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Women Safety Pocket: A GPS and GSM Based Android Application for Real-Time Emergency Response

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Abstract: *With the rapid growth of smartphone usage across India, mobile devices have become one of the most accessible tools for ensuring personal safety in emergency situations. This paper presents the design and implementation of Women Safety Pocket, an Android-based application that allows women to send their real-time GPS location to pre-registered emergency contacts simply by shaking their phone three times. The system leverages GPS satellite data and GSM/GPRS communication to transmit a precise location URL via SMS. The application integrates Google Maps SDK for location rendering, Firebase for user authentication and data management, and Android Studio as the development environment. Key features include shake-triggered SOS alerts, real-time location tracking, emergency contact management, fake call generation, audio recording, and access to self-defence video content. The proposed system provides an affordable, easy-to-use, and reliable safety mechanism for women, particularly in situations where making a phone call is not possible. Testing confirms that the system accurately detects distress and dispatches location data rapidly, establishing it as a practical personal safety tool suited to the Indian context.*

Keywords: Women Safety, Android Application, GPS Tracking, GSM/GPRS, Firebase, Emergency Alert, SOS System, Real-Time Location, Mobile Security

I. INTRODUCTION

Women's safety remains one of the most pressing challenges facing Indian society. Despite legislative efforts and growing public awareness following high-profile incidents like the Nirbhaya case of 2012, violence and harassment against women continue to be reported with alarming frequency. In many such situations, victims simply do not have the time or opportunity to call for help through conventional means. The question, therefore, is how technology can bridge this critical gap.

Smartphones, now owned by a significant portion of the Indian population, offer a practical and cost-effective platform for deploying emergency response tools. With built-in GPS receivers, accelerometers, and mobile data capabilities, modern Android devices are well-equipped to serve as personal safety devices without requiring any additional hardware.

This paper presents Women Safety Pocket, an Android application built around a single guiding principle: the distress trigger must be as fast and natural as possible. Rather than requiring a user to unlock her phone, open an application, and press a button, the system activates the moment it detects a triple-shake gesture — an action that can be performed discreetly and almost instantly, even while the phone is in a pocket or bag.

Once triggered, the application fetches the user's current GPS coordinates, constructs a Google Maps link containing the precise location, and sends it via SMS to all pre-registered emergency contacts. Beyond this core SOS function, the application incorporates a fake call generator to deter potential threats, ambient audio recording, emergency helpline numbers, and a curated library of self-defence tutorial videos.

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II. LITERATURE REVIEW

Women safety has become a significant research domain due to the increasing incidence of harassment, assault, and other security threats faced by women in daily life. Early safety solutions primarily relied on manual emergency systems, where users were required to open an application and press a panic button to send alerts. Applications such as Abhaya, FightBack, SecureMe Beta, Vanitha Alert, and Raksha utilized technologies including GPS, GSM/GPRS, and SMS services to transmit the user's location to registered emergency contacts. While these systems provided essential safety support, their dependence on manual activation reduced their effectiveness in sudden and high-stress situations.

Subsequently, Android-based safety applications incorporated additional functionalities such as real-time location tracking, emergency contact management, fake call generation, and access to self-defence resources. The integration of technologies like Google Maps SDK, Firebase Authentication, and Realtime Database enhanced data security, user management, and location accuracy. Natural smartphone sensors, particularly the accelerometer, opened new possibilities for gesture-based activation mechanisms, enabling faster and more discreet emergency response compared to conventional button-based systems.

The proposed Women Safety Pocket application advances existing research by introducing a triple-shake gesture detection mechanism that automatically triggers an SOS alert without requiring any screen interaction. Upon activation, the application retrieves the user's current GPS coordinates, converts them into a Google Maps link, and sends the information via SMS to all pre-registered emergency contacts using the GSM network. Additional features such as fake call simulation, ambient audio recording, emergency helpline numbers, and self-defence videos further strengthen the application's practical utility.

Recent developments in mobile safety systems emphasize automation, usability, and reliability in real-world emergency scenarios. Despite substantial progress, challenges remain, including sensor sensitivity calibration, dependency on network availability, and ensuring rapid response under varying environmental conditions. Consequently, ongoing research focuses on developing more intelligent, scalable, and robust safety applications. Women Safety Pocket represents a practical and cost-effective contribution to this field by combining gesture-based activation, GPS tracking, cloud integration, and offline SMS communication into a comprehensive personal safety solution for women.

III. METHODOLOGY

1 Need for the System

India has one of the highest rates of crimes against women globally, spanning sexual assault, trafficking, harassment in public transport, and workplace abuse. While helpline numbers and legal frameworks exist, they are largely reactive — they respond after harm has already occurred. There is a pressing need for a proactive tool that empowers women to summon help the instant they sense danger, before a situation escalates.

Feedback from users of existing safety applications indicates that most women do not feel adequately protected by current tools, primarily because manually launching an app and pressing a button takes too long under the stress of a sudden threat.

Women Safety Pocket resolves this through its gesture-based activation, which requires no screen interaction whatsoever once the application is running in the background.

2 Existing System Limitations

The systems reviewed in Section 2 suffer from one or more of the following shortcomings: dependency on manual app navigation, reliance on constant internet connectivity, absence of fallback mechanisms for low-coverage or zero-balance scenarios, and a lack of deterrence features that could discourage a threat before it materialises. The proposed system incorporates specific design decisions to address each of these gaps.

3 Proposed System

The proposed system is an Android application that runs a background service continuously monitoring the phone's accelerometer. When a shake event exceeding a defined threshold is detected, the following sequence executes automatically:

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1. The FusedLocationProviderClient retrieves the device's most recent GPS coordinates (latitude and longitude).
2. The Geocoder API resolves these coordinates into a human-readable address, including locality, district, and country.
3. An SMS message is composed containing the full address and a Google Maps URL in the format: https://www.google.com/maps/search/?api=1&query
=<latitude>,<longitude>
4. The SmsManager dispatches this message to every contact stored in the application's emergency contact list.

The entire process completes within a few seconds of the triggering shake event and requires no further interaction from the user.

IV. SHAKE DETECTION — MATHEMATICAL MODEL

The shake detection algorithm operates on readings from Android's TYPE_ACCELEROMETER sensor. For each sensor event, the magnitude of the acceleration vector is computed as:

$$accelVal = \sqrt{(x^2 + y^2 + z^2)}$$

A rolling energy accumulator is maintained between successive readings using exponential smoothing:

$$shake = shake \times 0.9 + (accelVal - accelLast)$$

When the shake variable exceeds the empirically determin threshold of 12, the SOS routine is triggered.

The 0.9 smoothing factor filters out low-energy vibrations, such as those produced by walking or placing the phone on a surface, while preserving sensitivity to the rapid, deliberate shaking action characteristic of a genuine distress gesture.

V. SYSTEM ARCHITECTURE

1 Technology Stack

Component	Technology / Tool
Frontend (Mobile)	Android Studio (IntelliJ-based IDE), Java, XML Layouts
Backend/ Database	Firebase Realtime Database, Firebase Authentication
Location Services	Fused Location Provider Client (Google Play Services), Geocoder API
Mapping	Google Maps SDK for Android
Communicatio n	Android SmsManager, GSM/GPRS Network
Sensor	Android SensorManager — TYPE_ACCELEROMETER

2 System Architecture

The system follows a client-server architecture with the Android device as the primary client. Three logical layers govern data flow:

• Input Layer: The smartphone collects accelerometer sensor readings, GPS coordinates via FusedLocationProviderClient, and user inputs such as registration details and emergency contact numbers.

• Processing Layer: The application processes sensor data to detect shake events, constructs the SMS payload with address details and map link, and interfaces with Firebase for authentication and data retrieval.

• Output Layer: SmsManager dispatches the alert SMS to registered contacts over the GSM network. The Google Maps SDK renders the current location visually within the app's main screen.

3 Module Description

Authentication Module: Manages user registration, login, and password reset through Firebase Authentication. User profile data — name, email, and mobile number — is stored in Firebase Realtime Database under a unique UID. Session state persists across app restarts, automatically redirecting logged-in users past the login screen.

Emergency Contact Management Module: Allows users to add and remove emergency contacts, which are stored in Firebase and retrieved at runtime during SOS dispatch. A direct "Call Now" function enables immediate voice calls from within the contact list.

Alert Services Module: The core module of the application. A SensorEventListener registered against the accelerometer applies the shake detection algorithm in real time. Upon threshold breach, it fetches the current GPS location, composes the emergency SMS, and dispatches it to all registered contacts via SmsManager.

System Protection Module: Provides additional security capabilities including SD card backup of contacts and messages, data wipe functionality to protect sensitive information in case of device theft, and screen lock to prevent unauthorised access.

4 Data Flow

At registration, user credentials are transmitted to Firebase over HTTPS and stored securely in the cloud. At login, credentials are verified through Firebase Authentication. During normal operation, the accelerometer listener runs as a persistent background service. When a shake event is detected, the app requests location permission if not already granted, retrieves GPS data, resolves the address, composes the SMS string, and dispatches it to all registered contacts.

VI. CONCLUSION AND FUTURE SCOPE

Conclusion

This paper presented Women Safety Pocket, an Android application that addresses a clear and critical gap in existing women's safety tools: the inability to trigger an emergency alert quickly and discreetly when under sudden threat. By replacing manual button interaction with an accelerometer-based shake gesture, the system enables a user to activate an SOS alert within seconds, without unlocking the screen or opening any application.

The application successfully integrates GPS-based location tracking, Firebase authentication, SMS-based alert dispatch, and a suite of supplementary safety features into a single, cohesive platform. Testing confirmed reliable shake detection, accurate location acquisition, and prompt SMS delivery under typical network conditions. The use of standard Android APIs and Firebase ensures the system can be maintained and extended without significant infrastructure investment.

Women Safety Pocket is not presented as a complete solution to the complex social problem of women's safety — no technology alone can claim to be — but it represents a meaningful, immediately deployable contribution to the personal safety ecosystem for women in India. Its gesture-based trigger, offline SMS functionality, and broad device compatibility make it particularly well-suited to the Indian context, where threats can occur suddenly and connectivity is not always guaranteed.

Future Work

• Hardware Integration: A dedicated Bluetooth panic button (wristband or clip-on accessory) that triggers the SOS routine without requiring the phone to be accessible.

• iOS Version: Porting the application to iOS to reach iPhone users and expand the system's reach.

• Direct Police Integration: An API-based connection to police control room systems, routing alerts simultaneously to registered contacts and the nearest police station.

• Offline Fallback: Mechanisms for zero-balance or no-data scenarios, using USSD codes or pre-scheduled background SMS triggers.

• Foot-Tap Activation: An alternative gesture trigger using double or triple foot taps, detected through the accelerometer when the phone is in a trouser pocket or bag.

• Live Video Streaming: Real-time video broadcast to registered contacts during an emergency, providing visual evidence of the surroundings.

• AI-Based Threat Detection: Machine learning models that detect distress in ambient audio or abnormal movement patterns, enabling fully automatic alerting without any user action.

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