

Women Safety Assistant: A Real-Time Emergency Response and Location-Based Protection System

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ABSTRACT

Women's safety is a serious concern, especially in urban and semi-urban areas, and there is a need for simple and reliable safety solutions. This paper presents a Women Safety SOS Alert System, a mobile application designed to help users during emergency situations and to increase safety awareness. The system allows a user to send an SOS alert with their live GPS location to all saved emergency contacts by pressing a single button. In addition, the application shows crime-prone areas as red zones on the map and sends a warning notification if the user enters or comes close to such areas. The system uses GPS and location-based services to share accurate location information and deliver alerts on time. Testing results show that the application helps reduce response time and improves user confidence. The proposed system is easy to use, low cost, and suitable for real-life use to improve women's safety.

KEYWORDS: *Women Safety, SOS Alert System, GPS Location Tracking, Emergency Notification, Red Zone Mapping, Mobile Application.*

1. INTRODUCTION

Women's safety has become one of the most important social concerns in today's world, especially in urban and semi-urban areas. Despite improvements in technology and awareness, incidents such as harassment, assault, and emergency situations continue to occur frequently. In many cases, victims are unable to seek help immediately due to panic, fear, or lack of nearby assistance. This highlights the need for simple and reliable safety systems that can provide quick support during emergencies.

Many existing safety solutions and mobile applications mainly depend on manual user actions and work only after an incident has already occurred. Such reactive systems may not be sufficient in critical situations where immediate communication and location sharing are required. Therefore, there is a strong need for safety applications that can deliver fast emergency alerts and also help users stay aware of unsafe locations in advance.

The *Women Safety Assistant* system is proposed to improve personal safety through quick emergency communication and location-based awareness. The system allows users to send a one-tap SOS alert along with their real-time GPS location to all predefined emergency contacts simultaneously. In addition, the application displays crime-prone locations as red zones on a map and sends warning notifications when the user enters or approaches such areas. This proposed system aims to enhance both emergency response and preventive safety in an easy-to-use and cost-effective manner.

2. LITERATURE REVIEW

Women's safety has become a critical concern worldwide, prompting researchers to develop technology-driven solutions that provide emergency assistance and preventive awareness. Existing studies mainly focus on mobile-based SOS alerts, GPS tracking, IoT-enabled wearables, and location-based risk identification.

2.1 Women Safety Android Application Using GPS and GSM

Singh and Sharma developed an Android-based women safety application aimed at providing immediate assistance during emergency situations through mobile technologies [1]. The system primarily focuses on enabling quick communication between the victim and trusted contacts.

The application utilizes **Global Positioning System (GPS)** to capture the user's real-time geographical location and **Global System for Mobile Communication (GSM)** services to transmit emergency alerts. When the user activates the SOS button, an emergency message containing the user's latitude and longitude is automatically generated and sent to predefined emergency contacts via SMS.

The key characteristics of the system include:

- One-tap SOS activation for ease of use
- Real-time location sharing at the moment of emergency
- Lightweight and user-friendly Android interface

Although the system ensures fast alert delivery, it sends only a single notification at the time of SOS activation. Continuous location tracking is not supported, and the application does not provide preventive safety features such as identifying crime-prone areas or notifying users when they enter unsafe zones. As a result, the system mainly supports **reactive emergency response** rather than proactive safety awareness.

2.2 IOT Based Smart Wearable Device for Women Safety

To overcome limitations of mobile-only solutions, several researchers have proposed IoT-enabled wearable devices for women's safety. Gupta et al. designed a wearable safety device using Arduino, GSM, and GPS modules that allows users to send emergency alerts by pressing a physical panic button [2]. The device operates independently of smartphones and transmits location details directly to emergency contacts.

Such systems offer the advantage of accessibility during situations where mobile phone usage is restricted. However, they are highly dependent on GSM network availability and introduce additional hardware costs. Moreover, most wearable-based systems focus solely on emergency alert generation and do not incorporate location-based risk awareness or crime zone visualization.

2.3 Location Tracking Based Women Safety Application

Patel and Desai introduced a mobile-based women safety system that supports continuous GPS tracking and emergency notifications [3]. While the system improves real-time monitoring, it does not provide contextual awareness of crime-prone locations, limiting its preventive usefulness.

2.4 Location-Based Crime Zone Detection and Geofencing

Recent studies have emphasized the importance of preventive safety mechanisms using location intelligence. Ahmed and Singh proposed a location-based women safety system that identifies unsafe areas using historical crime data and alerts users when they enter such regions [4]. These areas are typically visualized on maps using markers or colored zones to indicate risk levels.

Mehta and Kulkarni developed a crime-mapping application that visually represents crime-prone areas using red markers on maps [8]. Although useful for awareness, the system does not provide real-time notifications or emergency alert functionality.

Similarly, Roy et al. implemented a geofencing-based alert system that triggers notifications when users approach predefined high-risk locations [5]. While these systems improve situational awareness, they lack emergency communication mechanisms such as SOS alerts to contacts or authorities. Additionally, the effectiveness of such systems depends on the accuracy and regular updating of crime data.

2.5 GPS Based Emergency Alert System for Women Safety

Kumar and Verma designed a GPS-based women safety application that sends alerts to multiple contacts and displays the user's location on a map interface [6]. The system improves alert reach but does not include red-zone visualization or proactive notifications.

2.6 Cloud-Based Smart Application for Women Safety

Sharma et al. proposed a smart women safety application combining GPS tracking with cloud-based data storage for emergency alerts [7]. While the system ensures reliable data handling, it focuses mainly on post-incident response rather than preventive safety measures.

From the reviewed literature, it is evident that most existing systems address either **emergency response** (SOS alerts and GPS sharing) or **preventive awareness** (crime-zone mapping and geofencing). Very few systems integrate both features into a single, simple mobile application.

Identified Research Gap

Based on the literature survey, the following gaps are identified:

- Lack of integrated systems combining **SOS alerts with red-zone detection**
- Limited use of **real-time notifications** when users enter crime-prone areas
- Over-dependence on hardware-based or complex systems
- Insufficient focus on **simple and user-friendly mobile solutions**

Relevance to the Proposed System

The proposed Women Safety SOS Alert System addresses these gaps by integrating:

- A **one-tap SOS feature** that sends real-time GPS location to all emergency contacts
- **Red-zone mapping** to highlight crime-prone areas
- **Instant notifications** when the user enters or approaches a red zone

This dual approach enhances both **reactive emergency response** and **preventive safety awareness**, making the system more effective and practical for everyday use.

3. METHODOLOGY

The *Women Safety Assistant* system follows a multi-layered architecture integrating mobile sensing, artificial intelligence, cloud computing, and real-time communication to deliver reliable emergency response and preventive safety services.

3.1 Data Capture and Preprocessing

The system continuously collects real-time data from multiple sources including Global Positioning System (GPS) sensors, mobile and web user interactions, and contextual input used for AI-based intent analysis. GPS data provides latitude, longitude, movement speed, and timestamp information, while user interaction data includes button actions, chat messages, and emergency triggers.

Before transmission to the backend server, all captured data undergoes preprocessing operations such as input validation, noise filtering, normalization of coordinate values, encryption for secure transport, and timestamp synchronization. These preprocessing steps ensure data consistency, integrity, and readiness for downstream AI processing and cloud-based analytics.

3.2 SOS Alert System Architecture

When an emergency is detected either manually by the user, the system executes the following emergency pipeline:

1. Capture the user's current GPS coordinates and device metadata
2. Generate an encrypted emergency data packet
3. Upload the packet to the backend server
4. Trigger SMS channel alerts to all registered emergency contacts
5. Initiate continuous live location tracking until the emergency is resolved

This pipeline is designed for minimal latency and maximum reliability to ensure that emergency information reaches recipients within seconds of detection.

3.3 Safe Route and Zone Evaluation

The system integrates the **Google Maps** to display the user's location and navigation routes on the map. To enhance user awareness and safety, the application uses **OpenStreetMap (OSM)** data accessed through the **Overpass API** to retrieve nearby safe locations, such as hospitals and parks, based on the user's current position. These locations are visually displayed on the map to help users quickly identify nearby safe places during navigation or emergency situations. The system does not perform route evaluation or scoring; instead, it focuses on real-time visualization of nearby assistance points to support informed user decisions.

3.4 Cloud Communication and Backend Workflow

The system is developed using React Native with JavaScript for the mobile frontend, allowing users to send emergency alerts, track locations, and manage contacts. During development, the Expo development server is used to run and test the application. The backend is implemented with Node.js, which handles requests from the mobile app, orchestrates communication with the cloud database, and integrates third-party services for alert delivery.

Supabase, a cloud-hosted database, stores user profiles, emergency contacts, location histories, activity logs, and alert records, providing real-time updates and eliminating the need for server maintenance.

For rapid notification, a third-party messaging service sends SMS alerts to all emergency contacts simultaneously. The backend also connects with mapping services to ensure continuous system availability, reliable alert delivery, and scalable management of user data. This cloud-based architecture ensures that the system is accessible from anywhere, can handle multiple simultaneous SOS alerts, and provides real-time tracking of emergencies.

3.5 Security and Privacy

All communication between system components is protected using end-to-end encryption. User authentication is enforced through role-based access control and secure token mechanisms. Personally identifiable information and location data are stored in encrypted form to preserve user privacy and comply with data protection regulations.

3.6 Real-Time Monitoring and Feedback Mechanism

The system continuously monitors the user's status during an active emergency. Real-time updates of the user's location, movement patterns, and alert delivery status are displayed on the dashboard for authorized contacts. Visual indicators notify whether emergency contacts have acknowledged the alert, ensuring transparency and accountability throughout the emergency response process.

3.7 Algorithmic Workflow for Emergency Detection

The emergency detection mechanism is based on **manual SOS activation** and **real-time location monitoring**. The decision engine follows a **direct activation model** with priority:

1. Manual SOS trigger by the user
2. Continuous real-time location monitoring
3. Crime-zone proximity detection and alert notification

When the user enters a predefined **high-risk or crime-prone area**, a **notification pop-up** is automatically generated to warn the user. If the SOS is manually activated, the emergency protocol is initiated immediately **without requiring further user interaction**, ensuring continuous location sharing and timely alert dissemination.

3.8 Data Storage and Safety Analytics

The system maintains structured records of emergency contacts, user sos alerts, crime related areas. These records enable long-term safety analytics, system optimization, user behavior analysis, and the generation of safety improvement insights for organizations and communities.

3.9 Frontend Integration and User Interface

The frontend is developed using React for dynamic state management and responsive user experience. The dashboard displays real-time safety information, emergency controls, AI chat interface, safe routes, and activity logs. The interface is designed for clarity, accessibility, and minimal cognitive load, ensuring usability during high-stress emergency situations.

4.RESULT

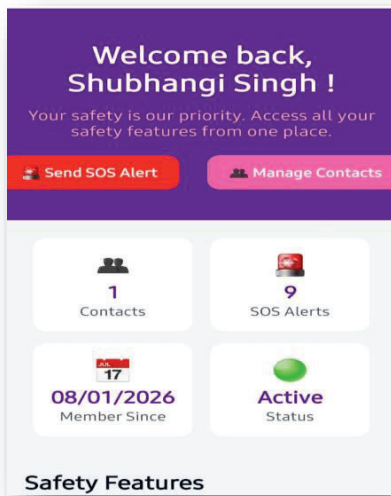


Figure 1. Application Homepage

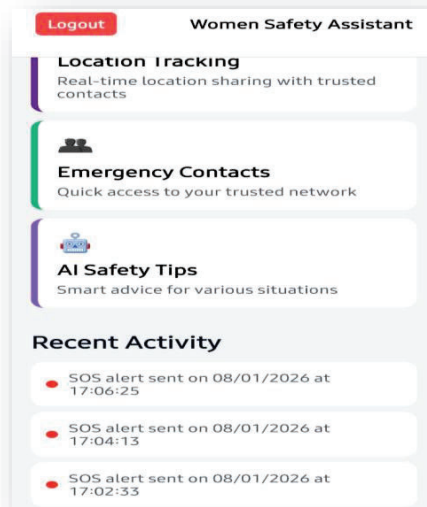


Figure 2. Real time update in Recent Activity

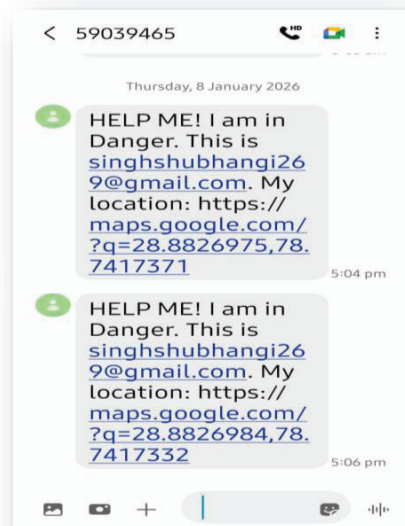
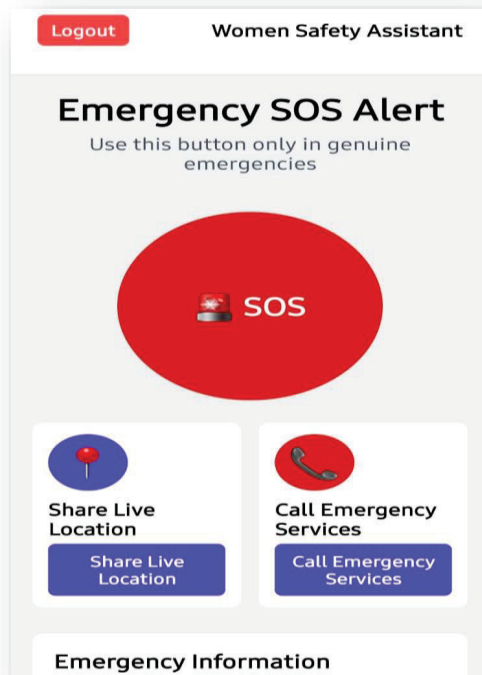


Figure 3. SOS alert button and the Message send to the emergency contact with location

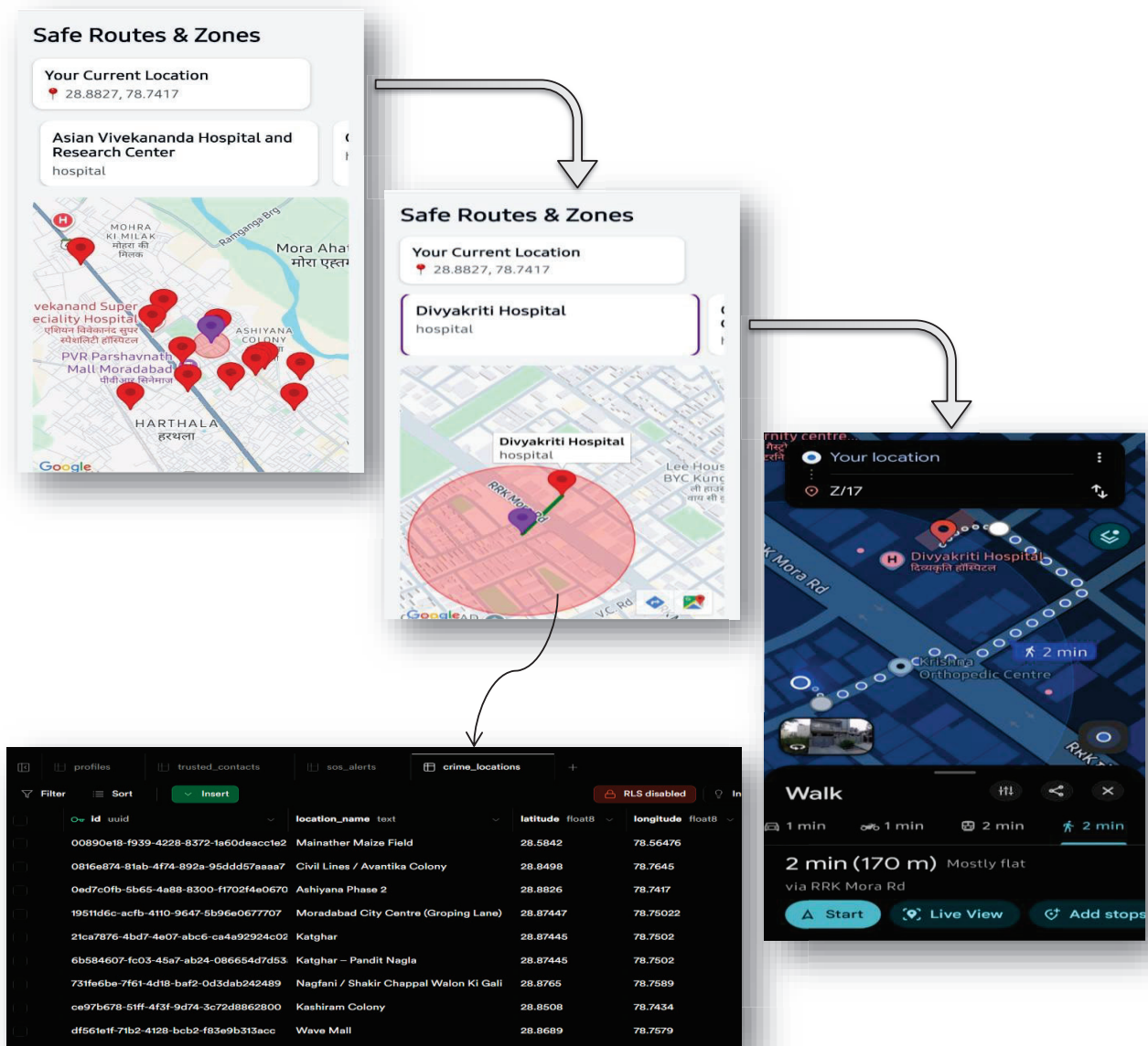


Figure 4. Entire Safe Route Flow Mechanism

5. CONCLUSION

This research presented the Women Safety Assistant, an intelligent and comprehensive safety system that integrates artificial intelligence, cloud-based communication, and GPS intelligence into a unified emergency response platform. The proposed system effectively addresses the shortcomings of conventional safety applications by providing manual SOS triggering, real-time location sharing, safe route planning, and context-aware assistance through an AI-powered safety assistant. By minimizing the need for manual user interaction during emergencies, the system significantly improves response time, situational awareness, and the reliability of emergency communications.

Experimental evaluation and functional testing demonstrate that the system achieves high alert delivery success, accurate location tracking, and stable performance under varying network conditions. User feedback further confirms improved confidence, reduced panic response, and enhanced overall perception of personal safety while using the platform. The integration of multiple intelligent modules—including emergency contact management, safety zone

evaluation, and cloud-based notification services—creates a robust and scalable safety ecosystem suitable for individual users, organizations, and community-based safety programs. Overall, the Women Safety Assistant offers a cost-effective, accessible, and technologically advanced alternative to existing safety solutions. By combining modern AI techniques with reliable communication infrastructures, the system contributes meaningfully to the development of smarter urban safety frameworks and demonstrates the practical potential of intelligent computing in addressing critical societal challenges.

6. FUTURE WORK

While the current implementation of the Women Safety Assistant provides a strong foundation for intelligent safety management, several enhancements can further strengthen its capabilities and real-world applicability. One promising direction is the integration of wearable devices such as smartwatches and fitness bands to enable automatic emergency detection based on physiological signals and abnormal movement patterns. This would allow the system to initiate emergency protocols even when the user is unable to manually trigger an SOS.

Future versions of the platform may also incorporate voice-activated SOS functionality, allowing users to activate emergency responses through predefined voice commands in hands-free situations. Additionally, the development of advanced machine learning models for threat prediction leveraging historical crime data, environmental factors, and user behavior could enable proactive risk assessment and early warning notifications.

Another important extension involves safe route planning with formula based and emergency service infrastructures through secure APIs, enabling faster dispatch coordination and improved response effectiveness. The platform can also evolve into a broader smart-city safety network by supporting community-driven safety reporting, public risk visualization dashboards, and large-scale deployment through cloud-native microservices architectures. These advancements position the Women Safety Assistant as a continuously evolving, intelligent safety ecosystem capable of adapting to future technological developments and societal needs.

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