

SAFETY SHIELD- A MULTI-LEVEL OFFLINE EMERGENCY ALERT SYSTEM FOR WOMEN

Dr. S. Parthasarathy¹, Harini S², Deeksha G³, Peraambigai Dhevi V S⁴, Sivasusila S⁵,
Mr. R. Thangasankaran⁶

¹ Professor, Department of Electrical and Electronics Engineering

⁶ Assistant Professor, Department of Electrical and Electronics Engineering

^{2,3} Undergraduate Students, Department of Information Technology

^{4,5} Undergraduate Students, Department of Computer Science and Engineering
K.L.N. College of Engineering, Sivagangai, Tamil Nadu, India

Abstract – Mobile-based women safety applications have emerged as an effective medium for providing immediate assistance during emergency situations. Despite their increasing adoption, a significant limitation in many existing systems is their dependence on continuous internet connectivity. In real-world scenarios such as network outages, low-signal regions, or power constraints, this dependency can disrupt alert delivery and reduce system reliability during critical moments.

This paper presents Safety Shield, a women safety mobile application developed to ensure consistent and reliable emergency alert generation under both online and offline conditions. The system classifies emergency situations into three categories—unsafe, mid danger, and most danger—and enables alert activation through multiple mechanisms, including SOS button interaction, device shake detection, and voice-based commands. In the absence of internet connectivity, the application switches to SMS-based communication and incorporates an OTP verification mechanism to confirm rescue acknowledgment.

Each generated alert includes essential contextual information such as the selected danger level, the user's geographical location, and the device battery status, allowing responders to better assess the situation. The system was evaluated under controlled usage conditions to examine alert triggering accuracy, delivery reliability, and offline behavior. The results demonstrate that the proposed approach improves alert continuity and response assurance when compared to conventional solutions that rely exclusively on internet-based communication.

Key Words: Women safety, offline alert system, emergency response, OTP confirmation, mobile application, Flutter-based system

I. INTRODUCTION

Concerns related to women's personal safety continue to increase across urban and semi-urban environments. While the widespread use of smartphones presents an opportunity to deliver rapid emergency assistance through mobile applications, practical challenges often

arise during real-life distress situations. Conditions such as poor network availability, sudden panic, and restricted ability to interact with application interfaces can significantly reduce the effectiveness of existing safety solutions.

Several women safety applications provide functionalities such as SOS alerts, live location sharing, and emergency contact notifications. However, most of these systems rely primarily on active internet connectivity for alert transmission and confirmation. Experimental observations indicate that alerts may fail or experience delays when mobile data is unavailable, even though basic communication services such as SMS remain functional. Additionally, applications that depend on a single alert-triggering mechanism may not be reliable when the user is unable to operate the device manually during an emergency.

To address these limitations, this work proposes Safety Shield, a multi-trigger women safety application designed to function reliably under varying network conditions. The system integrates multiple alert activation methods and introduces an offline confirmation mechanism to ensure that emergency notifications are both delivered and acknowledged. The primary objective of this study is to enhance alert reliability and provide users with assurance that assistance has been successfully initiated, even in environments with limited or no internet

II. PROBLEM STATEMENT

Despite the growing availability of mobile-based women safety applications, real-world emergency response remains constrained by structural and operational limitations within existing systems. Most current solutions depend heavily on uninterrupted internet connectivity for alert dissemination, live location sharing, and responder notification. In practical emergency scenarios, such dependency proves unreliable due to network outages, low signal availability, or battery constraints, resulting in delayed or failed alerts. This creates a critical gap between the moment assistance is required and the time help is actually initiated.

In addition to connectivity challenges, many safety applications rely on single-mode activation mechanisms that require deliberate manual interaction. During high-stress or physically restrictive situations, users may be unable to unlock their devices or navigate application interfaces, rendering such systems ineffective. Furthermore, the lack of acknowledgment mechanisms leaves users uncertain about whether their emergency alerts have been received or acted upon. This absence of confirmation increases psychological distress and reduces trust in the system. Collectively, these shortcomings limit the reliability, responsiveness, and practical usability of existing women safety solutions, highlighting the need for a system capable of ensuring alert continuity, multi-modal activation, and response assurance under diverse operational conditions.

III. PROPOSED SYSTEM

Safety Shield is proposed as a resilient women safety mobile application engineered to provide continuous and reliable emergency assistance under both online and offline conditions. The system adopts a multi-level emergency classification model that categorizes incidents into unsafe, mid danger, and most danger, allowing responses to be proportionate to the severity of the situation. Emergency alerts can be triggered using multiple activation methods, including an SOS button, device shake detection, and voice-based commands, ensuring accessibility even when manual interaction is limited.

To address connectivity constraints, the system integrates an offline alert mechanism using SMS through an Android native communication module. When internet access is unavailable, emergency messages containing critical contextual information—such as danger level, geographical location, and device battery status—are transmitted directly to trusted contacts. An OTP-based verification mechanism is incorporated to confirm legitimate rescue attempts and to notify the user once assistance has been acknowledged. Incident data is securely logged for future analysis and reference. By combining multi-trigger activation, offline communication, and confirmation-based response assurance, Safety Shield establishes a dependable safety framework that enhances user confidence, reduces response uncertainty, and strengthens real-world emergency intervention.

IV. METHODOLOGY

The development of the Safety Shield application followed a structured and iterative methodology, with primary emphasis on operational reliability, accessibility during emergencies, and confirmation of response initiation. The design approach was guided by practical observations of existing women safety systems and the challenges encountered during real-world emergency situations.

Based on these observations, the system architecture and functional workflow were progressively refined to ensure dependable alert generation under both online and offline conditions.

1. Problem Identification and System Focus

The initial analysis identified a recurring limitation in existing women safety applications: excessive dependence on continuous internet connectivity and single-mode alert activation. During emergency situations, users may encounter poor network coverage or may not be in a position to interact with complex application interfaces. To address this, the scope of the system was defined around two key requirements: ensuring alert delivery even in the absence of internet access and enabling emergency activation through multiple, easily accessible triggers. This focus shaped the overall system design, prioritizing reliability and simplicity over feature complexity.

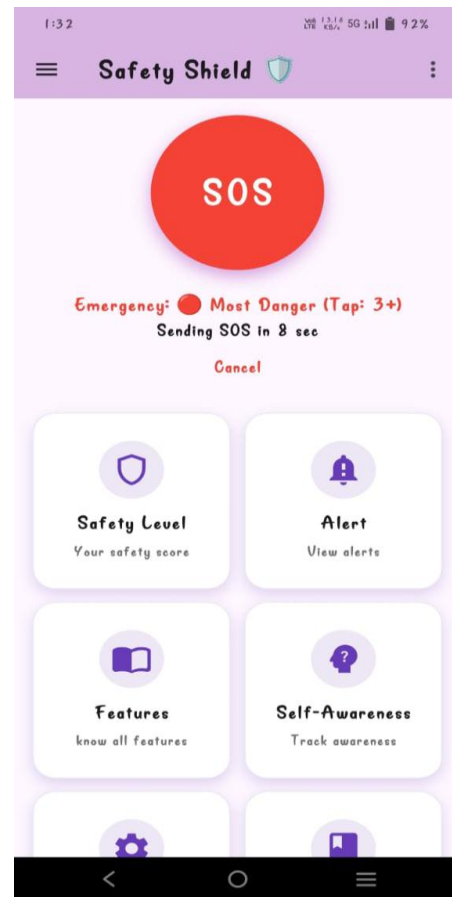


Fig -1: Emergency Activation Home Screen

2. Multi-Trigger Emergency Activation Design

To improve usability during high-stress situations, the system was designed to support multiple emergency activation mechanisms. In addition to a conventional SOS button, the application integrates device shake detection

and voice-based commands as alternative triggers. This multi-trigger approach ensures that alerts can be initiated even when manual interaction is restricted. Trigger validation logic was incorporated to minimize accidental activation while maintaining rapid responsiveness during genuine emergencies.

3. Offline Alert Communication and Confirmation Mechanism

A key methodological component of Safety Shield is its ability to function under constrained connectivity conditions. When internet access is unavailable, the system automatically switches to an offline communication mode using SMS through an Android native module. Emergency messages are delivered to preconfigured trusted contacts along with contextual details required for immediate response. An OTP-based verification mechanism is employed to confirm that a trusted contact has acknowledged the alert, providing the user with reassurance that assistance has been initiated. This confirmation mechanism also helps prevent misuse and false alerts.

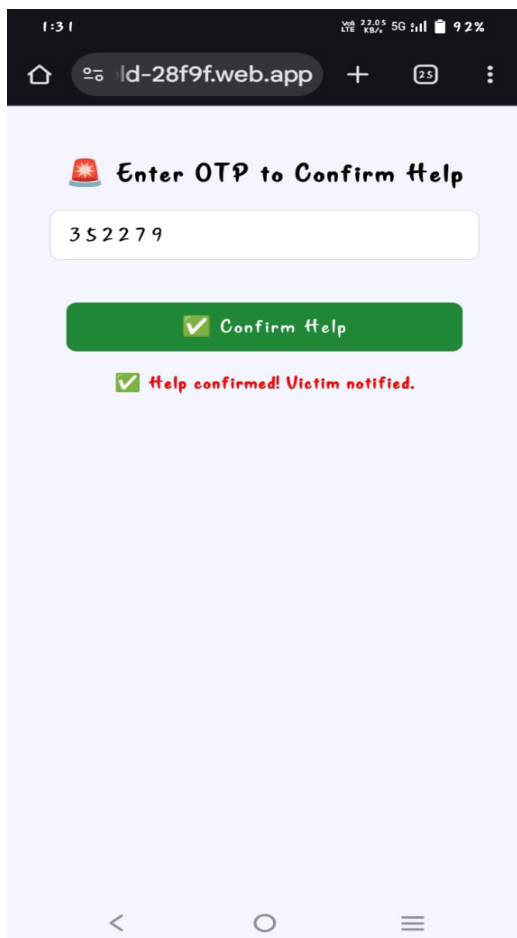


Fig -2:OTP Based Emergency Alert Confirmation Interface

4. Data Capture and Secure Incident Logging

Upon emergency activation, the system captures essential contextual information, including the selected danger level, the user's current geographical location, and the device battery percentage. This information is packaged with the alert to support informed decision-making by responders. All incident-related data is securely stored for traceability and future reference, ensuring transparency and accountability without compromising user privacy.

5. Platform Selection and Implementation Strategy

A mobile-first development approach was adopted based on the widespread availability of smartphones and their suitability for rapid emergency interaction. The application frontend was developed using Flutter to ensure cross-platform compatibility, while backend services and authentication were managed using Firebase. Native Android components were integrated for handling offline SMS and voice-based alert delivery. This hybrid implementation strategy enabled seamless coordination between application logic and device-level communication services.

V. FLOWCHART

After trigger validation, the application captures essential contextual information, including the user's geographical location at the time of activation, device battery percentage, and emergency severity classification. A connectivity check is then performed to determine the most suitable communication mode. When internet access is available, alert information is transmitted through the backend for processing and notification. In scenarios where connectivity is limited or unavailable, the workflow is automatically redirected to the offline communication module, enabling the delivery of SMS and voice alerts directly to trusted contacts.

An OTP verification step serves as a critical decision point within the workflow, confirming that the emergency alert has been acknowledged and that assistance has been initiated. All actions within the process, including alert generation, delivery status, and acknowledgment, are securely logged to maintain transparency and enable future reference. By structuring the emergency response through clearly defined stages and decision points, the Safety Shield system ensures reliable alert execution, efficient communication, and response assurance, even under adverse network conditions.

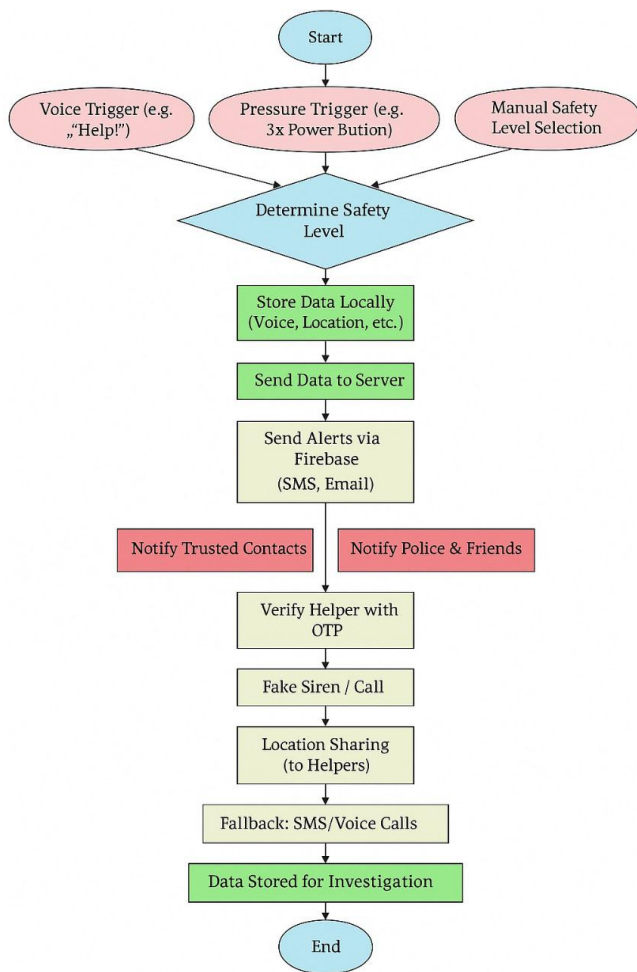


Fig -3: Workflow of Multi-Trigger Emergency Alert and Offline Communication Mechanism

VI. SYSTEM ARCHITECTURE

The Safety Shield ecosystem is structured around a modular client-server architecture designed to support reliable emergency communication under varying network conditions. The mobile application frontend is developed using the Flutter framework, enabling a consistent and responsive user interface across Android devices with diverse hardware specifications. This design choice ensures that emergency interactions remain accessible and intuitive, which is critical during high-stress situations where rapid user response is required. The separation of presentation logic from system services allows the interface to remain lightweight while maintaining stable interaction with backend components.

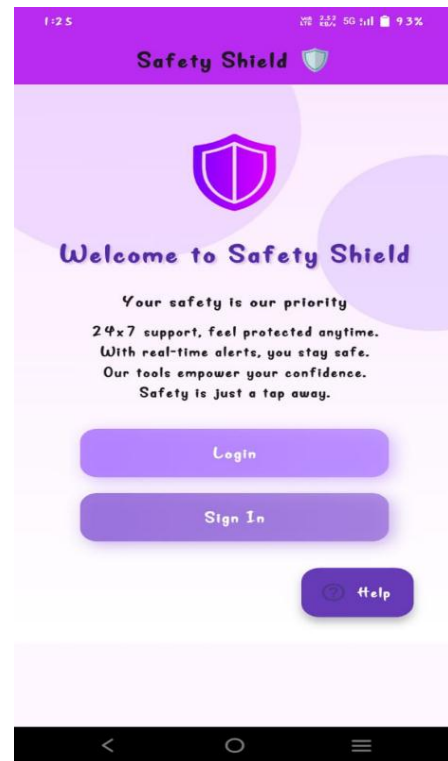


Fig -4: Welcome Screen of Safety Shield

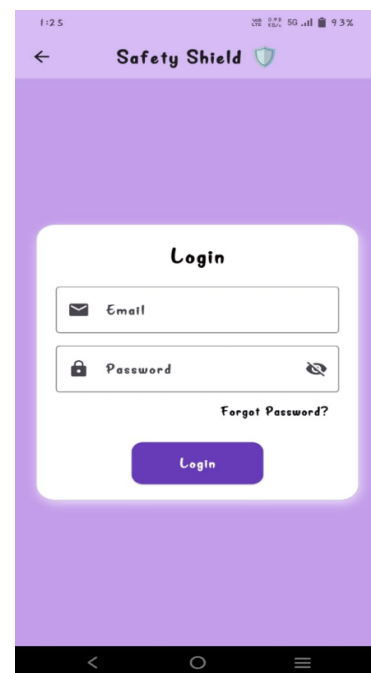


Fig -5: User Login Interface

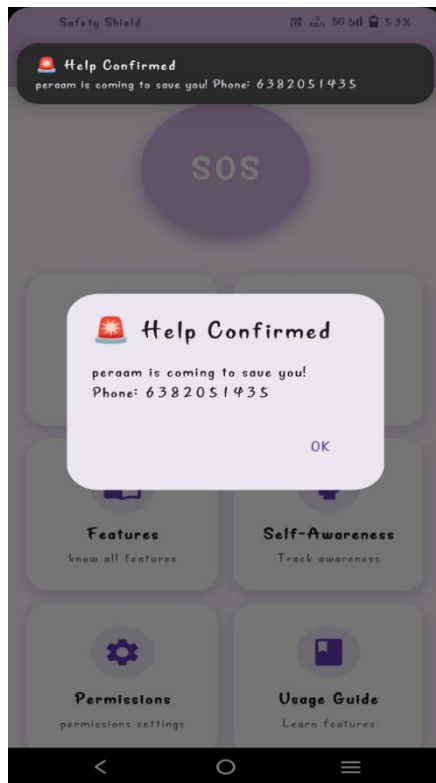


Fig -6: Emergency Help Confirmation Alert

User authentication, data storage, and incident logging are managed through Firebase services, providing secure identity verification and controlled access to sensitive user information. Emergency alert processing and OTP generation are handled by the backend, which coordinates communication between the user device and designated trusted contacts. To address connectivity constraints, the architecture integrates an Android native communication layer implemented using Kotlin. This module operates independently of internet availability and is responsible for dispatching SMS when network access is limited or unavailable. By combining cloud-based services with device-level communication capabilities, the system ensures continuity of alert delivery while maintaining data integrity and system reliability. The modular design further supports maintainability and scalability, allowing individual components to be enhanced without disrupting core safety functionalities.

VII. CONCLUSION AND FUTURE SCOPE

In conclusion, Safety Shield presents a reliable and context-aware women safety solution that addresses critical shortcomings observed in existing emergency response applications. By integrating multi-trigger alert activation, offline communication support, and acknowledgment-based confirmation mechanisms, the system enhances the dependability of emergency assistance in real-world scenarios. The hybrid architecture, which combines a responsive mobile

interface with secure backend services and native device communication, enables timely alert delivery while maintaining user privacy and operational transparency. As a result, Safety Shield strengthens the connection between individuals in distress and their trusted support network, contributing to improved personal safety and confidence in everyday mobility.

Looking ahead, the future scope of Safety Shield extends toward deeper integration with institutional emergency services such as local law enforcement and healthcare providers, enabling coordinated response beyond personal contacts. Additional enhancements may include contextual evidence capture, such as optional background audio or visual recording during emergencies, and analytical tools to study alert patterns for system optimization. As the application evolves, continued refinement of its technical and operational architecture will ensure adaptability to broader deployment environments, reinforcing its role as a scalable and dependable safety platform designed to meet the dynamic needs of modern society.

ACKNOWLEDGMENT

The authors express sincere gratitude to the mentors and coordinators of the Industrial Research Park (IRP), K.L.N. Autonomous College, for their guidance and continuous support throughout the development of the Safety Shield project.

REFERENCES

- [1] S. Mandapati, S. Pamidi and S. Ambati, "A mobile based women safety application (I Safe Apps)," *IOSR Journal of Computer Engineering (IOSR-JCE)*, vol. 17, no. 1, pp. 29-34, 2015.
- [2] A. Kumar, A. Sharma and R. Gupta, "Women Safety Application Using GPS Tracking and SOS Alert," *International Journal of Engineering Research & Technology (IJERT)*, vol. 9, no. 6, pp. 512-516, 2020.
- [3] P. Verma and S. Gupta, "Emergency Alert System for Women Safety Using Android," *International Journal of Computer Applications*, vol. 181, no. 43, pp. 1-5, 2018.
- [4] R. Priyanka, M. Keerthana, S. Ranjani and V. Rajesh, "An Android Application for Women Safety with Real-Time Location Tracking," *International Journal of Advanced Research in Computer Science*, vol. 10, no. 3, pp. 45-49, 2019.
- [5] M. E. Joorabchi, A. Mesbah and P. Kruchten, "Real challenges in mobile app development," *2013 ACM/IEEE International Symposium on Empirical Software Engineering and Measurement*, Baltimore, MD, USA, 2013, pp. 15-24, doi: 10.1109/ESEM.2013.9.

[6] S. Boukhary and E. Colmenares, "A clean approach to Flutter development through the Flutter clean architecture package," 2019 International Conference on Computational Science and Computational Intelligence (CSCI), Las Vegas, NV, USA, 2019, pp. 1115–1120, doi: 10.1109/CSCI49370.2019.00211.

[7] S. Sharma, S. Khare, V. Uniyal and S. Verma, "Hybrid development in Flutter and its widgets," 2022 International Conference on Cyber Resilience (ICCR), Dubai, United Arab Emirates, 2022, pp. 1–4, doi: 10.1109/ICCR56254.2022.9995973.

[8] A. K. Jain, S. Gupta and P. Tiwari, "SMS-Based Emergency Alert System for Personal Safety Applications," International Journal of Advanced Computer Science and Applications, vol. 11, no. 4, pp. 312–318, 2020.

[9] K. Patel, R. Shah and M. Desai, "Secure Authentication and Real-Time Data Management Using Cloud-Based Mobile Applications," International Journal of Computer Applications, vol. 175, no. 32, pp. 18–23, 2019.

[10] S. Ramesh and P. Karthikeyan, "Design and Implementation of an Offline Emergency Alert System Using SMS," International Journal of Emerging Technologies and Innovative Research, vol. 8, no. 5, pp. 1021–1026, 2021.