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Women Safety Companion with Threat Detection

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Abstract: *Ensuring personal safety has become a significant concern in modern society, particularly for individuals exposed to vulnerable environments. With the proliferation of smartphones equipped with advanced sensors and communication capabilities, mobile-based safety applications have emerged as effective solutions for real-time emergency response. This paper presents a comprehensive survey of existing personal safety systems, focusing on technologies such as voice recognition, motion sensing, location tracking, and automated alert mechanisms. Furthermore, a multi-trigger safety framework is discussed, integrating keyword detection, time-based monitoring, shake detection, simulated call generation, and one-touch SOS activation. The proposed approach addresses the limitations of single-trigger systems by enhancing reliability and responsiveness. The study also outlines key challenges and potential future research directions in intelligent safety applications.*

Keywords: Personal Safety, Emergency Detection, Mobile Applications, Voice Recognition, GPS Tracking, SOS Systems, Human-Centric Computing

I. INTRODUCTION

Personal safety has become an increasingly critical issue due to the rising number of crime incidents and unpredictable emergencies. Conventional safety mechanisms, such as manual emergency calls or physical alarms, often fail in situations where the user is unable to actively seek help.

Recent advancements in mobile computing have enabled the development of smartphone-based safety applications that leverage built-in sensors, wireless communication, and intelligent algorithms. These systems are capable of detecting abnormal situations and automatically notifying predefined emergency contacts.

However, most existing applications rely on a single mode of activation, such as a panic button or location sharing, which limits their effectiveness in real-world scenarios. This paper surveys current approaches and emphasizes the need for **multi-trigger emergency detection systems** that can operate under diverse conditions.

II. LITERATURE SURVEY

Sr. No.	Authors & Year	Title	Key contribution	Limitation
1	Jyoti Mishra et al., 2024. (ResearchGate)	Embedded Intelligence for Smart Home — TinyML Keyword Spotting	TinyML approach for ondevice keyword spotting — low latency, edge deployment.	Evaluation mainly on controlled datasets; realworld noise not fully explored.
2	(IJFMR paper), 2025. (IJFMR)	AI-Powered Woman Safety Application with Real-Time Voice Initiation	Voice-initiated SOS app prototype for Android (predefined emergency keywords).	Depends on continuous background listening; limited field evaluation.

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3	IJITCE article, Sept 2024. (ijitce.org)	SOS Women Safety Device (IoT)	Low-cost IoT device + GSM/GPS for instant SMS/call alerts.	No robust voice/keyword detector; network dependency.
4	RescueNow (IJRASET), 2025. (IJRASET)	RescueNow — Real-time SOS & Predictive Women's Safety System	Mobile app with silent recording, GPS, multi-trigger SOS and predictive risk mapping.	Mostly prototype results; generalization to in-the-wild distress uncertain.
5	S. Hariharan et al., 2025 (IIJSR). (IIJSR)	A Novel and Reliable SOS Alert Band System for Women	Wearable SOS band with one-touch trigger, GPS and sensor fusion.	Battery & connectivity constraints; limited largescale testing.

III. METHODOLOGY

The proposed methodology focuses on the design and implementation of a **multi-trigger smartphone-based personal safety system** that integrates both proactive and reactive emergency detection mechanisms. The system follows a **modular, event-driven architecture**, where multiple independent modules operate concurrently using smartphone sensors such as the microphone, accelerometer, and GPS, along with real-time data processing and communication interfaces.

The system incorporates five primary functional modules: **keyword-based voice detection, time-based safety monitoring, motion-based shake detection, simulated call generation, and SOS emergency activation**. The keyword detection module utilizes speech recognition to identify predefined emergency phrases and trigger alerts automatically. The time-based monitoring module tracks user-defined travel duration and initiates alerts in case of delayed or absent user response. The shake detection module leverages accelerometer data to identify predefined motion patterns for quick emergency activation. The simulated call feature provides a preventive mechanism by generating a realistic incoming call interface, while the SOS module enables immediate manual alert transmission with real-time location data.

The overall system operates through a structured workflow involving **input acquisition, event detection, decision validation, alert generation, and notification transmission**. Upon detection of any emergency condition, the system automatically sends alerts to predefined contacts, shares location details, and performs auxiliary actions such as audio recording when required. The performance of the system is evaluated based on **response time, detection accuracy, reliability, usability, and resource efficiency**. By integrating multiple detection mechanisms, the proposed methodology enhances system robustness, reduces dependency on user interaction, and ensures rapid and reliable emergency response across diverse real-world scenarios.

IV. PROPOSED ARCHITECTURE

The system consists of five main modules:

Keyword Detection Module – Detects emergency words using voice recognition and triggers alerts.

Time-Based Safety Module – Monitors travel time and sends alerts if the user does not respond.

Shake Detection Module – Uses accelerometer sensor to detect emergency shake gesture.

Fake Call Module – Generates fake incoming calls to help users escape unsafe situations.

Emergency SOS Module – Sends instant alerts with live location using a single tap.

The system connects a mobile frontend with backend services like GPS and messaging APIs. It ensures fast and secure communication with emergency contacts.

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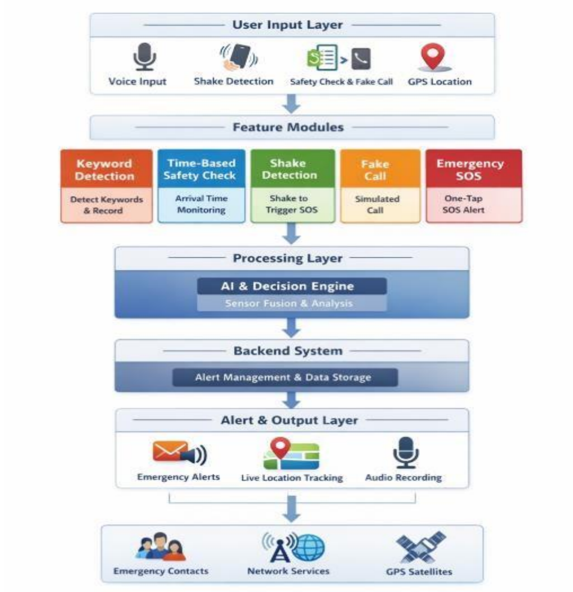

Fig 1: Proposed System Architecture of Women Safety Companion with Threat Detect.

V. WORKFLOW

The workflow starts with user registration and setup of emergency contacts. The system continuously monitors user activity like voice input, motion, and time. When the user performs an action (keyword, shake, or SOS), it checks for emergency conditions. If any condition is satisfied, the system triggers the alert process. The user's live location is fetched using GPS. An emergency message along with location is sent to contacts. The system continues tracking until the user is safe

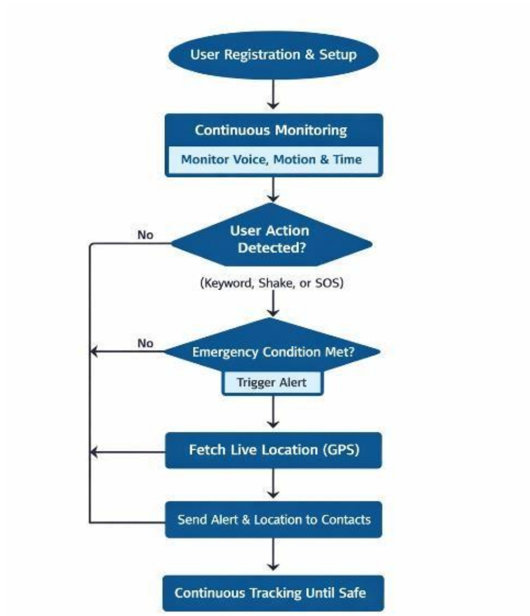

Fig 2: Workflow of Threat Detection and Emergency Alert Generation

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VI. ALGORITHM

1. Initialize microphone, GPS, and accelerometer
2. Load user-defined keywords, contacts, and expected time
3. Continuously monitor system:

Capture audio input
Extract MFCC features from audio
Apply CNN–LSTM model to obtain text
If detected text matches predefined keywords, trigger alert (KEYWORD)
Check time condition
If expected time is exceeded:
Send confirmation prompt
If no response, trigger alert (TIME)
Read accelerometer data
If shake detected, trigger alert (SHAKE)
If SOS button is pressed, trigger alert (SOS)
If fake call is activated, generate simulated call interface

4. Alert Handling:

Retrieve current GPS location
Send alert message with location to emergency contacts
If alert type is keyword-based, start audio recording

VII. FLOWCHART

The below flowchart illustrates the working of the proposed multi-trigger personal safety system. The process begins with system initialization, followed by loading user-defined settings such as emergency keywords, contacts, and expected arrival time. The application then activates essential sensors including the microphone, GPS, and accelerometer.

The system continuously monitors multiple conditions in parallel. It checks for keyword detection through voice input, evaluates time-based conditions for delayed arrival, detects shake patterns using motion sensors, and monitors manual triggers such as the SOS button. Additionally, a fake call feature can be activated to simulate an incoming call for preventive safety.

If any emergency condition is detected, the system triggers an alert mechanism that retrieves the user's location, composes an alert message, and sends it to predefined emergency contacts. The system then continues monitoring, ensuring real-time responsiveness and reliability

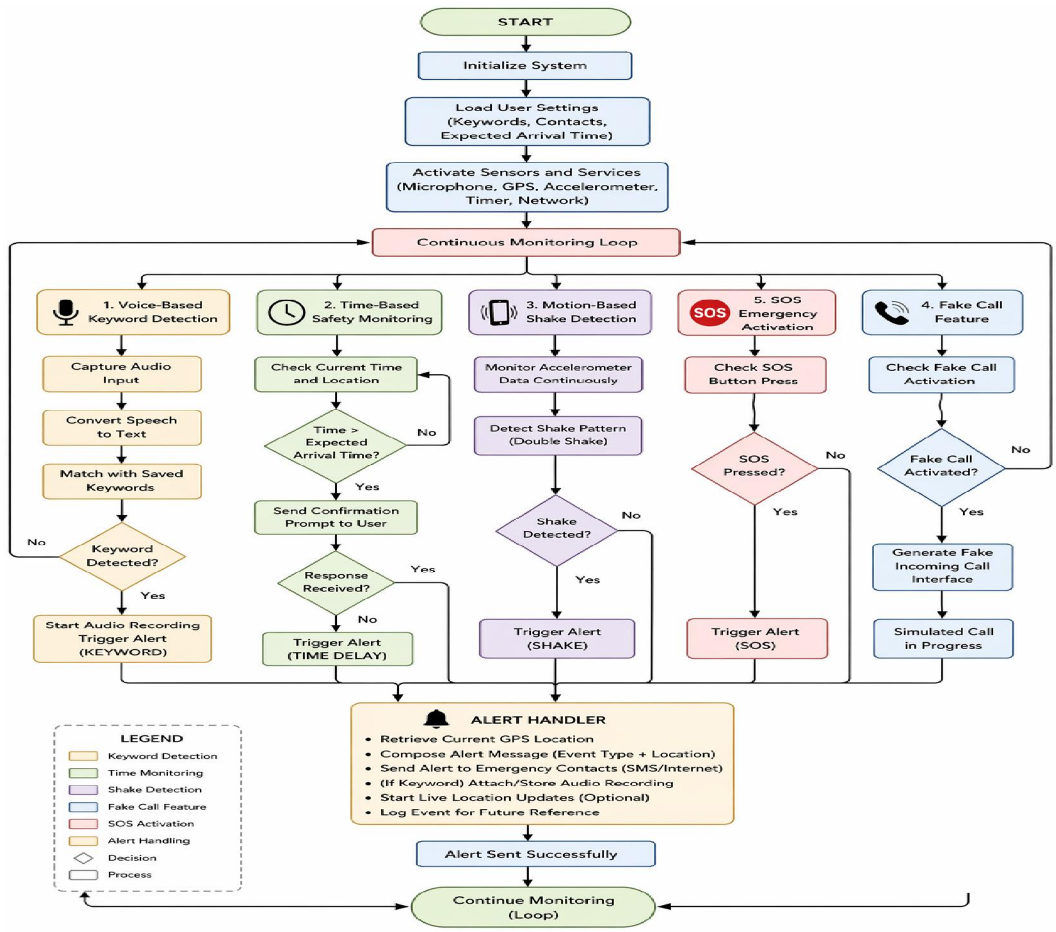

Fig. 1. Flowchart of the proposed multi-trigger personal safety application.

Fig 3: Flowchart of the implemented system

VIII. IMPLEMENTATION

The proposed Women's Safety Companion with Threat Detection was implemented as an Android-based mobile application using the React Native framework and Expo Development Client. The system follows a modular architecture, enabling independent development and testing of core components such as voice monitoring, emergency detection, alert generation, GPS tracking, and evidence recording. An incremental SDLC model was adopted to support scalability and continuous enhancement.

The Voice Monitoring Module operates continuously in the background, capturing audio input through the smartphone microphone. Emergency keywords such as "save me", "help me", and multilingual variants are processed using a speech recognition API. Upon detecting a distress keyword, the system automatically activates the emergency protocol without requiring manual interaction, ensuring usability during high-stress situations where the victim may be incapacitated.

Once an emergency is detected, the Emergency Alert Module is triggered. This module simultaneously initiates continuous audio recording for up to one hour, acquires the user's real-time GPS location, and sends automated alert messages to pre-registered emergency contacts. Each alert includes the trigger type, timestamp, geographical coordinates, and a Google Maps link for precise navigation.

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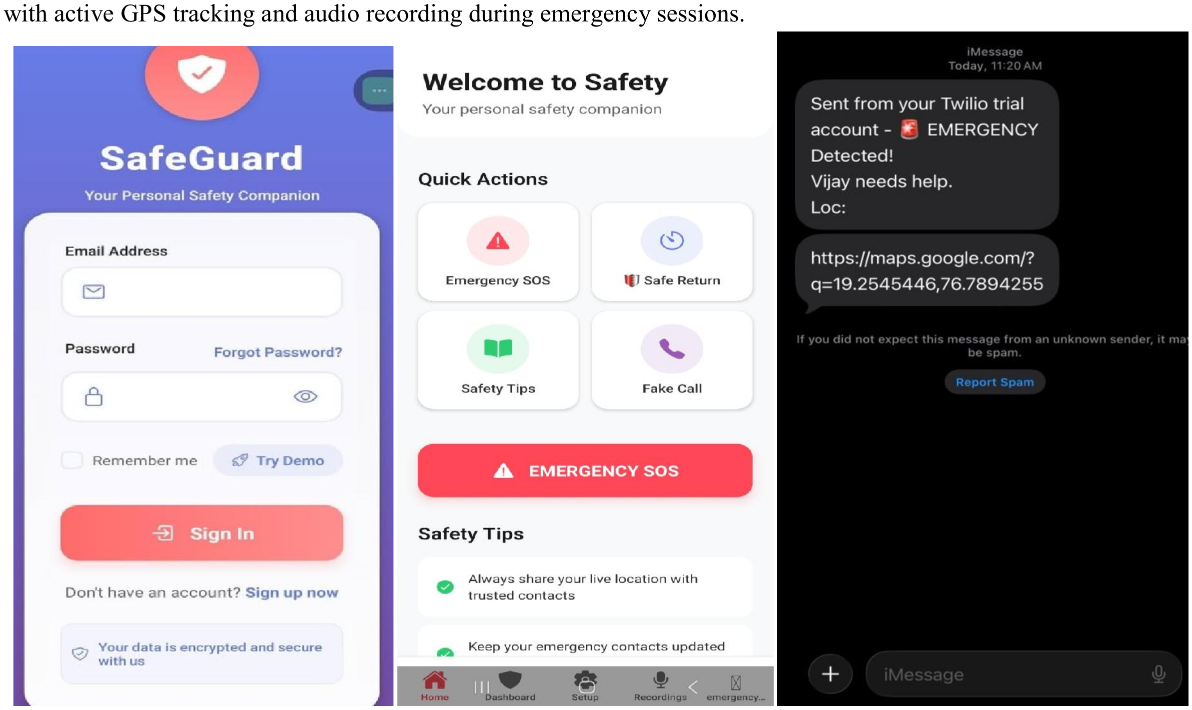
The Location Tracking Module continuously updates the user's position throughout the emergency session. The Recording and History Module securely stores all emergency audio recordings in timestamped .wav format, enabling playback, sharing, or deletion. A centralized Safety Dashboard displays live system status, including microphone activity, GPS availability, recording duration, and monitoring state. Manual SOS and fake-call features were also integrated to provide additional safety mechanisms.

The application was tested on Android smartphones equipped with a microphone, GPS sensor, minimum 4GB RAM, and internet connectivity. Background execution permissions and notification services were configured to ensure uninterrupted operation during emergencies.

IX. RESULTS

The implemented system successfully demonstrated real-time, hands-free emergency detection in practical testing scenarios. When predefined distress keywords were spoken, the application accurately detected the emergency context and triggered the SOS protocol within a few seconds. System screenshots confirm successful keyword detection, emergency alerts, and activation of recording and tracking features.

The alert notification system performed reliably, with emergency contacts receiving instant messages containing accurate location coordinates, timestamps, and Google Maps links. This validated the end-to-end communication pipeline from voice detection to alert delivery. The Safety Dashboard confirmed continuous background monitoring with active GPS tracking and audio recording during emergency sessions.



The audio evidence recording feature generated multiple timestamped recordings, all of which were successfully stored and accessible through the Emergency Recordings module. These recordings enhance post-incident analysis and can serve as legal or investigative evidence. System logs further verified correct detection of emergency keywords and consistent trigger execution.

User interface evaluation showed that the application was intuitive and responsive, allowing users to rely on automatic emergency detection without manual intervention. Compared to traditional safety applications requiring physical SOS activation, the proposed system significantly reduced response time during panic situations.

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Although increased battery consumption and sensitivity to background noise were observed due to continuous voice monitoring, the system effectively met its design objectives. The results confirm that integrating voice-based threat detection, real-time location tracking, and automated alert mechanisms significantly improves emergency response and personal safety.

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