International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 04 Issue: 01 January 2026
Page No: 213-217
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2026.0029

Shesecure: An RF & GPS Based Distress Response Framework Using Smart Poles

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Abstract
The SheSecure project is an RF and GPS-based women safety alert system designed to provide immediate emergency assistance in distress situations. It leverages a portable RF-enabled transmitter (remote) that can be discreetly carried by a user. When the button on the remote is pressed, it wirelessly transmits an alert signal to strategically placed Smart Poles equipped with RF receivers, GPS modules, and GSM modules. Upon receiving the signal, the Smart Pole fetches the GPS coordinates and sends them via SMS to pre-configured emergency contacts. The system operates without requiring internet connectivity, making it highly reliable in areas with poor network coverage. The primary goal is to offer a low-cost, fast-response safety mechanism that can be deployed in urban and rural regions. The hardware setup includes ESP32 microcontrollers, 433 MHz RF modules, GPS, and GSM devices, while the software involves Arduino-based programming. This project addresses critical safety challenges, especially for women, by ensuring quick communication with authorities and nearby responders. By integrating IoT concepts with traditional communication modules, SheSecure aims to provide a robust, scalable, and efficient safety infrastructure adaptable to various public spaces.

Keywords: *Women Safety, IoT, RF Communication, GPS, GSM, Smart Poles.*

1. Introduction
In the era of rapid technological advancement, engineering solutions are increasingly expected to be innovative, efficient, and socially impactful. This project, titled "SheSecure: An RF & GPS-Based Distress Response Framework Using Smart Poles", is designed to address a specific challenge in the domain of Computer Networks, IoT, Embedded Systems, etc. The primary motivation behind this project stems from the need to solve real-world problems through practical application of engineering principles and tools. With growing demands in the field of IoT, Safety & Security, there is a need for systems that are not only technically sound but also optimized for performance, scalability, and cost-effectiveness. SheSecure is a smart, offline women safety alert system designed to respond instantly in emergency situations. It eliminates the need for smartphones and internet connectivity, making it highly suitable for deployment in public spaces, isolated areas, and rural zones. The system enables women to press a compact RF remote during distress, which sends a signal to a nearby Smart Pole. This pole, embedded with GPS and GSM modules, fetches its coordinates and sends them via SMS to pre-registered emergency contacts. Simultaneously, a buzzer and LED indicator activate to alert the nearby public. The idea is to offer a fast, discreet, and affordable response mechanism in situations where mobile phones may be inaccessible. The innovation lies in combining offline RF

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transmission with GPS-based tracking and GSM messaging [1]. Most systems today rely on mobile apps or internet access. SheSecure, on the other hand, uses low-cost modules like Arduino/ESP32, RF transmitter-receiver pairs, NEO-6M GPS, and SIM800L GSM, to make a self-reliant emergency alert system that functions independently of external services Shown in Table 1.

2. Objectives

- To design and simulate both transmitter and receiver modules of the SheSecure system using platforms such as Wokwi or Circuit Design IDE, ensuring reliable communication and validating the complete workflow before hardware implementation.
- To implement the hardware of the remote (transmitter unit) consisting of a push-button panic switch, RF transmitter, and GPS integration, providing a compact, portable, and user-friendly device for distress alert activation.
- To develop the hardware of the Smart Pole (receiver unit) equipped with an RF receiver, buzzer, LED indicators, and GSM/GPS support, enabling instant local alerts and emergency communication in public spaces.

3. Review of Literature / Related Work

Table 1 Review of Literature / Related Work

Sr no.	Area of Research	Contribution	Reference
1	Women Safety Device with Panic Button & Camera	Created a wearable panic device that sends GPS-based SMS alerts and captures camera images for evidence.	C. M. Maind et al. (2025)
2	Wearable Safety Band with Buzzer & GSM	Developed a wearable band with GPS and GSM that activates a buzzer and sends location alerts when triggered.	H. Rao et al. (2023)
3	Compact GSM-GPS Keychain Panic Button	Introduced a small panic button device that sends SMS alerts with location to emergency contacts when pressed.	Patil et al. (2021)
4	Mobile App with Cloud Data Storage	Created a women safety mobile app that shares live GPS location and stores previous alerts in the cloud for record keeping.	Nair et al. (2020)
5	GSM & GPS Based Force Sensor Device	Proposed a compact women safety device activated by force sensors to send distress messages with GPS coordinates automatically	M. P. Thaware et al. (2017)

4. Background Concepts

SheSecure integrates key IoT communication technologies including Radio Frequency (RF) signaling, GPS location tracking, and GSM messaging. RF communication operates at 433 MHz to provide short-range wireless transmission between the portable transmitter and Smart Pole receivers. The GPS module (Neo-6M) retrieves precise geographic coordinates, while the GSM module (SIM800L) transmits location-linked alerts to emergency contacts via SMS. The system operates independently of the internet, ensuring reliability even in remote or low-signal areas. The ESP32 and Arduino microcontrollers serve as the core control units, handling sensor input, communication logic, and system integration [2].

5. Proposed Methodology

The SheSecure framework consists of two main components: Transmitter Unit (user device) and the Receiver Unit (Smart Pole). In emergencies, the user

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presses a panic button on the transmitter, which sends an encoded RF distress signal to nearby Smart Poles. The receiver continuously monitors RF channels, and upon detecting a valid signal, activates LED indicators and a buzzer for local alert. Simultaneously, the GPS module fetches the current coordinates, and the GSM module sends an SMS to preconfigured emergency contacts [3].

5.1 Transmitter Side (User Device)

- The user carries a small, battery-powered device containing either an Arduino Nano or ESP32 with a 433 MHz RF transmitter.
- In an emergency, pressing the panic button sends a coded RF distress signal wirelessly to nearby Smart Poles.
- The use of RF ensures instant transmission without internet dependency.

5.2 Receiver Side (Smart Pole)

- A Smart Pole equipped with an RF receiver module connected to Arduino Mega or ESP32 continuously listens for incoming distress signals.
- On receiving a valid signal, the microcontroller activates LEDs and a buzzer for local alerts.
- The Neo-6M GPS module fetches the exact location of the pole.
- The SIM800L GSM module sends SMS alerts to predefined emergency contacts containing the location link.

6. Implementation

6.1 Software Requirements

- **Wokwi :** to simulate Arduino/ESP32 with RF, GPS, and GSM modules virtually.
- **Circuit Design IDE:** for detailed breadboard and PCB wiring simulations with component-level accuracy.
- **SimulIDE:** for basic microcontroller and component testing [4].

6.2 Hardware Requirements

- Transmitter (User Device):
- Arduino Nano / ESP32
- 433 MHz RF Transmitter Module
- Push button (panic trigger)
- 9V battery or Li-ion rechargeable battery
- Compact enclosure

6.3 Receiver (Smart Pole)

- Arduino Mega / ESP32433 MHz RF Receiver Module
- Neo-6M GPS Module
- SIM800L GSM Module
- Buzzer + LED indicators Shown in Figure 1

6.4 Workflow

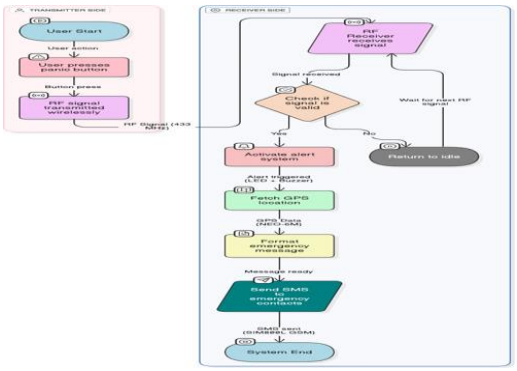

Figure 1 Workflow

7. Result and Analysis

Testing confirmed that the SheSecure system successfully transmitted distress alerts within milliseconds of activation. The RF signal range achieved stable transmission up to 100–150 meters in open environments. The GPS module provided location accuracy within 5–10 meters, while the GSM module ensured message delivery within 5 seconds Shown in Figure 2 and 5.

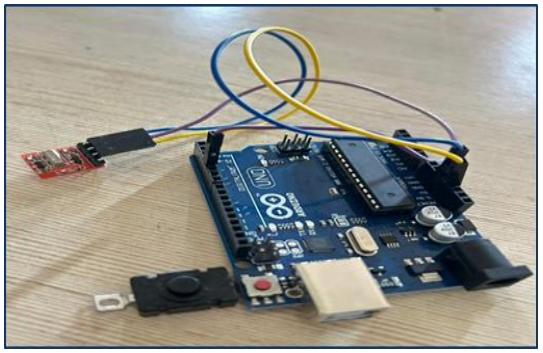

Figure 2 Arduino Uno Microcontroller Connected to a Sensor Module Via Jumper Wires

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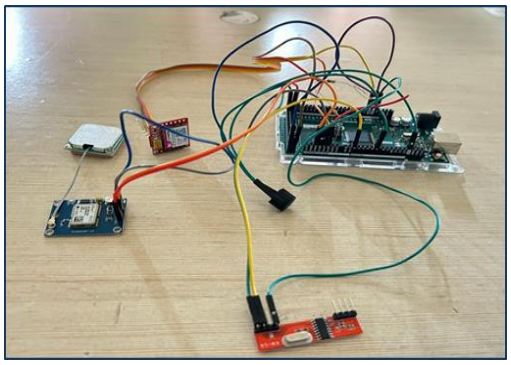

Figure 3 Arduino-Based Prototype with Multiple Connected Sensor and Communication Modules

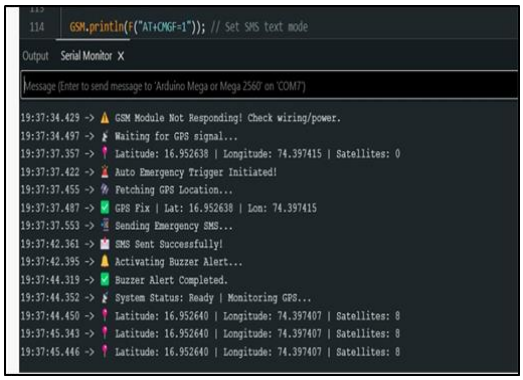

Figure 4 Arduino Serial Monitor Output Displaying Real-Time GPS Data (Latitude, Longitude, and Satellite Count)

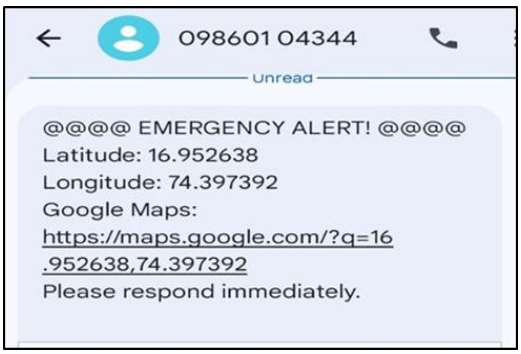

Figure 5 SMS Screenshot

8. Discussions

The integration of RF, GPS, and GSM technologies provides a reliable and decentralized emergency alert framework. Unlike internet-dependent systems, SheSecure ensures uninterrupted functionality even in remote regions. The hardware is cost-efficient and can be maintained with minimal infrastructure requirements. While scalability is feasible, challenges include optimizing power consumption and expanding communication range for large-scale deployment. Future developments could explore AI-driven alert classification and integration with cloud dashboards for centralized monitoring [5]

Conclusion

The SheSecure project provides a comprehensive and technologically advanced solution to address the growing concern of women's safety through an integrated RF and GPS based distress response system. Unlike conventional mobile applications that rely on internet connectivity, SheSecure functions entirely offline, enabling instant communication even in low-network or remote regions. The system's design combines RF transmission for immediate signal relay, GPS for accurate location tracking, and GSM for reliable SMS alerts to emergency contacts. This hybrid framework ensures rapid detection and efficient communication during emergencies. The Smart Pole infrastructure extends the operational scope of personal safety devices by linking them to public areas, allowing for faster intervention by authorities and bystanders. The system's affordability, modularity, and scalability make it ideal for widespread deployment across cities, campuses, and rural environments. Additionally, its low power consumption and independence from smartphones enhance its reliability in critical situations. Overall, SheSecure establishes a new benchmark for emergency alert systems, merging IoT principles with traditional communication technologies. Future developments may include AI-based data analysis for alert prioritization, integration with cloud dashboards for centralized monitoring, and mobile application support for enhanced user accessibility and tracking efficiency.

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https://doi.org/10.47392/IRJAEH.2026.0029

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