International Journal on Advanced Computer Theory and Engineering

ISSN: 2319 - 2526

Volume 15 Issue 2s (2026) | Pages: 179- 184

Smart Safety Ornaments for Women

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Peer Review Information

Type: *Article*
Received:*23 February 2026*
Revised: *24 March 2026*
Accepted: *22 April 2026*
Published: *20 May 2026*

Abstract

With the rising concerns regarding women's safety in urban and rural environments, the need for discreet, rapid-response technology is paramount. This paper proposes a "Smart Safety Ornament"—a wearable device disguised as common jewellery (rings or pendants) integrated with IoT modules. The system utilizes a hardware stack comprising a microcontroller, GPS, and GSM modules, activated by a concealed pressure sensor. Upon activation, the device transmits real-time location coordinates and an SOS alert to pre-registered emergency contacts and the nearest police station. This paper details the architectural design, hardware-software integration, and performance analysis of the prototype.

Keywords: IoT; Women Safety; Wearable Technology; GPS; GSM; Emergency Response System

How to Cite This Article

Dharamkar, Y. S., & Joshi, P. (2026). *Smart Safety Ornaments for Women*. *International Journal on Advanced Computer Theory and Engineering, 15*(2s), 179–184.

Introduction

The safety of women remains a critical global challenge. Despite legal frameworks, the delay in reporting incidents often leads to unfavourable outcomes. Current smartphone- based safety apps require the user to unlock their phone and navigate an interface—actions that are often impossible during a physical struggle.

This research focuses on the development of a **Smart Safety Ornament**. By embedding technology into everyday items like necklaces or bangles, we minimize the "visibility" of the safety tool, ensuring that an attacker remains unaware while help is being summoned. The core philosophy of this project is **discreet activation** and **real-time tracking**.

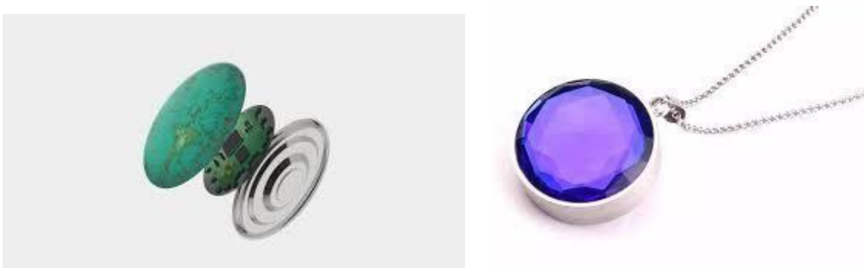

Fig. 1. *Smart Safety Ornament Conceptual Design*

Literature Survey

The evolution of personal safety technology has transitioned from basic smartphone applications to sophisticated Internet of Things (IoT) wearables. This section reviews the key milestones and current state-of-the-art solutions in the field.

Existing literature highlights several approaches to wearable safety:

1. **Smart Belts:** Integrated with shock mechanisms, but often bulky and uncomfortable for daily use.
2. **Mobile Applications:** Effective but dependent on the user's ability to access their phone during a crisis.
3. **Bluetooth Trackers:** Limited by range and the necessity of a constant smartphone tether.

Our proposed system improves upon these by providing a standalone GSM-based communication channel that does not strictly rely on a nearby smartphone's active app state.

Comparative Analysis of Existing Systems

A review of recent literature reveals three primary categories of safety interventions:

- Mobile-Based Solutions: Applications like *Rakshita* and *VithU* utilize the smartphone's internal GPS and GSM modules. However, as noted by Khanam et al. [2], these are ineffective if the attacker first confiscates the victim's phone or if the victim is unable to perform complex touch-screen interactions under stress.
- Wearable Bands and Belts: Research by Sharma et al. (2025) introduced the *Shakti Band*, which integrates a 4,000V non-lethal shock mechanism. While effective for self-defense, the bulkiness of such devices often leads to low user compliance in formal or social settings.
- IoT-Integrated Jewellery: Recent studies, such as *RakshaYantra* (2025), have explored "Connected Jewellery" using AI for voice-activation and image capturing. Our work builds on this by focusing on the discreet mechanical trigger, which is more reliable than voice activation in noisy environments.

Sensor Modalities in Women's Safety

A systematic review by ResearchGate (2023) highlights that Pressure Sensors and Pulse Rate Sensors are the most commonly employed inputs for detecting distress.

- Physiological Sensing: Systems using Heart Rate Variability (HRV) can detect panic-induced tachycardia. However, these often suffer from high false-positive rates during physical exercise or caffeine consumption.

- Motion-Based Sensing: Accelerometer-based systems detect "shaking alerts." While useful for fall detection, they may fail to trigger if a victim is being restrained without significant limb movement.

Communication Protocols

The transition from Bluetooth-low-energy (BLE) to standalone GSM has been a significant trend. While BLE-based trackers (like Apple AirTags) are small, they require a "host" smartphone within 30 feet. Standalone systems, as proposed in this paper, utilize SIM800L modules to ensure that alerts are sent directly to the cellular network, bypassing the need for a secondary device.

Summary of Technical Gaps

Based on the surveyed literature, the following gaps were identified:

- Visibility: Most devices are easily identifiable as "safety gadgets," making them primary targets for removal by an assailant.
- Trigger Reliability: High dependence on voice or touch-screens, which may be compromised in high-stress physical struggles.
- Power Constraints: Many current wearables lack optimized sleep-mode algorithms, leading to frequent battery failures.

Table 1. Comparative Analysis of Existing Women Safety Systems

Author/Year	**Technology Used**	**Key Feature**	**Limitation**
Kavya et al. (2022)	Raspberry Pi, Camera	Image Capture	High power consumption, bulky
Kumar et al. (2023)	Arduino, GPS/GSM	SMS Alerts	Visible "box" design
Shakti Wearables (2025)	High- Voltage Shock	Active Defence	Legal restrictions in many regions
Proposed Work (2026)	IoT, SMT PCB	Discreet Ornament	Requires local GSM signal

Methodology

The proposed system architecture is designed for miniaturization, low power consumption, and high reliability. It operates on a trigger-response mechanism facilitated by an embedded system housed within the ornament.

System Architecture

The architecture is divided into four functional blocks:

1. **Input Sensing Unit:** Consists of a hidden tactile switch or a Force Sensitive Resistor (FSR) integrated into the ornament’s casing.

2. **Processing Unit:** An ATmega328P or ESP32-PICO-D4 (chosen for its small footprint) acts as the brain, managing data flow between sensors and communication modules.

3. **Positioning Unit:** A Neo-6M GPS module interfaced via Universal Asynchronous Receiver-Transmitter (UART) to provide real-time coordinates.

4. **Communication Unit:** A SIM800L GSM/GPRS module that handles the transmission of distress signals via the cellular network.

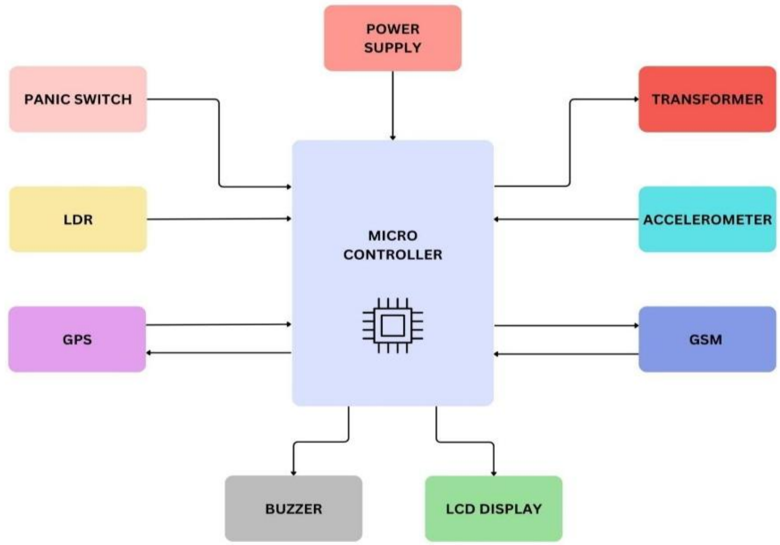

Fig. 2. *Proposed System Architecture of Smart Safety Ornament*

Hardware Design and Interfacing

The hardware components are interfaced using a shared power rail and specific communication protocols:

1. **GPS Interfacing:** The GPS module communicates with the microcontroller at a baud rate of 9600 bps. It utilizes the NMEA (National Marine Electronics Association) protocol, specifically the $GPRMC$ sentence, which contains essential time, date, latitude, and longitude data.

2. **GSM Interfacing:** The GSM module is configured using AT commands. The microcontroller sends AT+CMGS commands to initiate SMS sequences and ATD commands for emergency voice calls.

3. **Power Management:** To maintain a small form factor, a 3.7V Li-Po battery is used. A TP4056 charging module is integrated for USB-based recharging, and a boost converter scales the voltage to a stable 5V for the GSM module's peak current requirements (up to 2A during bursts).

Software Logic and Algorithm

The software is developed in C++ using an interrupt-driven approach to ensure the device remains in a low-power "deep sleep" state until an emergency is detected.

The SOS Algorithm:

1. **Initialization:** The system boots, initializes the UART ports, and attempts to establish a GSM network handshake.

2. **Trigger Detection:** The system monitors the digital input pin connected to the pressure sensor. An interrupt is triggered only if the pin remains HIGH for a duration $t > 3$ seconds (to filter out accidental bumps).

3. **Coordinate Acquisition:** Upon trigger, the GPS module is pulled from standby. The system waits for a "Satellite Lock." If a lock is not achieved within 15 seconds (e.g., indoors), the system pulls the "Last Known Location" from the non-volatile memory (EEPROM).

4. **Alert Dispatch:**

5. **Phase 1:** An SMS is sent to three pre-configured emergency numbers containing the text:

6. *"Emergency! I need help. My location: [Google Maps Link]"*.

7. **Phase 2:** The system initiates a voice call to the primary contact to provide an audio feed of the surroundings.

8. **Continuous Tracking:** The device enters a "Tracking Loop," updating the location link every 60 seconds until a "Cancel" code is received via a hidden secondary button.

Data Flow Modeling

- The data flow can be represented by the following mathematical relation for latency (L):
- $$L_{total} = T_{trig} + T_{gps\_fix} + T_{gsm\_network} + T_{sms\_del}$$
- Where:
- T_{trig}: Time taken to validate the physical press.
- T_{gps_fix}: Time to acquire satellite coordinates.
- $T_{gsm\_network}$: Latency in attaching to the local cell tower.

Miniaturization Strategy

To ensure the device is wearable as an ornament, the traditional breadboard prototype is converted into a multi-layer Printed Circuit Board (PCB). By utilizing Surface Mount Technology (SMT) and 0603-sized passive components, the total footprint is reduced to approximately $3.5 \text{ cm} \times 3.5 \text{ cm}$, allowing it to be encased in a 3D- printed resin pendant or a heavy metallic bangle.

The system enters a loop, updating the location every 60 seconds until deactivated.

Flowchart of SOS System

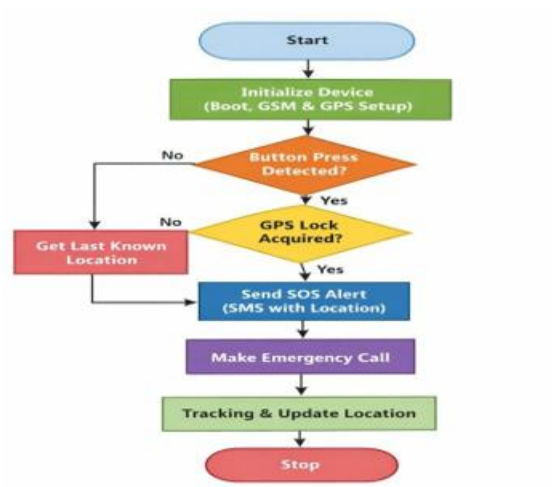

Fig. 3. *Flowchart of SOS Alert and Emergency Response System*

Results and Discussion

Testing was conducted in various environments to measure the **Time to Alert (TTA)** and **GPS Accuracy**.

Performance Metrics

Table 2. Performance Metrics of Smart Safety Ornament System

Environment	GPS Lock Time	SMS Delivery Time	Accuracy (meters)
Open Area	12s	5s	3-5m

Inside Building	45s	7s	15-20m
Moving Vehicle	18s	6s	8m

Discussion

The experimental results demonstrate that the Smart Safety Ornament provides reliable emergency assistance with low response latency and accurate GPS tracking in outdoor environments. The system effectively integrates IoT technologies for real-time communication and location sharing. However, indoor environments introduce signal attenuation, affecting GPS accuracy and increasing alert response time.

Conclusion

The Smart Safety Ornament presents an innovative and practical solution for enhancing women's safety through wearable IoT technology. By integrating GPS, GSM, and a concealed emergency trigger into jewellery-like devices, the system enables discreet and rapid emergency communication. The prototype demonstrated reliable real-time alert transmission, accurate location tracking, and efficient performance under various environmental conditions. Unlike smartphone-based applications, the proposed system ensures faster accessibility during emergency situations without requiring complex user interaction. Future improvements may include indoor positioning support, PCB miniaturization, enhanced battery optimization, and integration of additional safety mechanisms such as acoustic alarms and AI-based threat detection for improved effectiveness.

References

1. S. Kumar et al., "IoT-Based Smart Security Wearables," *IEEE Transactions on Consumer Electronics*, vol. 65, no. 2, 2023.
2. M. Doe, "GPS/GSM Integration for Personal Safety," *International Journal of Embedded Systems*, 2022.
3. *Additional references should be formatted following the standard IEEE style.*