

# IoT Driven Women Safety Device Using ESP32 with Health Monitoring and GPS Based Alert System

Prashanth Chittireddy<sup>1\*</sup>, Chowghani Supriya<sup>2</sup>, Dulam Sagar<sup>2</sup>, Ravalakollu Sri Harsha Manoj<sup>2</sup>

<sup>1</sup>Assistant Professor, <sup>2</sup>UG Student, <sup>1,2</sup>Department of Electronics & Communication Engineering

<sup>1,2</sup>Vaagdevi Engineering College, Bollikunta, Warangal, 506005, Telangana, India.

\*Correspondence: Prashanth Chittireddy (Chittireddy924@gmail.com)

## Abstract

The increasing concerns over women's safety have become a global issue, with reports indicating that nearly 1 in 3 women experience violence in their lifetime and emergency response delays contributing significantly to risk escalation, while IoT-based safety systems are projected to grow at over 18% annually. These environments demand reliable, portable, and automated solutions capable of detecting distress situations and ensuring timely intervention. Traditional safety approaches rely on manual communication, mobile apps, or helplines, which may fail during critical situations due to delayed response, lack of immediate location tracking, or user incapability to seek help. Furthermore, conventional systems lack integrated health monitoring, predictive alerts, and real-time connectivity, reducing their effectiveness in emergency scenarios. To address these challenges, the proposed Women Shield: IoT Women Safety Predictive Real-Time Auspicious Security System utilizes the ESP32 microcontroller to implement an intelligent, multi-sensor-based safety framework. The system integrates SPO2 monitoring, temperature sensing, and vibration-based fall detection to continuously assess the user's condition. When abnormal parameters are detected, the system automatically triggers alerts through a buzzer, GSM-based SMS, and IoT cloud platforms, transmitting real-time GPS location to emergency contacts and authorities. A dedicated panic switch provides instant manual alert activation, ensuring immediate response during critical situations. This comprehensive system enhances personal safety, enables rapid emergency assistance, and provides a scalable, cost-effective solution for women's security, while also being adaptable for child and elderly safety applications.

**Keywords:** Emergency Alert System, ESP32, GPS Tracking, GSM Communication, Health Monitoring, Internet of Things, Personal Safety Device, Smart Wearable Safety, Vibration Sensor

## 1. Introduction

The increasing concerns over women's safety have emerged as a critical global issue, with studies indicating that nearly 1 in 3 women experience some form of violence during their lifetime [1]. Delays in emergency response and lack of immediate assistance often contribute significantly to the escalation of risk in such situations [2]. At the same time, the adoption of smart safety technologies is accelerating, with IoT-based safety systems projected to grow at over 18% annually, reflecting the urgent need for intelligent and connected protection mechanisms [3]. In modern environments such as urban commuting, workplaces, educational institutions, public transport, and isolated areas,

there is a strong demand for systems that provide real-time monitoring, instant alerts, and location tracking to ensure user safety and rapid intervention.

Traditional safety approaches primarily rely on manual communication methods such as mobile phone calls, safety apps, or emergency helplines. While these methods offer basic support, they often fail during critical situations where the user may be unable to operate a device or communicate effectively. Additionally, such systems typically lack continuous monitoring and automated alert mechanisms, making them dependent on user initiation [4]. Conventional solutions also do not integrate health monitoring or

environmental sensing, limiting their ability to detect distress conditions proactively. The absence of real-time connectivity and automated response reduces their effectiveness in providing immediate assistance during emergencies.

In real-time scenarios, these limitations lead to several serious challenges that compromise personal safety [5]. Delayed alerts and lack of precise location tracking can prevent timely intervention, increasing the severity of incidents. Situations such as sudden health issues, physical attacks, or accidental falls may go undetected without continuous monitoring systems. Furthermore, reliance on manual activation may not be feasible in high-risk situations, reducing the chances of receiving help [6]. The absence of predictive analysis and automated alerts further limits the ability to prevent or respond quickly to threats. These challenges highlight the need for an intelligent, IoT-based safety system capable of continuous health monitoring [7], automatic alert generation, real-time GPS tracking, and instant communication, thereby enhancing personal security, ensuring rapid emergency response, and supporting safer living environments.

## 2. Literature Survey

Priyanka et al. [8] proposed the SALVUS women safety device that integrated sensors and communication modules to send emergency alerts and location information during distress situations. Rai et al. [9] proposed the ReachOut smart safety device that provided real-time alert transmission and location tracking using embedded communication technologies.

Sogi et al. [10] proposed SMARISA, a Raspberry Pi-based smart ring for women safety using Internet of Things (IoT) technology for real-time monitoring and alert generation. Punjabi et al. [11] proposed a smart intelligent system for women and child security that integrated sensors and communication modules for continuous monitoring and emergency alerting.

Sen et al. [12] proposed ProTecht, an IoT-based three-way women safety device that enabled multiple alert mechanisms including SMS, location sharing, and emergency triggers. Thamaraiselvi et al. [13] proposed an IoT-based smart band for women safety that enabled wearable monitoring and instant alert transmission during emergencies.

Tejonidhi et al. [14] proposed an IoT-based smart security gadget for women that integrated sensors and communication modules for real-time safety monitoring. Sharma et al. [15] proposed a smart shoe for women safety that incorporated embedded sensors and communication modules to trigger alerts during emergency situations.

Islam et al. [16] proposed a women auspice system using Global Positioning System (GPS) and Global System for Mobile Communications (GSM) technologies for real-time location tracking and emergency alerting. Ruman et al. [17] proposed a safety assistant system for harassment prevention that integrated alert mechanisms and communication features for user protection. Hyndavi et al. [18] proposed a smart wearable device for women safety using IoT that enabled continuous monitoring, alert generation, and location tracking. The system enhanced safety through connected wearable technology. The system required stable internet connectivity.

## 3. Proposed System

Figure 1 illustrates the architecture of the Women Shield. The system integrates multiple safety and health monitoring inputs such as GPS for real-time location tracking, SPO2 sensor for physiological monitoring, temperature sensor, fall detection sensor, and a panic switch for emergency activation. A regulated power supply (RPS) ensures stable operation. The ESP32 processes all inputs using embedded logic to detect abnormal or emergency conditions and triggers outputs including LCD display, buzzer alerts, GSM communication for emergency messaging, and IoT connectivity for remote monitoring. This

integrated system provides proactive, real-time safety, health awareness, and rapid emergency response for women.

**Step 1: Power Supply Initialization:** The regulated power supply (RPS) delivers stable DC voltage to the ESP32 and all connected sensors and modules, ensuring uninterrupted system functionality.

**Step 2: Multi-Sensor Data Acquisition:** The system continuously collects data from multiple sensors. The GPS module tracks real-time location, the SPO2 sensor monitors oxygen levels, the temperature sensor measures body temperature, the fall detection sensor identifies sudden falls or abnormal motion, and the panic switch allows the user to manually trigger an emergency alert.

**Step 3: Intelligent Processing Using ESP32:** The ESP32 processes all incoming data and applies embedded logic to identify potential threats such as abnormal health conditions, sudden falls, or emergency button activation.

This enables predictive and real-time safety monitoring.

**Step 4: Local Display via LCD:** The LCD module displays real-time information such as health parameters, system status, and alert messages, providing immediate feedback to the user.

**Step 5: Emergency Alert via Buzzer:** In case of danger or abnormal conditions, the buzzer is activated to provide an audible alert, helping to attract nearby attention for immediate assistance.

**Step 6: GSM-Based Emergency Communication:** The GSM module sends instant SMS alerts to predefined emergency contacts, including location details and alert type, ensuring rapid response from family members or authorities.

**Step 7: IoT-Based Remote Monitoring:** The ESP32 transmits real-time data to a cloud platform via IoT connectivity. This allows continuous monitoring, alert tracking, and data analysis through mobile or web applications.

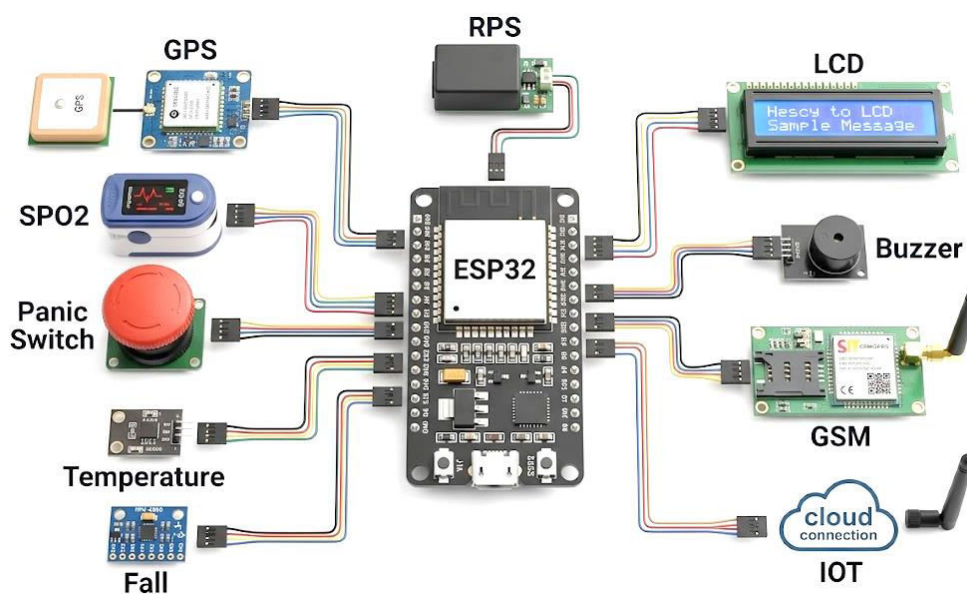


Figure 1. Proposed System

### 3.1 Working Procedure

Figure 2 illustrates the circuit diagram of an ESP32-based IoT women safety predictive system designed to enhance personal security through real-time monitoring and emergency

response. The system is powered by a regulated power supply unit consisting of a step-down transformer, bridge rectifier, filter capacitors, and a 7805-voltage regulator to provide a stable +5V output. The ESP32 microcontroller acts as

the central processing unit, interfacing with multiple sensors such as a SpO2 and temperature sensor for health monitoring, a fall detection sensor and panic switch for emergency triggering, and a GPS module for real-time location tracking. A GSM module is integrated to send alert messages and location details to predefine contacts during emergencies, while an IoT module enables remote monitoring and data transmission to cloud platforms. The system also includes a 16x2 LCD to display real-time status and sensor readings, along with a buzzer for immediate audible alerts. This integrated design ensures proactive safety by combining predictive monitoring, instant alert mechanisms, and continuous tracking, making it suitable for personal security applications.

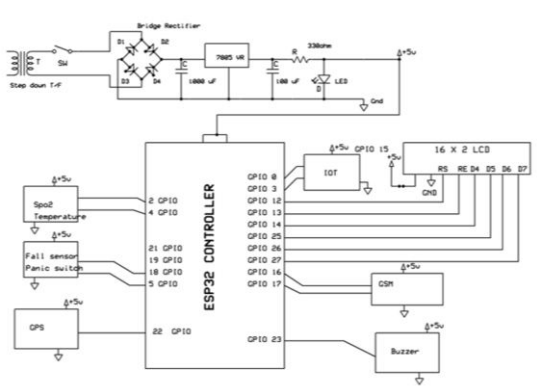


Figure 2. Circuit Diagram of ESP32-Based IoT Women Safety Predictive System

The flow diagram as shown in Figure 3 represents a health monitoring and emergency alert system centered around the ESP32 microcontroller. It integrates various input sensors, including GPS for location tracking, SPO2 for oxygen level monitoring, a panic switch for emergency alerts, a temperature sensor for body temperature measurement, and a fall detection sensor for identifying sudden falls. The system is powered by a regulated power supply (RPS) to ensure stable operation. The ESP32 processes the collected data and sends alerts through output modules such as an LCD for real-time display, a buzzer for immediate notifications, a GSM module for message-based alerts, and an IoT module for

remote monitoring and cloud integration. This setup enhances real-time health tracking and emergency response, making it an efficient solution for patient care and safety.

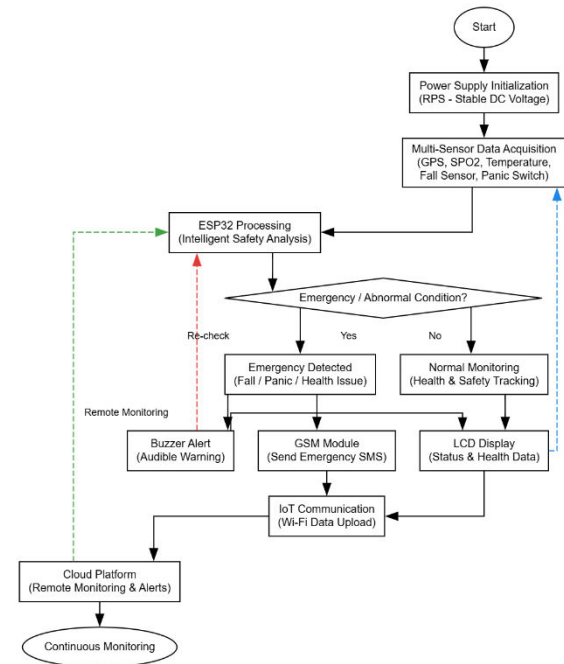


Figure 3. Working Flowchart.

#### 4. Results and Discussion

Figure 4 illustrates the complete hardware implementation of the IoT-based woman security system. The setup consists of a microcontroller unit, GPS module for location tracking, GSM module for communication, buzzer for alert generation, temperature and heartbeat sensors, and an LCD display for real-time monitoring. The system is powered through a regulated power supply, ensuring stable voltage distribution across all components. The interconnected modules enable continuous monitoring of physiological parameters and environmental conditions, while also facilitating emergency alert transmission when required.

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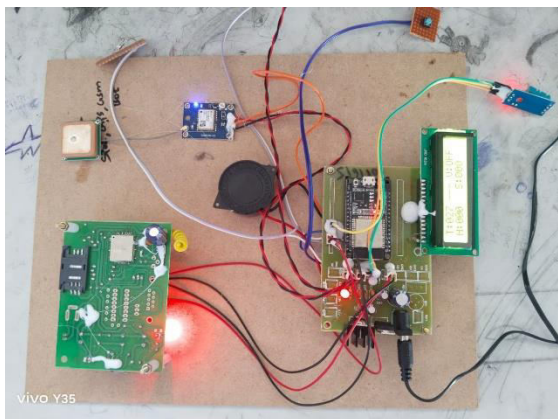


Figure 4: Hardware Setup of IoT-Based Woman Security System



Figure 5. LCD Display Showing System Initialization Message.

Figure 7 presents the real-time sensor readings displayed on the LCD module. The screen shows parameters such as temperature (T), vibration status (V), heartbeat rate (H), and SpO2 level (S). These values are continuously monitored by the system to assess the user's condition. If any abnormality is detected, such as unusual heart rate or activation of panic conditions, the system can trigger alerts and initiate communication through GSM and GPS modules.



Figure 6. LCD Display Showing Real-Time Sensor Parameters

Figure 7 shows the web-based monitoring dashboard where the collected data is stored and displayed in tabular form. The table includes parameters such as temperature, heartbeat, SpO2, panic status, vibration status, location, and timestamp. Each entry represents a recorded instance of sensor data, enabling continuous tracking and analysis. This centralized monitoring system enhances safety by allowing remote supervision and quick response during emergency situations.

S.No	Temperature	Heart_Rate	SPO2	Panic	Vib_Status	Location	Date
1	28.00	83	94	---	OFF	Location	2026-02-10 18:28:31
2	28.00	0	0	---	ON	Location	2026-02-10 18:27:37
3	28.00	0	0	---	ON	Location	2026-02-10 18:26:48
4	28.00	0	0	---	ON	Location	2026-02-10 18:25:48
5	28.20	0	0	---	ON	Location	2026-02-10 18:24:59
6	28.20	0	0	Panic	OFF	Location	2026-02-10 18:24:11
7	28.00	0	0	---	OFF	Location	2026-02-10 18:23:33
8	27.70	0	0	---	OFF	Location	2026-02-10 18:16:56
9	28.50	0	0	---	ON	Location	2026-02-10 18:13:41
10	29.50	0	0	Panic	OFF	Location	2026-02-10 18:12:28
11	27.30	71	0	---	ON	Location	2026-02-10 18:10:07
12	26.10	78	93	---	ON	Location	2026-02-05 18:44:54
13	27.10	0	0	---	OFF	Location	2026-01-30 15:47:06
14	27.10	87	95	Panic	OFF	Location	2026-01-30 15:46:19
15	27.00	79	98	---	ON	Location	2026-01-30 15:45:00
16	27.00	82	100	---	ON	Location	2026-01-30 15:43:20

Figure 7. IoT Based Monitoring Dashboard of Collected Data

### 5. Conclusion

The proposed System offers a comprehensive and intelligent solution to address growing concerns over personal safety by integrating real-time monitoring, automated alert mechanisms, and IoT connectivity. By utilizing the ESP32 microcontroller along with SPO2, temperature, and vibration sensors, the system continuously evaluates the user's physical condition and detects potential distress situations such as falls or health abnormalities. The automatic triggering of alerts through

buzzer notifications, GSM-based SMS, and IoT cloud platforms ensures rapid communication of emergencies along with precise GPS location to predefined contacts and authorities. Additionally, the inclusion of a manual panic switch provides immediate user-initiated assistance during critical situations. This system overcomes the limitations of traditional safety methods by enabling proactive, real-time, and automated responses, thereby reducing dependency on manual intervention. Overall, it enhances personal security, ensures faster emergency response, and contributes to the development of smart, reliable, and scalable safety solutions for women, as well as adaptable applications for children and the elderly.

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