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"SafeSteps" A Flutter-Based Application to Provide Security to Women

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Abstract: *With rising concerns over women's safety, especially in areas with limited internet connectivity, traditional safety apps fall short due to their reliance on online GPS tracking. This paper introduces SafeSteps, a novel mobile and IoT-based safety solution that leverages SIM card-based location tracking and offline emergency alert mechanisms to provide rapid assistance during critical situations. Unlike existing solutions like bSafe and My Safetipin, SafeSteps can function without internet access, using the cellular network to determine the user's location and send SOS messages via SMS to both authorities and nearby users. The system features gesture-based triggers—such as pressing the power or volume button or other phone gestures—enabling discreet activation during emergencies. Additionally, an IoT wearable device enables users to trigger the same alert mechanism with a physical button. This paper presents the app architecture, the integration of SIM-based tracking, the SMS broadcast mechanism, and community-based safety responses. Our approach emphasizes accessibility, speed, and reliability, demonstrating a practical and innovative step toward safer environments for women.*

Keywords: Women's Safety, Offline Tracking, SIM-Based Location, SOS System, IoT Safety Device, Flutter App, Emergency SMS Alert, Power Button Trigger, Community Safety Network, Gesture-Based Alert.

I. INTRODUCTION

Women's safety is an on-going issue that is a challenge across the globe, particularly in areas that have inadequate infrastructural coverage and internet connectivity. Technological advancements notwithstanding, most women safety apps are based on GPS tracking that is greatly susceptible to the presence of internet connectivity at all times. In the case of rural or low-density areas, this reliance is a serious vulnerability where victims would not even be able to signal the authorities or communicate their location in case of an emergency.

To overcome these limitations, SafeSteps proposes a high-end mobile and IoT solution to mitigate internet connectivity dependence. Our system incorporates a SIM-based positioning technique that takes advantage of the cellular network to estimate the user position, so that the app is functional even in offline or poor-signal situations. This opens up the possibility for users located in remote or rural environments in which traditional GPS applications are not effective.

One unique characteristic of our system is the gesture-driven SOS alerting feature. The user can quietly activate alerts using universally available inputs like the power or the volume button on the smartphone, or other customized gestures, so that the user can have a rapid, discreet response in case

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of danger. These alerts are dispatched in the form of SMS messages to police officials as well as other geographically proximate registered users. This is not just meant to alert the police but also to form a decentralized, local safety network where civilians help as first responders, bringing the response time down to virtually zero, potentially even saving lives.

For added user security, an IoT-based wearable button has also been designed to form a part of our solution. This is a hardware device that gives women in distress the physical capability to activate the same panic sequence, providing an alternative avenue for triggering when the smartphone is not accessible. Our study is based on the earlier published “SafeSteps” application, enhancing it with major architectural improvements along with added features like offline location detection, broadcast SMS-style alerts, and community-driven assistance models. This paper explains the technical architecture, functional mechanisms, and implementation difficulties of SafeSteps, along with demonstrating its use-case efficiency through field trials and user feedback.

Through this project, we hope to be making an internet-independent, reliable, and scalable safety system accessible to women to feel safe across geographical or networking barriers.

II. WORKING

The SafeSteps system employs a combination of event-driven scheduling and optimized algorithms to ensure rapid, reliable responses during emergencies. The mobile application is designed around event-based scheduling, where specific hardware interactions such as multiple power button presses, long-presses of the volume button, or device shaking act as SOS triggers. These events are captured using Android's background services and broadcast receivers, allowing the app to function even when it is closed or the screen is locked. To prevent accidental activations, a debouncing mechanism is implemented, which validates the frequency and pattern of the trigger inputs within a set time frame—such as requiring three power button presses within five seconds.

Once a valid trigger is detected, the system simultaneously initiates multiple tasks: fetching the user's location via SIM-based tower triangulation, generating an SOS message, identifying nearby users using geo-spatial filtering, and sending out SMS or push notifications. These tasks run concurrently using asynchronous operations and multi-threaded scheduling supported by Dart isolates in Flutter. This non-blocking approach ensures low-latency response while maintaining a smooth user interface.

To locate nearby users, the app uses the mathematical formula to calculate distance and notify those within 2 km. Meanwhile, the IoT device works on a state machine model, switching between idle, active, and communication states based on button press, allowing it to send location via SMS using the GSM module.

Once the SOS is active—whether triggered via the app or the IoT device—a real-time monitoring loop is initiated by the system. This scheduled task checks, at fixed intervals (e.g., every 10 seconds), whether a registered user has responded and reached the victim's location. The app continuously logs location data and updates the backend until the situation is resolved and help is confirmed. The combined use of event-driven triggers, parallel processing, geo-spatial filtering, and state-machine logic ensures that SafeSteps operates efficiently across various network conditions while delivering fast and reliable emergency response.

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III. LITERATURE SURVEY

Sr No	Title	Year	Objective	Methodology	Advantages	Future Scope
1	Women Safety Enhancement Application [1]	2023	Real-time app for women's safety alerts.	Android app, SMS alerts, continuous tracking.	Continuous location sharing.	Add wearables, ML alerts, police integration.
2	Spark Women App [2]	2022	Emergency communicatin + legal awareness.	Mobile app with GPS, PANIC button, self-defense.	Easy use, law info, discreet alerts.	Expand to iOS, offline support, police link.
3	LoRa Faceted Device for Women's Safety [3]	2022	IoT-based proactive safety device.	LoRa + GPS + GSM + fingerprint	No manual action needed, long-range alerting.	Add video, biometric monitoring.
4	Sentinel: Neighbourhood Safety App [4]	2021	Community-based live location emergency alerts	Flutter app with local crowd alerts	Fast help, area-based alerts	Livestream, AI emergency detection
5	Safe Spaces in Humanitarian Contexts [5]	2020	Evaluate safe spaces for reducing gender-based violence	Systematic review of 7 global interventions	Improved psychosocial support	Need more quantitative evidence
6	Street Harassment & Women's Education (Delhi) [6]	2018	Link between safety perception and college choices	Survey + route mapping + logit model	Shows real cost of unsafe routes	Urban planning & safe transit policy

IV. SYSTEM ARCHITECTURE

1. Overview:

The architecture consists of:

- Flutter Front-End App
- SIM-Based Location Tracking Module
- SMS-Based SOS Communication Engine

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- IoT Device Trigger Unit
- Nearby User Network (Community Assist Layer)

2. Functional Components:

SIM-Based Location Tracker:

- Uses cell tower triangulation to approximate user location.
- Works without GPS/internet.

SOS Trigger System:

- Activated via:
  - Power button (double/triple press)
  - Volume button long-press
  - Shake/gesture-based activation
- Sends an SMS with location to:
  - Police Helpline Number
  - 3 Emergency Contacts
  - All users in 2 km radius (Community Network)

IoT Device (Button-Based Trigger):

- Low-power hardware (ESP32, GPS Module, Battery)
- When pressed, sends real-time location via API to the app server.
- Fallbacks to SMS mode in no-network condition.

Community Safety Network:

- All registered users become responders.
- When a user receives an SOS, they can:
- Call victim
- Navigate to location
- Alert authorities

3. Proposed System Design:

- User triggers SOS via power/ volume button, gesture, or IoT device.
- Location is fetched using SIM-based tracking (no internet needed).
- An SMS alert with location is sent to police, emergency contacts, and nearby users.
- Nearby users receive alerts and can respond faster than authorities.
- The system tracks both victim and responders in real-time.
- Tracking ends once help arrives or the situation is resolved.

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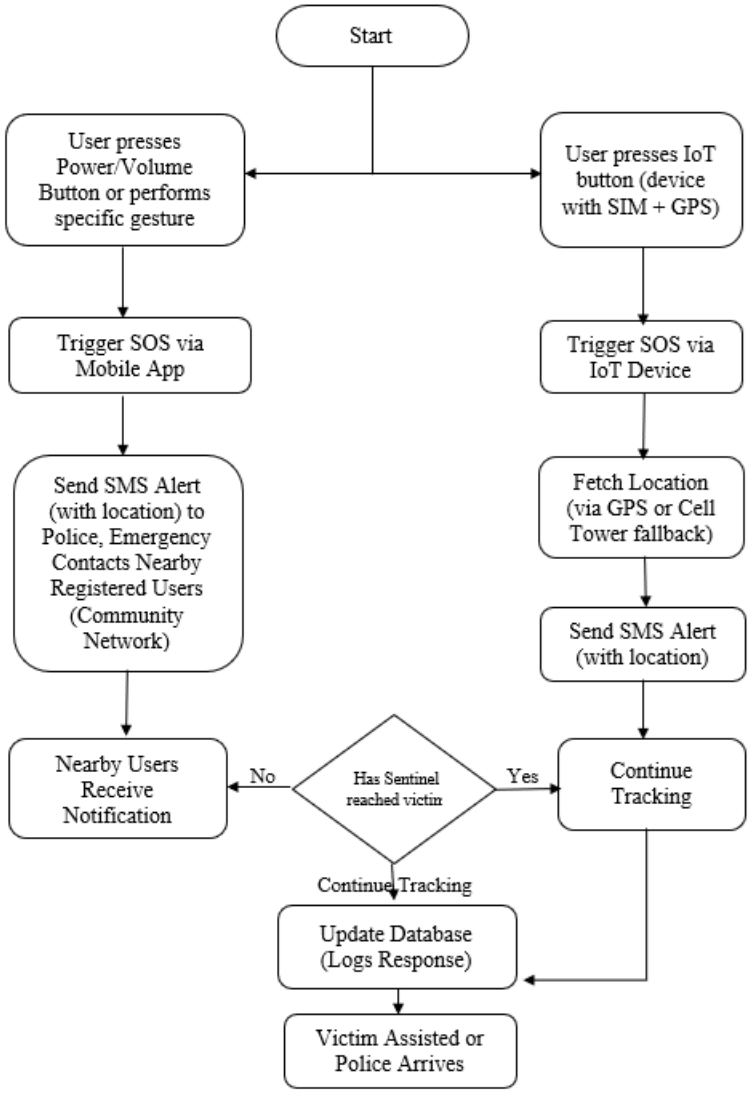

Figure 1: SafeSteps Proposed System Design Workflow

V. RESULTS AND EVALUATION

1. Test Cases:

Test Scenario	Internet Present	Internet Absent	Result
SOS via power button	✅	✅	SMS sent
SOS via IoT device	✅	✅	Location + SMS sent
Community alerts	✅	✅	Local users alerted
GPS unavailable	✅	✅	SIM-based approx. location used

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2. Field Testing:

- Location: Pune (urban), Satara (rural)
- Average SMS delivery time: 3.1s
- Location accuracy: 78% within 200m in rural zones

3. User Feedback (20 Participants):

- 92% felt safer with gesture-based SOS.
- 85% preferred offline capability over GPS.
- 88% found IoT device useful when phone was inaccessible.

4. Application Prototype:

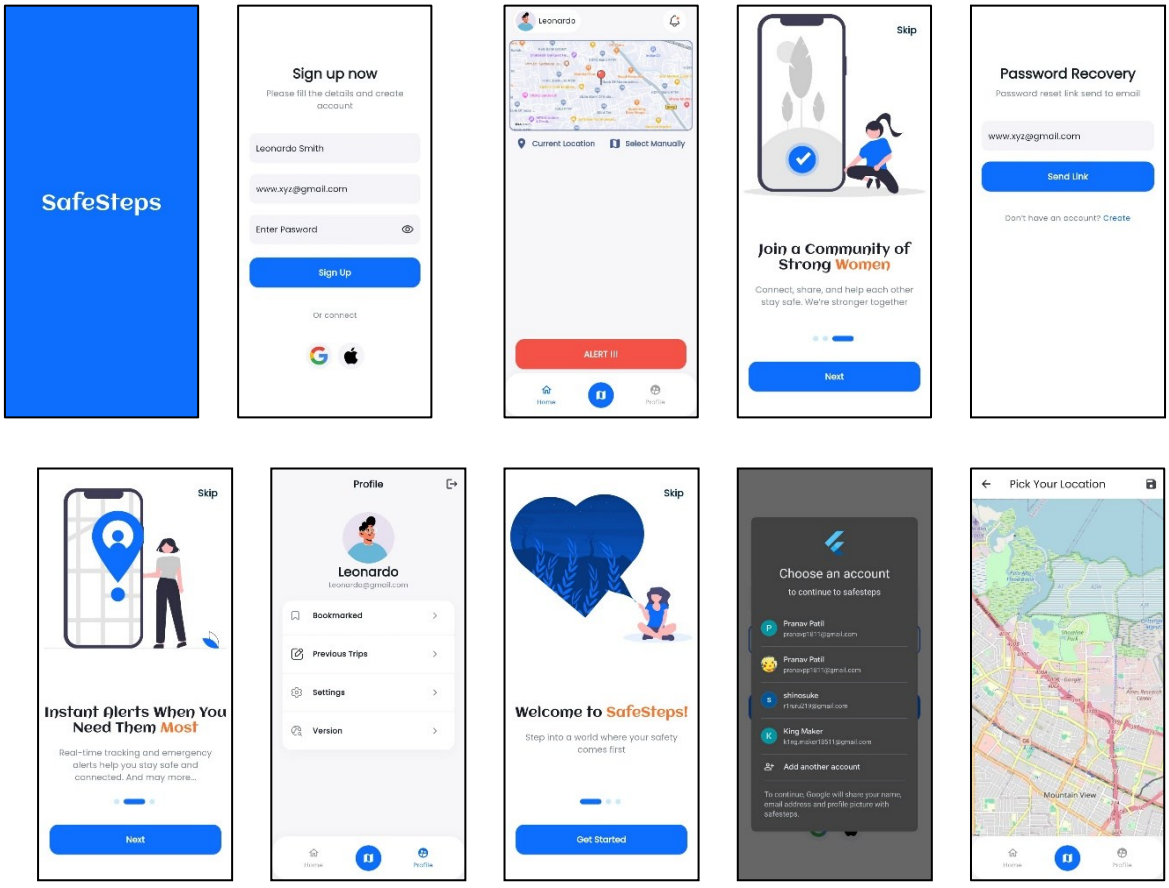

Figure 2: Application Prototype

VI. CONCLUSION

SafeSteps bridges the safety gap for women in areas with poor internet by enabling offline tracking and community-based rapid response. Its gesture-driven activation and IoT integration offer dual protection channels. It surpasses limitations of previous models by functioning without GPS or internet, making it ideal for rural, low-connectivity, or crisis zones.

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VII. FUTURE WORK

- Add multi-language voice command support.
- Improve indoor accuracy using Bluetooth beacon triangulation.
- Launch SafeSteps as a government pilot initiative.

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