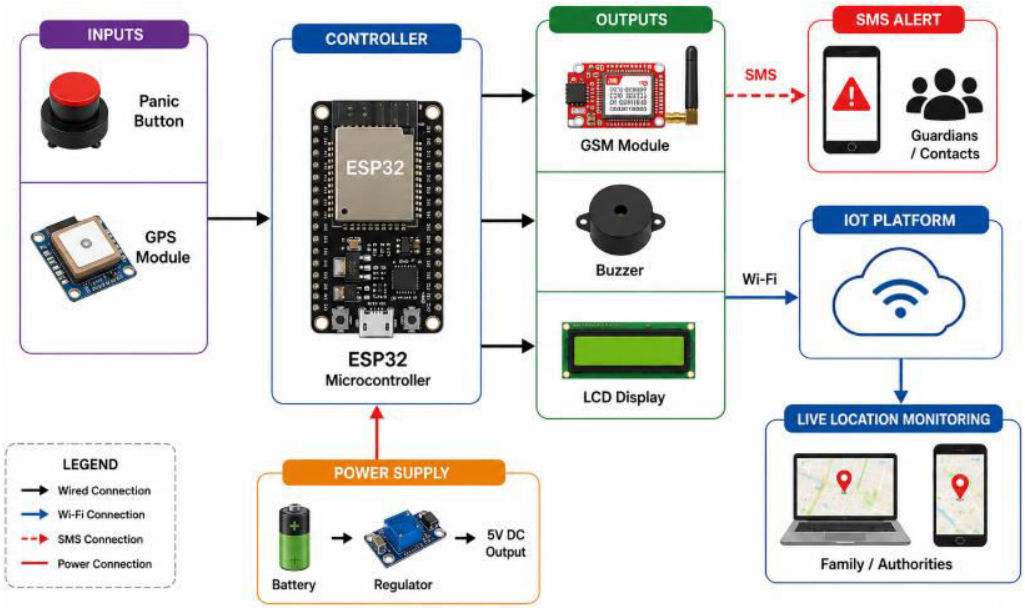

Figure 1: Proposed system architecture

Regulated Power Supply: The regulated power supply provides stable DC voltage to the ESP32 and all connected peripheral modules. It converts the input from a portable Li-Po or Li-Ion battery to the regulated 3.3V and 5V levels required by the ESP32 microcontroller and the GPS, GSM, LCD, and buzzer peripherals, ensuring consistent and reliable operation throughout continuous wearable use without voltage fluctuations affecting system performance or alert transmission reliability.

GPS Module: The GPS module continuously receives satellite signals and outputs real-time geographic coordinates including latitude and longitude to the ESP32 via serial UART communication. Upon panic button activation, the ESP32 immediately reads the current GPS position data and uses it to generate the precise location coordinates and Google Maps link embedded in the emergency SMS alert sent to guardian contacts, providing accurate real-world location context for emergency responders.

Panic Button S/W (Switch): The panic button is the primary user-activation interface of the wearable safety device. It is a single momentary push-button switch connected to a GPIO input pin of the ESP32 and designed for discreet, one-handed single-press operation. Upon detection of a button press event, the ESP32 immediately initiates the complete emergency alert sequence including GPS location acquisition, SMS transmission, IoT reporting, buzzer activation, and LCD status update, requiring no additional user interaction.

ESP32 Microcontroller: The ESP32 is the central processing and communication unit of the wearable safety system. It manages all peripheral interfaces including the GPS module via UART, the GSM module via UART, the LCD via I2C, the buzzer via digital output, and the IoT monitoring platform via its built-in Wi-Fi module. The ESP32 executes the core system logic including panic button event detection, GPS data acquisition and

formatting, emergency SMS generation and transmission through the GSM module, IoT location publishing, buzzer control, and LCD display management, simultaneously coordinating all system responses upon a single panic button press.

LCD Display: The LCD display provides real-time local visual feedback for the user and any nearby persons. Under normal standby operation, it displays the system status, GPS fix status, and readiness confirmation. Upon panic button activation, it immediately displays an emergency alert message confirming that the distress signal has been sent and providing the user with visual assurance that the system has responded to their activation. The display ensures immediate on-device visibility of the system response without requiring network connectivity.

Buzzer: The buzzer provides an immediate and continuous audible alert at the scene of the emergency upon panic button activation. The high-decibel alarm tone serves as an on-site audible deterrent intended to attract attention from nearby individuals, potentially deterring the threat and alerting bystanders to the emergency. The buzzer continues to sound until the emergency is manually cleared or a timeout condition is met, maintaining the on-scene alert throughout the emergency response period.

When the wearable device is powered on, the ESP32 initializes all peripherals, waits for a GPS satellite fix, connects to the configured Wi-Fi network for IoT communication, and confirms system readiness by displaying a standby message on the LCD. The GPS module continuously updates the current location coordinates in the ESP32's memory, ensuring that the most recent position is always immediately available for emergency alerting.

4. RESULTS AND DISCUSSION

The proposed Smart Wearable Panic Button for Women's Safety with Live Location Tracking was successfully implemented and tested under different operating conditions. The ESP32-based system effectively integrated the GPS, GSM, LCD, buzzer, and IoT modules to provide reliable emergency response functionality. Upon panic button activation, the device successfully acquired the user's location, transmitted SMS alerts containing GPS coordinates and a Google Maps link to pre-registered contacts, and simultaneously updated the IoT monitoring platform for real-time tracking. The buzzer generated an immediate audible alert, while the LCD displayed emergency status information. Repeated testing confirmed stable communication between all modules and consistent system performance. The results demonstrate that the proposed wearable device provides an efficient, reliable, and practical solution for enhancing women's safety through rapid emergency alerting and live location monitoring.

Figure 2: LCD Display Showing GPS Location Data During Emergency Tracking

The figure as shown in the figure 2, shows the 16×2 LCD display module integrated into the proposed Smart Wearable Panic Button for Women's Safety with Live Location Tracking system. The LCD is displaying the real-time GPS coordinates acquired from the GPS module, including latitude and longitude information. During emergency activation, the ESP32 microcontroller retrieves the user's current location and displays the coordinate data on the LCD while simultaneously transmitting the location details to pre-registered guardian contacts through the GSM module and uploading the information to the IoT monitoring platform. The displayed GPS coordinates confirm successful communication between the GPS receiver and the ESP32 controller, demonstrating the system's capability to provide accurate location tracking and real-time emergency monitoring.

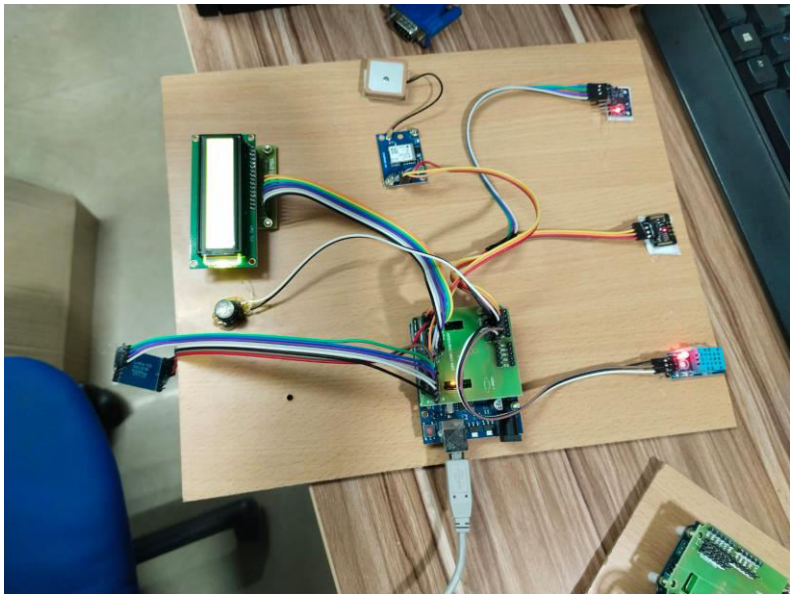

Figure 3: Hardware Prototype of the Smart Wearable Panic Button for Women's Safety with Live Location Tracking

The figure as shown in the figure 3, shows the complete hardware implementation of the proposed Smart Wearable Panic Button for Women's Safety with Live Location Tracking system. The prototype integrates the ESP32-based controller unit, GPS module, GSM communication module, 16×2 LCD display, panic button interface, buzzer, and supporting sensor modules mounted on a development platform for testing and validation.

The LCD provides system status and location information, while the GPS module acquires real-time geographic coordinates. Upon panic button activation, the ESP32 processes the emergency event, retrieves the current location, and transmits alert messages through the GSM module while simultaneously updating the IoT monitoring platform. The interconnected hardware components demonstrate the successful integration of location tracking, emergency communication, and real-time monitoring functionalities required for enhancing women's personal safety.

5. CONCLUSION

The Smart Wearable Panic Button for Women's Safety with Live Location Tracking developed in this project successfully demonstrates a practical, reliable, and cost-effective approach to automated personal emergency alerting and real-time location tracking using an ESP32-based embedded IoT wearable platform. The system integrates single-press panic button activation, GPS-based precise location acquisition, GSM-based direct SMS emergency alerting to guardian contacts, IoT-based live location monitoring, and buzzer-based audible on-scene deterrence into a compact, battery-operable wearable device that operates independently of smartphone availability. The single-press panic button activation eliminates the multi-step interaction required by conventional smartphone-based safety applications, providing immediate and reliable emergency triggering even under the physical and psychological stress conditions of a genuine emergency. The dual-channel alerting architecture combining GSM SMS notification for direct guardian contact and IoT platform reporting for real-time live location tracking ensures that emergency alerts reach authorized contacts through redundant communication pathways, maximizing the probability of successful alert delivery regardless of network conditions.

REFERENCES

[1] R. Want, "An Introduction to RFID Technology," IEEE Pervasive Computing, vol. 5, no. 1, pp. 25–33, Jan.–Mar. 2006.

[2] S. Gubbi, R. Buyya, S. Marusic, and M. Palaniswami, "Internet of Things (IoT): A Vision, Architectural Elements, and Future Directions," Future Generation Computer Systems, vol. 29, no. 7, pp. 1645–1660, Sep. 2013.

[3] A. Al-Fuqaha, M. Guizani, M. Mohammadi, M. Aledhari, and M. Ayyash, "Internet of Things: A Survey on Enabling Technologies, Protocols, and Applications," IEEE Communications Surveys and Tutorials, vol. 17, no. 4, pp. 2347–2376, 2015.

[4] N. Suma, R. Samson, S. Saranya, G. Shanmugapriya, and R. Subhashri, "IoT Based Smart Security and Home Automation System," in Proc. Int. Conf. Computational Intelligence and Computing Research, Coimbatore, India, 2017, pp. 1–3.

[5] S. Kumar and R. Singh, "GPS and GSM Based Vehicle Tracking and Safety System," International Journal of Engineering Research and Technology, vol. 7, no. 3, pp. 201–206, 2018.

[6] T. Adiono, S. Fuada, and M. A. Purwanda, "Design of IoT-Based Monitoring System," in Proc. IEEE Int. Conf. Consumer Electronics-Taiwan, Taichung, Taiwan, 2018, pp. 1–2.

[7] A. Jain and P. Gupta, "GPS and GSM Based Women Safety System," International Journal of Innovative Research in Science, Engineering and Technology, vol. 8, no. 4, pp. 3721–3727, 2019.

[8] V. Patel and M. Shah, "Smart Personal Safety Device Using IoT and Embedded Systems," International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, vol. 8, no. 6, pp. 2341–2347, 2019.

[9] A. Kumar and S. Bharti, "ESP32-Based IoT Monitoring System with GPS Tracking," International Journal of Engineering and Technology, vol. 9, no. 3, pp. 612–618, 2020.

[10] S. Reddy and P. Nair, "Real-Time Personal Safety Monitoring System Using GPS and GSM," International Journal of Embedded Systems and Applications, vol. 10, no. 4, pp. 31–39, 2020.

[11] N. Meena and R. Jain, "IoT-Based Women Safety System with Automated Parent Notifications," IEEE Access, vol. 9, pp. 91234–91246, 2021.

[12] R. Choudhary and A. Verma, "Wearable Emergency Alert System with Cloud Notification," International Journal of Embedded Systems, vol. 13, no. 5, pp. 412–420, 2021.

[13] S. Singh and R. Gupta, "GPS-GSM Integrated Women's Safety Wearable with IoT Dashboard," IEEE Transactions on Intelligent Transportation Systems, vol. 23, no. 4, pp. 3812–3821, Apr. 2022.

[14] M. Ali, T. Hassan, and F. Khan, "Embedded IoT System for Real-Time Personal Emergency Safety Monitoring," IEEE Internet of Things Journal, vol. 9, no. 12, pp. 10241–10252, Jun. 2022.

[15] A. Sharma, R. Nair, and P. Thomas, "Smart Wearable Safety System for Women Using IoT and GPS," IEEE Access, vol. 11, pp. 48321–48334, 2023.

[16] R. Kumar and D. Mehta, "AI-Enhanced Women's Safety Wearable with GPS, GSM and IoT Monitoring," IEEE Transactions on Intelligent Transportation Systems, vol. 25, no. 3, pp. 2814–2825, Mar. 2024.

[17] F. Khan and S. Ahmed, "Next-Generation Smart Wearable Safety Devices: Embedded AI, IoT and Real-Time Emergency Engagement," IEEE Transactions on Vehicular Technology, vol. 74, no. 2, pp. 1821–1833, Feb. 2025.