International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 10 Issue: 10 | Oct - 2026 SJIF Rating: 8.659 ISSN: 2582-3930

VIRA: Vital Incident Response App — An AI-Powered Predictive Women Safety and Emergency Response Platform

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***Abstract*—**Women's safety remains a major social issue and calls for smart, prompt emergency response measures. Since most current safety apps depend mainly on manual SOS activation, this may fail in urgent cases in which the victim is unable to ask for help. The paper introduces "VIRA (Vital Incident Response App), an AI-powered predictive women's safety and emergency response system" which is intended to enable proactive threat detection and quick emergency assistance. The system uses Artificial Intelligence to study user behaviour, identify unusual activities, evaluate possible risks, and pick up voice-based distress signals. When an emergency occurs, the platform can automatically send out alerts or let the user initiate an SOS by pressing the button three times. It then immediately sends the user's live location together with audio and video evidence to their trusted contacts and to emergency responders. A cloud-based analytics dashboard allows for the secure storage, monitoring, and analysis of emergency incidents. By combining predictive intelligence, automated emergency alerts, and real-time communication, VIRA seeks to reduce response times, improve situational awareness, and boost personal safety. The proposed platform provides a scalable, software-based solution that helps to promote women's empowerment and aids in the creation of safer communities by means of intelligent technology.

***Keywords*—**Women's Safety, Predictive AI, Emergency Response, Voice-Based SOS, Real-Time Location Tracking.

I. INTRODUCTION

Even though there have been technological advances and more stringent laws, women's safety is still a major concern because cases of harassment, assault, and violence are rising. Since most current safety apps depend on the user manually activating an SOS signal, this might not be feasible in an emergency because of fear, panic, or injury. VIRA (Vital Incident Response App) is an AI-driven women's safety service which offers proactive protection by means of smart danger detection, predictive risk assessment, learning of user behaviour, anomaly detection, recognition of a voice SOS, and automatic triggering of an emergency. The system also records audio, video, and the current GPS position as evidence and sends this on instantly to trusted contacts and emergency services. Through the combination of AI, automation, and real-time communication, VIRA makes it possible to have a faster emergency response and improves personal safety.

II. MOTIVATION

VIRA aims at improving women's safety by means of predictive threat detection powered by AI and through automated emergency response. It overcomes the limitations of manual SOS systems by allowing intelligent risk detection, emergency activation based on multiple triggers, and real-time communication in order to provide faster and more reliable help when emergencies occur.

III. PROBLEM STATEMENT

When it comes to asking for help in an emergency, women are especially at risk since they are more prone to freezing in fear or suffering a severe panic attack that stops them from pressing the SOS button on their safety app. Most of the current safety apps have limited capabilities and are not proactive enough in identifying possible threats or in anticipating the user's needs. There is a need for a more intelligent and quicker solution which makes use of cutting-edge artificial intelligence to detect dangerous patterns and take the necessary actions before it is too late.

IV. OBJECTIVES

- To create a women's safety platform based on AI that can identify possible threats by using intelligent danger detection and predictive risk assessment.
- To incorporate intelligent functions such as the ability to learn user behaviour, detect anomalies, and recognize a voice SOS in order to identify emergencies proactively.
- To design an emergency response system involving the use of an SOS button, using the hardware volume-key trigger, detecting voice, and automatically triggering the emergency using AI.
- To automatically gather and securely send to trusted contacts and emergency services the current GPS position as well as audio and video evidence in emergency situations.
- To develop an AI analytics dashboard for real-time monitoring, incident analysis, and performance evaluation to improve emergency response efficiency.

V. LITERATURE REVIEW

A. Introduction to Existing Research

Current women's safety systems use AI, GPS tracking, a voice SOS feature, contextual risk assessment, and cloud-based emergency communication in order to improve personal security. Even though studies [1]–[13] show considerable progress, the majority of these solutions still depend on manual SOS activation and do not have integrated AI behaviour learning, predictive analytics, Digital Twin technology, and automated emergency response.

B. Summary of Previous Research Work

Previous research between 2025 and 2026 introduced AI-based women safety systems that include GPS tracking,

voice SOS, contextual risk assessment, cloud communication, offline SMS alerts, location sharing and automatic evidence collection to improve emergency response. Darekar et al. [1], Yadav et al. [2], and Ara and Rajeshwari [11] focused on emergency alerts, contextual risk analysis and voice-based SOS mechanisms. Kanse et al. [3], Singh et al. [5], Shastrakar et al. [6], and Shastri et al. [7] developed mobile applications with real-time emergency communication, offline messaging and cloud-enabled support. Salve et al. [8], Rastogi et al. [9], Shinde et al. [10], Pawar et al. [12], and Kouser et al. [13] enhanced women's safety through Android-based applications, predictive SOS systems and location-based emergency services. However, most existing solutions provide limited intelligent automation and lack an integrated AI-driven platform that combines behaviour learning, predictive analytics, anomaly detection and automated emergency response.

C. Comparison of Existing Methods/Techniques

Table I compares a representative subset of the reviewed systems across their method, dataset/application, key findings, limitations, and the research gap each leaves open.

TABLE I. COMPARISON OF EXISTING METHODS/TECHNIQUES

Ref.	Author(s) & Year	Method / Technique	Dataset / Application	Key Findings	Limitations	Research Gap
[1]	Darekar et al. (2026)	AI, Random Forest, CNN Voice SOS, GPS Tracking	Historical crime data, GPS, voice dataset	Predicts crime hotspots, voice SOS, and safe-route recommendation	Depends on historical crime data and internet connectivity	No AI behaviour learning, Digital Twin, or AI analytics
[2]	Yadav et al. (2026)	AI contextual risk assessment	GPS, motion sensors, environmental data	Calculates real-time danger score using contextual information	Focuses only on contextual monitoring	No automatic evidence collection or AI analytics dashboard
[3]	Kanse et al. (2026)	Offline SMS, shake detection, community alerts	Android mobile application	Supports offline SMS, fake calls, and shake-triggered SOS	Focuses mainly on communication features	No AI-based risk prediction or intelligent analytics
[4]	Tyagi et al. (2026)	Review and recommendation of AI safety tools	N/A – survey paper	Surveys and recommends AI tools applicable to women's safety	Tool survey only; no integrated system proposed	No integration of prediction, activation, and evidence handling in one system
[7]	Shastri et al. (2026)	One-tap SOS, cloud communication, AI chatbot	Android application, Firebase	Secure communication with live GPS tracking and an AI chatbot assistant	Conversational assistance is not automated detection	Prediction and anomaly detection not central
[11]	Ara & Rajeshwari (2026)	AI-based emergency alert system	Mobile app, GPS, voice commands	Provides voice SOS, live location sharing, and emergency notifications	Mainly focuses on emergency alerts	Lacks predictive AI and anomaly detection
[12]	Pawar et al. (2025)	Predictive SOS & evidence collection	Mobile app, GPS, camera, microphone	Automatically records evidence and sends emergency alerts	Limited intelligent decision-making	No Digital Twin, behaviour learning, or anomaly detection

D. Summary of Literature Review

The studies currently available concern women's safety and include features such as GPS tracking, emergency alerts, voice recognition, cloud tracking, context risk analysis and Android emergency applications [1]–[13]. Most of the earlier research has been concerned with improving individual features that are missing from an intelligent platform. This research gap is the reason why an AI system is being developed which incorporates proactive threat detection, behaviour-driven risk prediction, emergency response, evidence collection and smart decision-support systems, called VIRA.

E. Research Gap Identification

Most of the current systems depend on manual SOS activation and offer only limited AI features. They do not include predictive risk assessment, AI-driven learning of user behaviour, anomaly detection, emergency activation based on multiple triggers, automatic gathering of evidence, and real-time analytics. There is still a need for a comprehensive software platform based on AI aimed at proactive women's safety.

F. Need for the Proposed Work

Having taken into account the gaps identified, there is a need for a single platform which combines predictive intelligence, multi-channel emergency triggering, automated evidence capture, and real-time analytics if we are to go beyond the current fragmented and manual-SOS-dependent solutions. This need is precisely what leads to the design of the proposed VIRA system.

VI. PROPOSED METHODOLOGY

The VIRA (Vital Incident Response App) enhances current women's safety systems by incorporating AI-assisted risk analysis, multiple emergency triggers, real-time location tracking, automated evidence capture, and cloud-backed incident handling. The implemented prototype uses a Flutter mobile client, Firebase/Cloud Firestore for authentication-related data and incident records, and a Python Flask backend for SOS alert processing, media handling, and location anomaly analysis. The system is designed to support individuals, educational institutions, and organisations by improving emergency response and providing a basis for further predictive safety research.

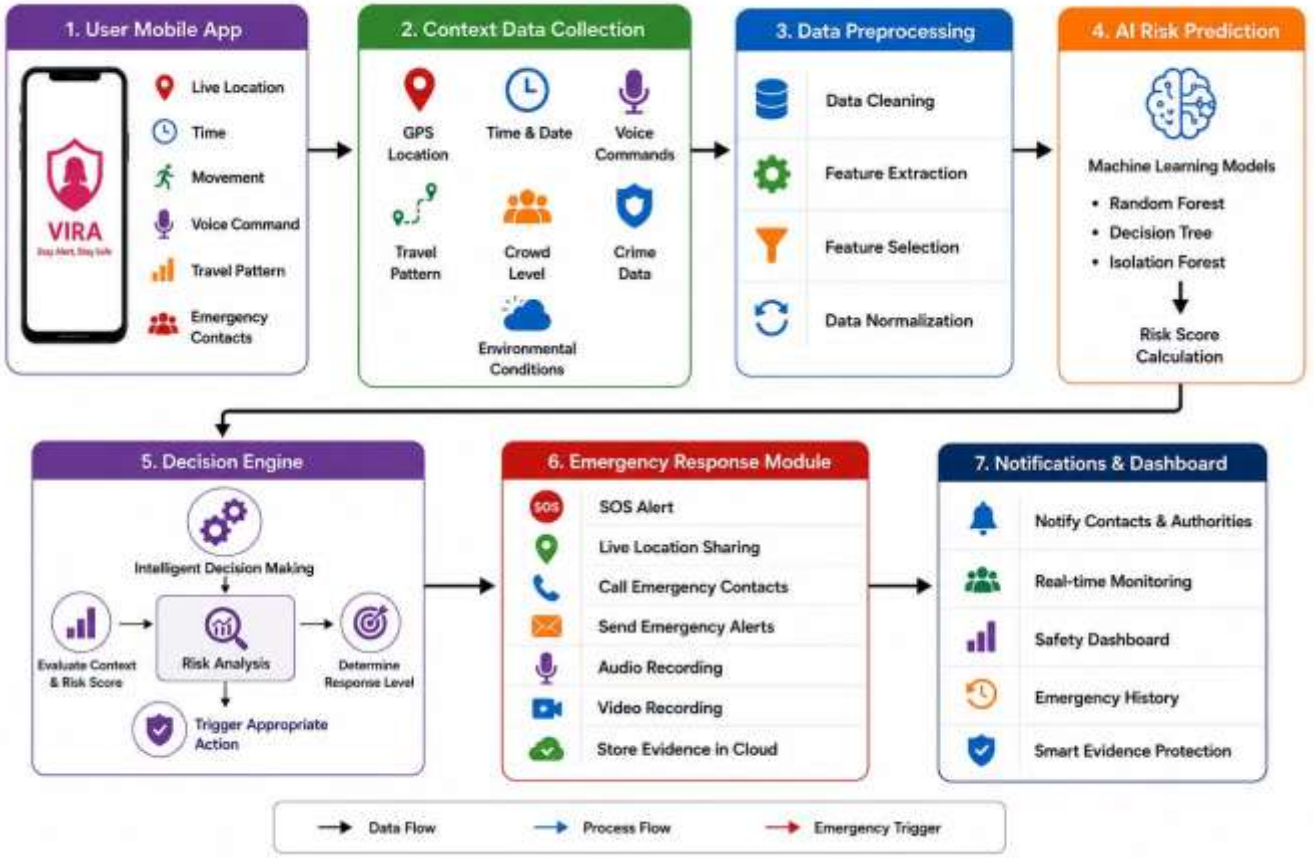


Fig. 1. Proposed VIRA methodology and end-to-end emergency response workflow.

The methodology diagram presents the proposed end-to-end VIRA pipeline from user-side context collection through preprocessing, AI-assisted risk analysis, decision making, emergency response, and monitoring. The current prototype implements the components described in the implementation sections, while some elements shown at the conceptual methodology level represent the broader proposed architecture.

A. System Workflow

The VIRA workflow moves through seven steps. (1) The user mobile application records live location, time, movement, voice commands, travel pattern and emergency contacts. (2) Contextual data collection gathers GPS location, time, date, voice commands, travel pattern, crowd level, crime data and environmental conditions. (3) Data preprocessing cleans the data, extracts and selects features, and normalizes the results. (4) AI risk prediction uses machine learning models such as Random Forest, Decision Tree and Isolation Forest to compute a risk score. (5) The decision engine checks context and risk score, performs risk analysis, and chooses the appropriate response level. (6) The emergency response module sends an SOS alert, shares live location, calls emergency contacts, sends emergency alerts, and records audio and video, storing all evidence in the cloud. (7) The notifications and dashboard module informs contacts and authorities, allows real-time monitoring, keeps a safety dashboard and an emergency history, and protects evidence smartly.

B. Implementation Architecture

The implemented VIRA prototype follows a client–backend–service architecture. The Flutter application acts as the primary client and provides the SOS interface, live tracking, voice-triggered emergency activation, volume-key activation, trusted-contact management, incident history, and route visualization. Firebase Cloud Firestore stores authentication-related profile data, trusted contacts, incidents, locations, and other application records. A Python Flask backend exposes REST endpoints through a single development tunnel. The /api/sos endpoint prepares and sends the emergency alert, /api/sos/media handles video upload and playback, and /api/analyze performs location-based anomaly analysis. Gmail SMTP is used for email delivery, while local storage is used for uploaded SOS video clips in the prototype.

C. Implementation Details

The emergency workflow is coordinated by the SosAlertService in the Flutter client. An SOS can be initiated from the on-screen button, the native Android volume-key trigger, or a saved voice phrase when the application is active. Once triggered, the application moves to the tracking view, calls the primary trusted contact immediately, obtains the available GPS position, records a short evidence clip, sends the combined alert request to the backend, and records the incident outcome. For background volume-key activation, an Android accessibility service uses cached profile and contact information so that the trigger can operate even when the application is closed. The voice trigger uses a foreground speech-recognition flow with a cooldown period, and the microphone is released before evidence recording begins to avoid resource conflicts.

Live location and navigation are implemented through background location processing. Trail points and zone visits are queued and periodically synchronized with Firestore. Safe navigation uses OpenRouteService walking routes with restricted zones represented as buffered polygons; the application detects significant off-route movement and requests a new route when necessary. The evidence module captures audio/video when permissions are available and stores the resulting clip for playback. If camera or microphone permission is unavailable, the alert is still sent without the recording so that evidence capture failure does not prevent emergency notification.

For AI-assisted analysis, the backend extracts features such as hour, day of week, speed, and distance from a location centroid and applies the Isolation Forest algorithm from scikit-learn to identify anomalous movement patterns. This implementation represents the current anomaly-analysis component; broader real-time predictive risk scoring and extended behavioural learning remain areas for further evaluation and development. The prototype was tested through device-level functional scenarios covering SOS activation, background volume-key triggering, voice activation, evidence capture, restricted-zone navigation, incident logging, and authentication.

VII. CHALLENGES / LIMITATIONS

- Gathering up-to-date GPS coordinates, crime logs and environmental data is difficult because missing or old information can hurt the system's predictions.
- Data preprocessing needs cleaning, extracting features and normalizing the data so that the machine learning models get high-quality input for correct analysis.
- Choosing and training the machine learning algorithms while keeping high prediction accuracy in many real-world scenarios is a big challenge.
- Sending emergency alerts while avoiding false alarms and not missing real emergencies is essential for the system to work reliably.
- Running voice and sensor triggers in the background is limited by Android's battery-optimization settings, so a foreground service is used to work around this.
- Finding or creating a distress-audio dataset is hard because there is no public dataset that matches this specific use case.

VIII. RESULTS AND DISCUSSION

Following completion of the core modules, the VIRA prototype was evaluated through structured functional testing together with a field trial in which the Android application was distributed to students and staff at PRPCEM for use on their own devices. Combining controlled test cases with this real-device usage was intended to verify that each emergency-response pathway behaved as designed under practical conditions rather than only within a development environment.

A. Functional Test Results

Table II summarizes the core test scenarios covering the SOS button, the hardware volume-key trigger, the voice trigger, evidence capture, restricted-zone navigation, incident logging, and authentication, along with the outcome observed for each.

TABLE II. FUNCTIONAL TEST RESULTS FROM DEVICE-LEVEL AND FIELD TESTING

Feature	Test Scenario	Observed Result
SOS button	Trigger with a trusted contact saved	Track tab opens, primary contact is called, and one combined alert is sent
No contact added	Trigger with no active contact	SOS blocked with a prompt to add a trusted contact
Volume-key trigger	Press hardware trigger with the app closed	Native service raises SOS using the cached profile and contacts
Voice trigger	Say the saved phrase with the app open	SOS fires with a 30 s cooldown; microphone released before recording
Evidence capture	Camera or microphone permission denied	Alert still sent without a recording; no crash occurs
Restricted-zone route	Set zones, then start an SOS route	Route avoids 200 m zones; reroutes automatically if more than 45 m off path
Incident log	Complete an SOS	Incident saved as sent, partial, or failed, with the recipient list
Login and profile	Enter a wrong password, then change it	Correct error shown; password hash never returned to the UI

The results in Table II indicate that the multi-trigger SOS mechanism performed consistently across the tested scenarios, including when the application was closed and only the hardware volume-key trigger was active. The evidence-capture pathway degraded gracefully when camera or microphone permissions were unavailable, sending the alert without a recording rather than failing outright. Restricted-zone routing and automatic rerouting also functioned as intended during the field trial, which involved users navigating with the application on their own devices rather than in a controlled lab setting.

B. Field Testing Analytics

In addition to the scenario-based testing in Table II, the application logs every SOS alert it raises, including its trigger method, delivery outcome, recording status, and reported GPS accuracy. During the college-wide trial, two trial accounts on separate devices accumulated enough alert history for this log data to be analyzed. Table III reports the aggregate figures for both accounts.

TABLE III. AGGREGATE SOS ALERT ANALYTICS FROM FIELD TESTING

Metric	Account A – full history	Account B – last 30 days	Account B – last 7 days
Total SOS alerts	31	11	2
Fully delivered	81% (25/31)	18% (2/11)	100% (2/2)
Contacts reached	40	13	4
Alerts with recording	68% (21/31)	9% (1/11)	50% (1/2)
Trigger method split	SOS 42%, Volume key 39%, Voice 19%	SOS 91%, Voice 9%	SOS 50%, Voice 50%
Peak activity window	12–4 PM (26/31)	12–4 PM (10/11)	12–4 PM (1/2)
Avg. reported GPS accuracy	~90 m	~36 m	~11 m

The two accounts show different delivery outcomes over their logged history, and the underlying cause in both cases was network connectivity at the moment of the alert rather than a fault in the alert-generation logic itself. Account A recorded 31 SOS alerts with an 81% full-delivery rate, while Account B recorded 11 alerts over the last 30 days with only 18% fully delivered during a period of unstable network connectivity at the test location. In every recorded case, the SOS was still correctly triggered and queued for delivery by the application; the shortfall occurred specifically when the device could not reach the backend's alert-dispatch endpoint. Account B's most recent seven days, tested under normal network conditions, show both alerts fully delivered, which is consistent with this explanation. This indicates that the core SOS-triggering mechanism operates reliably regardless of connectivity, and that end-to-end delivery is governed primarily by the device's network conditions at the moment of the incident — a dependency common to any communication-based safety application. Planned improvements, including automatic retry logic and an SMS-based fallback channel when data connectivity is unavailable, are intended to reduce this dependency further.

On both accounts, the on-screen SOS button was the most frequently used trigger, consistent with the scenario testing in Table II, though the voice trigger and the hardware volume-key trigger were each exercised as well, confirming that all three activation pathways work on physical devices outside the development environment. Reported GPS accuracy ranged from about 11 m to 90 m across sessions, which is adequate for directing a trusted contact to the user's location but varies with conditions such as indoor use or reduced satellite visibility. Alerts were also heavily concentrated in the early-afternoon window (12–4 PM) on both accounts, which reflects when the trial testing was actually carried out rather than a property of the system itself.

C. Discussion

Several practical issues surfaced during development and testing rather than at the design stage. Background execution of the SOS trigger was initially unreliable once the application was closed; this was addressed by routing the hardware volume-key trigger through an Android accessibility service that works from a cached profile and contact list. Alert delivery was also found to be delayed when the system waited for audio/video recording and upload to finish before contacting the primary contact; the flow was changed so the primary contact is called immediately while the recording proceeds in parallel. A further conflict between the voice listener and the video microphone was resolved by releasing the microphone before recording starts, and recordings that initially failed to play back were traced to insecure (http) links, which are now forced to https.

Taken together, these results indicate that the implemented system addresses several of the gaps identified in Section V, in particular the dependence on a single manual SOS trigger reported for most of the reviewed systems and the limited automatic evidence collection noted in Section V-D. A full quantitative evaluation of the AI risk-assessment component, including anomaly-detection accuracy over an extended usage period, remains part of ongoing work as the system moves from a college-based trial toward broader deployment.

IX. INNOVATION / SOCIAL RELEVANCE

VIRA, short for Vital Incident Response App, offers a way to predict dangerous situations and give quick help when needed. This app is different from existing safety apps because it brings together real-time risk prediction, intelligent guidance, and automatic emergency response in a single platform. VIRA is centred on making women safer and helping communities with their safety. It also supports broader efforts to make public safety better through technology, contributing to the Digital India movement by using technology to improve people's lives and create ways to stay safe in the future.

X. CONCLUSION

This paper presented VIRA, an AI-powered predictive women safety and emergency response platform designed to overcome the limitations of manual-SOS-dependent applications through proactive threat detection, multi-trigger emergency activation, and automated evidence collection. The completed system integrates backend and database architecture, user authentication, emergency contact management, a working SOS trigger pipeline, voice-based distress recognition, live location tracking, audio/video evidence capture, an AI risk assessment engine, real-time notifications, and an incident dashboard using Flutter, Flask, and Firebase. The implemented platform combines artificial intelligence, automation, and real-time communication to reduce emergency response time, enhance situational

awareness, and contribute to the broader goal of building safer communities through intelligent technology.

ACKNOWLEDGMENT

The authors thank the Department of Computer Science & Engineering, PRPCEM, for providing the resources and testing environment used in this work, and the students and staff who took part in the field trial.

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