Women's Safety Device Using IOT

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ABSTRACT

The increasing rate of crimes against women highlights the urgent need for innovative technological solutions that ensure their safety. This paper presents a smart, wearable safety device leveraging Internet of Things (IoT) technologies to provide real-time assistance during distress situations. The device is equipped with a GPS module for location tracking, emergency alert systems, and a buzzer for nearby attention. The compact design, low power consumption, and cost-effectiveness of the prototype make it suitable for daily use. This device exemplifies how IoT can be harnessed to create responsive, accessible safety solutions for women, contributing toward a safer society.

Keywords : Emergency alert, GPS, IoT, women's safety

1.INTRODUCTION

In recent years, the safety of women has become a major concern globally, especially in developing countries where crime rates against women have seen a consistent rise. Traditional safety measures such as mobile-based applications or emergency helplines have shown limited effectiveness due to their reliance on the victim's ability to access and operate a smartphone during distress. Advancements in the Internet of Things (IoT) offer a promising opportunity to design proactive, real-time safety solutions. We propose a wearable IoT-based women's safety device that can operate independently and assist victims by instantly notifying trusted contacts and authorities when a threat is detected.

2. BODY OF THE PAPER

2.1 METHODOLOGY

The proposed Women's Safety Device is an IoT-enabled wearable system designed to provide real-time emergency assistance through integrated sensors, communication modules, and alert mechanisms. The step-by-step methodology is as follows:

A. Module Initialization:

When powered on, the microcontroller initializes all connected modules including the GPS, GSM, sensors, and buzzer. The system enters a continuous monitoring state, ensuring readiness for emergency activation at any moment.

B. Monitoring and Trigger Detection:

The device consistently monitors user input through a dedicated emergency push button and connected sensors (e.g., accelerometer, pressure sensor). Upon detecting a manual button press or abnormal motion pattern, the system recognizes it as a distress signal.

C. Location Fetching via GPS Module:

Once triggered, the GPS module activates and fetches the real-time location coordinates (latitude and longitude) of the user. These coordinates are formatted into a clickable Google Maps link for easy navigation by responders.

D. Emergency Alert Transmission:

The GSM module is immediately triggered to send an SMS alert to a list of pre-stored emergency contacts. The alert includes a custom message and the user's current location, enabling quick assistance from family or authorities.

E. Local Alert Activation:

Simultaneously, the device activates an onboard buzzer to alert nearby individuals in the vicinity. This helps in attracting immediate local attention and deterring the perpetrator in certain cases.

F. Manual Recovery and Reset:

The system remains active until manually reset by the user or an authorized person. This ensures the alert is not prematurely terminated and provides adequate time for response and resolution of the emergency situation.

G. Power Management and Portability:

The device is designed to consume minimal power, with an efficient circuit layout and low-power components to ensure prolonged battery life. Its compact form factor allows it to be worn discreetly, ensuring both comfort and usability for women in daily life.

2.2 TECHNOLOGY USED

1. Embedded Hardware Components:

- **Arduino Nano / ESP32: Serves as the core microcontroller unit responsible for interfacing with sensors, GPS, GSM modules, and managing input/output operations.**
- **Panic Button (Push Switch): Used by the user to manually trigger the emergency alert system when in distress.**
- **GPS Module (e.g., NEO-6M): Provides real-time geolocation data (latitude and longitude) to accurately pinpoint the user's location during emergencies.**
- **GSM Module (e.g., SIM800L): Enables SMS-based communication with preconfigured emergency contacts by sending alert messages containing the user's location.**
- **Buzzer: Produces a loud audible sound when triggered, drawing immediate attention from nearby people.**

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2. Sensors and Monitoring:

- **Accelerometer / Vibration Sensor: Detects sudden abnormal movements such as falls or physical assault, which can be configured to automatically trigger the alert system without user intervention.**

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3. Software and Communication Protocols:

- **Embedded C / Arduino IDE: Programming language and development environment used to write, upload, and debug the code running on the microcontroller.**
- **AT Commands: Used for communication between the microcontroller and GSM module to send SMS alerts via mobile networks.**
- **UART Protocol: Facilitates serial communication between modules (e.g., GPS ↔ Microcontroller, GSM ↔ Microcontroller).**

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4. Power Supply:

- **Rechargeable Li-Ion Battery (3.7V): Provides portable and long-lasting power to ensure the device remains operational throughout the day.**
- **Voltage Regulator Circuit: Ensures consistent and safe voltage levels to all electronic components, preventing damage due to power fluctuations.**

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5. Optional Enhancements:

- **Bluetooth / Wi-Fi Module (ESP32 only): For future upgrades involving mobile app integration, OTA updates, or advanced communication features.**
- **OLED Display (optional): Can be used for showing real-time location, battery status, or alert confirmation.**

2.3 RESULTS AND DISCUSSIONS

.A. GPS Location Accuracy

The GPS module (NEO-6M) was tested in both open outdoor environments and semi-obstructed urban areas.

In open areas, the system achieved a location accuracy of approximately **3–5 meters**, ensuring precise geolocation for emergency response. Indoor performance showed a slight drop in accuracy due to satellite visibility limitations, which can be mitigated in future versions using hybrid location services.

B. Alert Trigger Response Time

The emergency alert mechanism was activated manually via button press and automatically through simulated sensor input.

- **Buzzer Activation Time:** ~1 second
- **GPS Fix and Location Fetching:** 2–4 seconds on average
- **GSM SMS Transmission Time:** ~2 seconds after GPS data acquisition Overall, the end-to-end alerting process was completed within **5–8 seconds**, proving to be quick and effective for real-time situations.

C. GSM Module Performance

The SIM800L GSM module reliably sent SMS messages containing emergency alerts and real-time location data. Testing across different network providers showed consistent delivery rates with negligible failure instances. Messages were received within **2–3 seconds** after transmission under normal network conditions.

D. Sensor Sensitivity and Accuracy

The accelerometer-based sensor triggered alerts during sudden motion events, such as simulated falls or aggressive shaking. False positives were minimal when properly calibrated. The sensitivity threshold can be dynamically adjusted depending on user preference in future enhancements.

E. Power Efficiency and Device Uptime

Using a 3.7V 1200mAh Li-Ion battery, the device functioned continuously in monitoring mode for **12–14 hours** on a single charge. In idle state with deep sleep optimizations, standby time can be extended to **over 24 hours**, making it practical for daily use.

F. User Experience and Portability

Test users reported that the device was lightweight, wearable, and easy to operate. The single-button interface allowed instant action without needing technical knowledge or smartphone assistance. The loudness of the buzzer (~90 dB) was sufficient to attract attention in public spaces.

G. System Limitations and Future Improvements

Although the device performed well in outdoor and semi-urban conditions, performance in dense indoor areas can be enhanced using Wi-Fi-based geolocation or integration with a mobile application. Future iterations may also incorporate automatic SOS calling, voice recording, and panic-based video streaming features.

3. CONCLUSION

The proposed IoT-based Women's Safety Device successfully demonstrates how embedded systems and real-time communication technologies can be effectively integrated to enhance personal safety. The combination of GPS-based location tracking, GSM-based emergency messaging, sensor monitoring, and audible local alerts ensures rapid response in critical situations. The device is compact, cost-effective, power-efficient, and user-friendly, making it suitable for day-to-day use by women across diverse environments, including rural and urban areas.

The system minimizes reliance on smartphones and complex applications, providing a standalone emergency solution. Experimental evaluations confirmed the reliability of GPS tracking, quick SMS alert delivery, and high user acceptability in terms of comfort and functionality. While the current prototype focuses on essential emergency features, future enhancements such as app integration, indoor navigation, and multimedia recording could further strengthen the solution and widen its adoption.

This project not only addresses a pressing social issue but also sets a strong foundation for future innovations in wearable safety technology driven by IoT.

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