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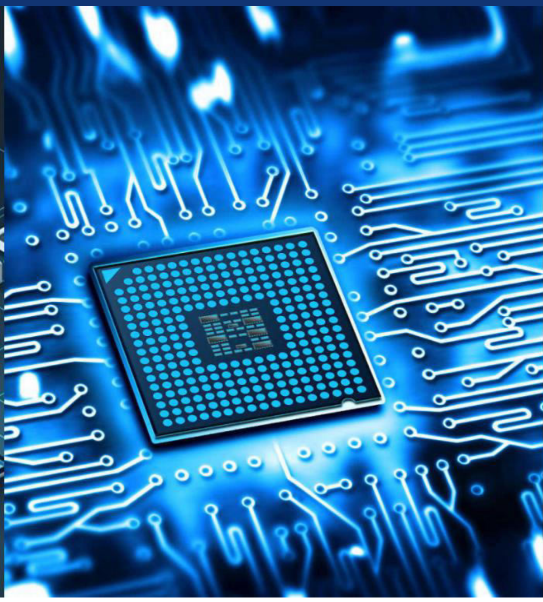


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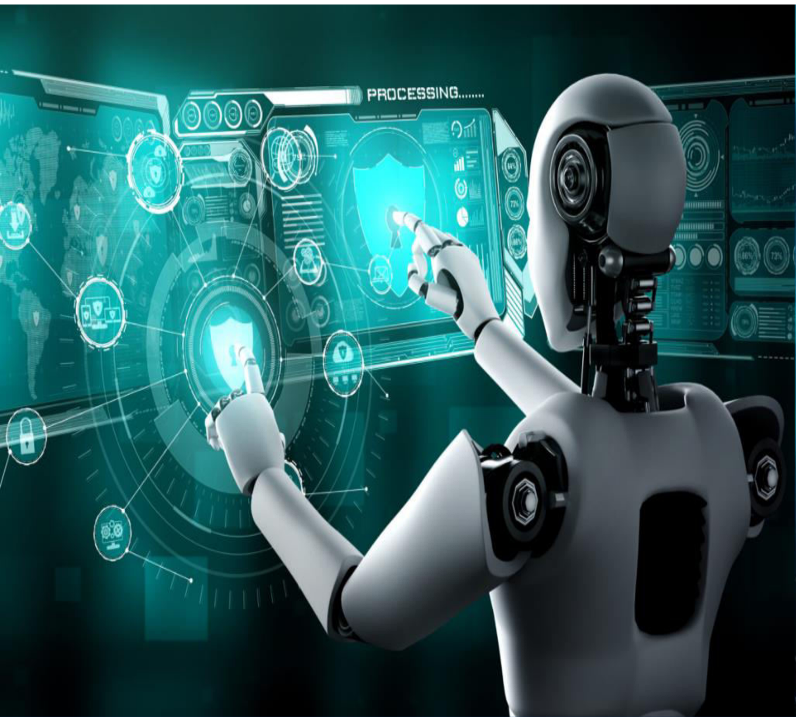

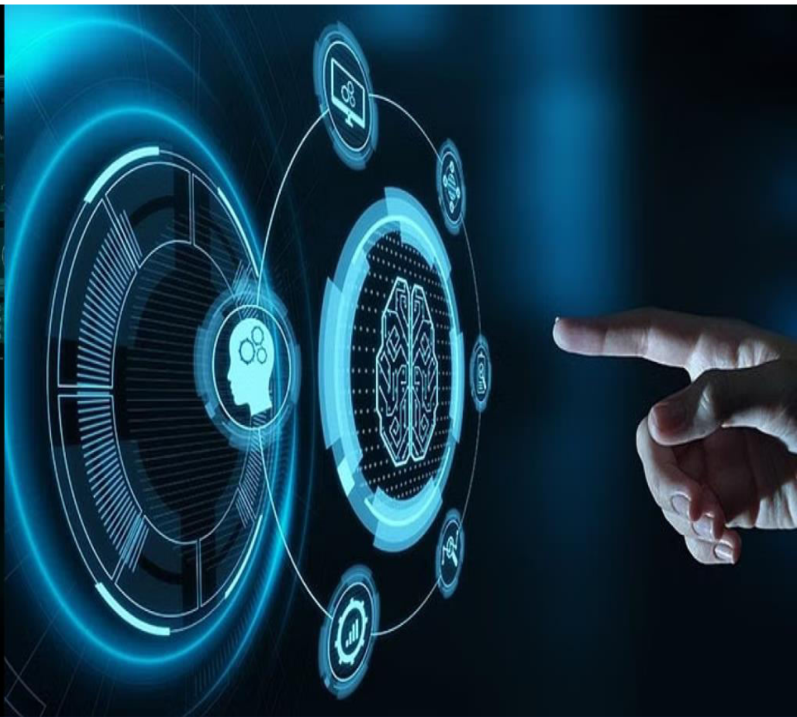

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Suraksha Women Safety Mobile App

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ABSTRACT: Women's safety continues to be a pressing societal concern, and although numerous smartphone-based safety applications have been introduced, most remain heavily dependent on continuous internet connectivity, offer no mechanism to preserve digital evidence, and lose emergency data whenever the network fails. This paper presents Suraksha, an Android-based women safety application designed around an offline-first architecture that ensures emergency alerts are never lost, regardless of network availability. A single tap on the SOS button retrieves the user's GPS location, generates a unique emergency request, and, depending on connectivity, either transmits the request to a Node.js/Express backend through Retrofit REST APIs for storage in Firebase Realtime Database, or stores it locally in a Room database and dispatches an SMS alert to registered contacts. Android WorkManager automatically synchronizes pending requests once connectivity is restored. The application also records audio and video evidence during an emergency and uploads it securely to Cloudinary, while a web-based tracking portal lets emergency contacts monitor the user's live location and status. Built using Kotlin, Jetpack Compose and the MVVM architecture, the system was evaluated through functional, integration, system and validation testing under both online and offline conditions. Results confirm reliable SOS generation, continuous location tracking, guaranteed offline SMS delivery, and secure evidence preservation, positioning Suraksha as a more dependable alternative to existing women safety applications.

KEYWORDS: Women Safety; Android Application; Offline-First Architecture; SOS Alert; Real-Time GPS Tracking; Firebase Realtime Database; Digital Forensic Evidence; WorkManager Synchronization

I. INTRODUCTION

Rapid urbanization and a rising number of harassment and assault incidents have made women's personal safety a critical societal and technological concern. Smartphones, equipped with GPS, background services and multimedia capabilities, have become a natural platform for delivering rapid emergency assistance, leading to a wave of women-safety mobile applications from both government agencies and independent developers.

An examination of currently deployed applications, however, reveals that most of them assume an always-available internet connection. When network coverage is poor, alerts are delayed or dropped entirely, and none of the widely used systems provide a mechanism to automatically capture and preserve audio or video evidence that could later assist investigators. The absence of background synchronization further means that any emergency data generated while offline is permanently lost once the application is closed or the device is restarted.

This paper presents Suraksha, an Android women-safety application engineered to remain functional under both network conditions. Suraksha combines one-tap SOS activation, continuous GPS tracking, automatic multimedia evidence capture, and a dual online/offline communication path within a single system. Emergency requests generated offline are queued locally and synchronized transparently through Android WorkManager, while a companion web-based tracking portal allows registered contacts to follow the user's location and status in real time. The remainder of this paper is organized as follows: Section II reviews related work, Section III describes the proposed system and its architecture, Section IV discusses implementation details, Section V presents the results obtained from testing, and Section VI concludes the paper with directions for future work.

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II. RELATED WORK

Shenoy et al. [1] proposed a holistic crime-prevention and response framework that combines mobile technology, GPS services, cloud infrastructure and community participation to improve women's safety. While conceptually strong, the framework stops short of offering offline communication, automatic evidence capture or background synchronization, and remains largely a design proposal rather than a deployable system.

Government-backed applications such as Himmat (Delhi Police), the 112 India Emergency Response Support System, and T-SAFE provide SOS alerting and location sharing with police control rooms, but all three require an active internet connection, offer no offline fallback, and do not capture or store multimedia evidence.

Jefry et al. [2] developed a geolocation-based safety application that transmits GPS coordinates to emergency contacts, and Kumari et al. [3] proposed a GPS/GSM-based alerting system; both approaches improve location sharing but remain internet-dependent, provide no evidence recording, and lack cloud integration or a live-tracking portal. Similar limitations are reported in subsequent Android-based safety systems [4]–[8], which focus almost exclusively on alert generation and location transmission.

Taken together, the reviewed literature shows that existing women-safety solutions converge on two core features SOS notification and location sharing while consistently omitting offline SMS fallback, automatic multimedia evidence capture, cloud-based forensic storage, background data synchronization and real-time web-based tracking. Suraksha is designed specifically to close this gap by combining all of these capabilities within a single offline-first architecture.

III. PROPOSED SYSTEM

Suraksha follows a modular client–server architecture organized into four layers - the Android mobile application, the backend server, cloud services, and a live tracking portal built on the Model–View–ViewModel (MVVM) pattern to separate the user interface from business logic and data management.

A. System Architecture

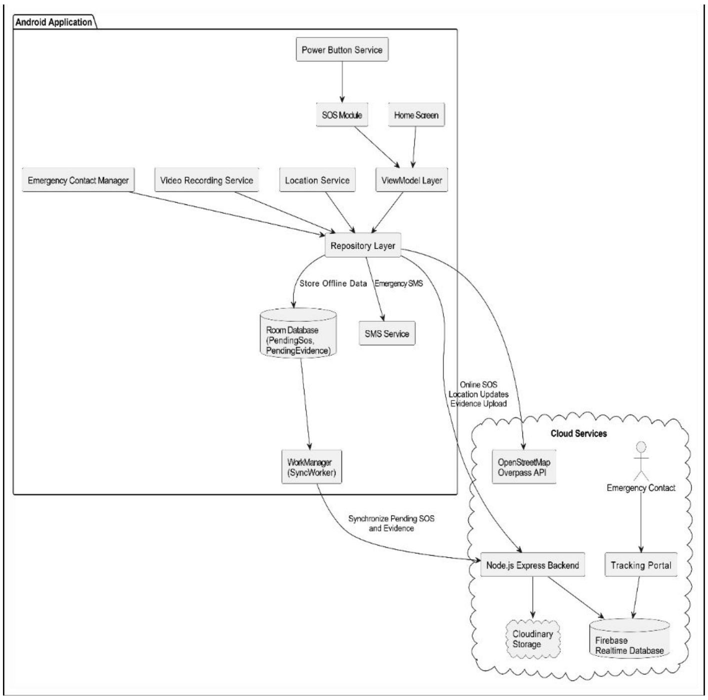

Fig. 1. Overall system architecture of Suraksha

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When the user triggers an SOS event, either through the in-app button or the device power button, the application retrieves the current GPS location through Google's Fused Location Provider and constructs an emergency request through the Repository Layer. If internet connectivity is available, the request, subsequent live location updates and recorded evidence are transmitted to the Node.js/Express backend through Retrofit-based REST APIs; the backend persists SOS and tracking data in Firebase Realtime Database and forwards multimedia files to Cloudinary storage. If connectivity is unavailable, the request and evidence metadata are stored locally in a Room database, and an SMS alert containing the user's location is dispatched directly to registered emergency contacts. Android WorkManager continuously monitors the local queue and automatically synchronizes pending records with the backend once the network is restored, while registered contacts can independently follow the emergency through a browser-based tracking portal.

B. Module Description

The proposed system is composed of the following functional modules:

- Emergency Contact Manager – add, update, delete and retrieve trusted contacts, persisted locally using Room for offline availability.
- SOS Module – captures the emergency trigger, generates a unique SOS identifier and coordinates the emergency workflow.
- Location Service – continuously retrieves GPS coordinates through the Fused Location Provider and streams updates to the backend.
- Video Recording Service – automatically captures audio/video evidence at the moment SOS is triggered.
- Repository Layer – abstracts data access and routes requests to Room (offline) or Retrofit (online) based on connectivity.
- WorkManager SyncWorker – background component that guarantees eventual delivery of queued SOS records and evidence.
- Node.js/Express Backend – exposes REST APIs, persists data in Firebase Realtime Database, and coordinates evidence upload to Cloudinary.
- Live Tracking Portal – an Express.js web application that lets emergency contacts view real-time location, status and evidence.

C. Offline-First Communication Workflow

The core reliability guarantee of Suraksha comes from its offline-first workflow, summarized below:

- Step 1 – SOS Trigger: the user activates SOS through the app button or the device power button; the current GPS location is captured immediately.
- Step 2 – Connectivity Check: the Repository Layer determines whether the device currently has internet access.
- Step 3 – Online Path: if connectivity exists, the request is sent via Retrofit to the Node.js backend, which writes it to Firebase Realtime Database and forwards evidence to Cloudinary.
- Step 4 – Offline Path: if connectivity is absent, the request and evidence metadata are written to Room, and an SMS containing the location is sent directly to registered contacts.
- Step 5 – Background Synchronization: once the network is restored, WorkManager's SyncWorker uploads all pending Room records to the backend and clears them locally to avoid duplication.
- Step 6 – Live Monitoring: the tracking portal reflects new location and status updates in real time as they arrive in Firebase.

IV. IMPLEMENTATION

Suraksha's Android client is implemented in Kotlin using Jetpack Compose for the UI layer and follows the MVVM pattern; Room provides local persistence, Retrofit handles REST communication, and Android WorkManager guarantees background synchronization. The backend is built with Node.js and Express, uses Firebase Realtime Database for emergency and tracking data, and integrates Cloudinary for secure multimedia storage; the OpenStreetMap Overpass API is used to identify nearby police stations. The live tracking portal is a lightweight Express.js web application that queries Firebase directly to render the user's live location and status.

On activation, the SOS Module obtains the current location and creates a PendingSos record. The Repository Layer checks network availability; when online, it invokes the Retrofit API to push the record and begins streaming location

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updates and evidence uploads, while the backend stores this data in Firebase and Cloudinary respectively. When offline, the same record, together with any recorded evidence metadata, is written to Room and an SMS containing the location is sent immediately to registered contacts, so that emergency contacts still receive actionable information without delay. Once network connectivity returns, WorkManager schedules a SyncWorker that uploads all pending Room records to the backend, after which they are removed from local storage to avoid duplication.

The tracking portal subscribes to Firebase Realtime Database and updates its view whenever new coordinates arrive, allowing authorized emergency contacts to observe the victim's movement, current status and uploaded evidence without installing any application.

V. RESULTS AND DISCUSSION

The application was evaluated on Android 10 and above devices with GPS and internet access, using functional, integration, system and validation testing to verify emergency alert generation, live tracking, offline SMS delivery, evidence upload and portal performance under both online and offline network conditions.

TABLE I. SUMMARY OF FUNCTIONAL TEST RESULTS

Module	Test Objective	Result
Emergency Contacts	Add / update / delete contact	Pass
SOS Module	Trigger emergency alert	Pass
Location Service	Retrieve GPS coordinates	Pass
Offline Communication	Send emergency SMS without internet	Pass
Synchronization	Upload pending SOS after reconnect	Pass
Cloud Upload	Upload audio/video evidence	Pass
Tracking Portal	Display live emergency location	Pass

The Home Screen (Fig. 2, left) offers one-tap access to SOS activation, while the SOS Activation screen (Fig. 2, right) confirms that a unique SOS identifier is generated and the appropriate online or offline pathway is triggered depending on connectivity.

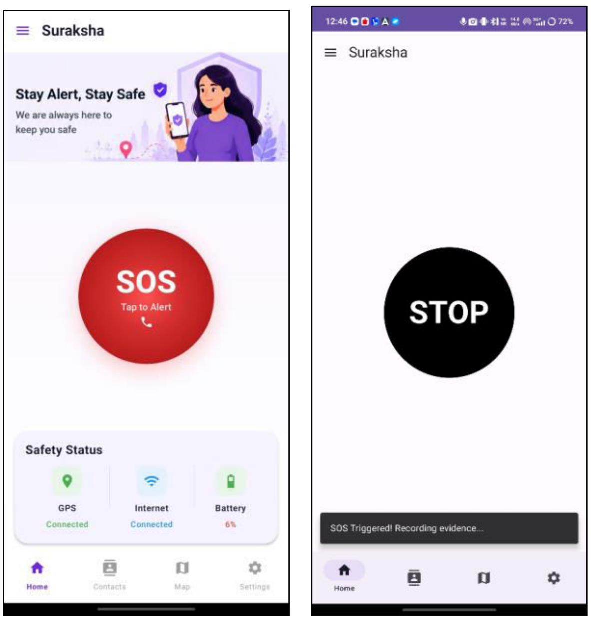

Fig. 2. Home screen and SOS activation screen

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The live tracking portal (Fig. 3) correctly reflects updated coordinates, emergency status and uploaded evidence in real time, confirming that Firebase-based synchronization between the mobile application and the web portal functions as designed.

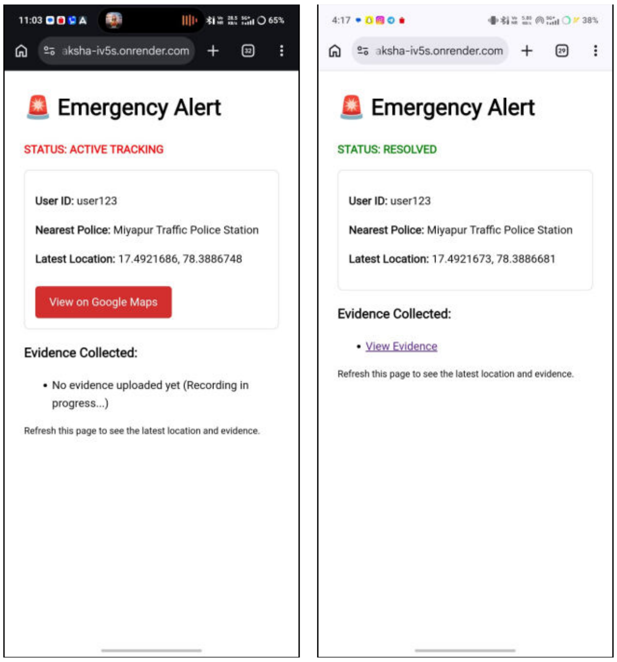

Fig. 3. Live tracking portal interface

Compared with Himmat, 112 India and T-SAFE, Suraksha's offline-first design ensures that no emergency request is lost when connectivity fails, since Room-backed local storage combined with SMS fallback and WorkManager-based synchronization together guarantee eventual delivery. Furthermore, unlike the reviewed research systems [1]–[8], Suraksha automatically records and preserves multimedia evidence in the cloud, providing investigators with material that purely GPS/SMS-based systems cannot offer.

VI. CONCLUSION AND FUTURE SCOPE

This paper presented Suraksha, an Android-based women safety application that unifies one-tap SOS alerting, continuous GPS tracking, automatic evidence capture and an offline-first communication architecture within a single system. By combining Room-based local storage, WorkManager-driven background synchronization, Firebase Realtime Database, Cloudinary storage and a live web tracking portal, the application delivers reliable emergency communication even when internet connectivity is intermittent or unavailable, directly addressing the reliability and evidence-preservation gaps identified in existing government and research-based safety applications.

Future enhancements to the system may include:

- Integration with wearable devices for gesture-based SOS triggering.
- AI-based risk prediction using location and behavioural patterns.
- Multilingual voice-command based emergency activation.
- Extension of the platform to elderly citizens, children and other vulnerable groups.

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