

SafeCircle: A Real-Time Women Safety Mobile Application with SOS Alerts and Live Location Tracking

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Abstract - SafeCircle is a mobile-based women safety application developed to provide immediate assistance during emergency situations. The application integrates real-time GPS tracking, SOS alert generation, trusted contact notification, OTP-based safety confirmation, and safety area awareness into a unified platform. The system is developed using Flutter as the frontend framework and Firebase services for authentication, real-time database management, cloud storage, and notification handling. Upon activation of the SOS feature, the application continuously shares the user's live location with registered emergency contacts until a safety confirmation is received. Additional functionalities such as emergency helpline access, chat support, educational safety resources, and feedback collection improve user engagement and awareness. The proposed system aims to reduce emergency response time, improve communication during critical situations, and enhance personal security through a scalable and user-friendly mobile solution. This paper presents SafeCircle, a comprehensive women safety mobile application designed to provide immediate emergency assistance, continuous location monitoring, and secure communication with trusted contacts. The application is developed using Flutter for cross-platform mobile development and Firebase services for authentication, real-time database management, cloud storage, and notification handling. SafeCircle integrates multiple safety-oriented functionalities, including one-touch SOS alert generation, real-time GPS location tracking, emergency contact management, OTP-based safety confirmation, emergency helpline access, chat support, safety awareness resources, and feedback management. When a user encounters an unsafe situation, the SOS feature can be activated instantly to notify pre-registered trusted contacts and share the user's live location in real time. The system continuously updates location information until the user reaches safety and successfully completes the OTP verification process. The application also incorporates safe-area and risky-area awareness features to help users make informed decisions while traveling. Security and privacy are ensured through authenticated access, encrypted data transmission, and secure cloud storage mechanisms.

The proposed system was implemented and tested on Android devices to evaluate its functionality, reliability, and responsiveness. Experimental results demonstrate that SafeCircle successfully delivers emergency notifications, maintains accurate real-time location tracking, and provides efficient communication between

users and their trusted network. The integration of multiple safety modules within a single platform enhances user convenience while reducing emergency response time. The developed application offers a scalable, user-friendly, and practical solution for improving women's personal safety and can serve as a foundation for future enhancements such as artificial intelligence-based risk prediction, wearable device integration, and automated emergency service connectivity.

Key Words: Women Safety, Flutter, Firebase, GPS Tracking, SOS Alert, OTP Verification, Mobile Application, Emergency Response, Location Sharing.

1. INTRODUCTION

Women safety remains a major social concern worldwide, with increasing incidents of harassment, assault, stalking, and other forms of violence creating a constant need for effective security measures. In many emergency situations, victims are unable to communicate their distress quickly due to panic, physical restrictions, or lack of immediate access to assistance. The delay between the occurrence of an incident and the arrival of help often increases the severity of the situation. Therefore, there is a growing need for technological solutions that can provide rapid communication, real-time tracking, and emergency support.

The widespread adoption of smartphones has created new opportunities for developing personal safety applications. Modern smartphones are equipped with advanced technologies such as Global Positioning System (GPS), internet connectivity, cloud services, sensors, and instant communication capabilities, making them suitable platforms for emergency response systems. Several women safety applications have been developed in recent years, incorporating features such as SOS alerts, location sharing, emergency contact notifications, and helpline services. However, many existing solutions suffer from limitations including complex user interfaces, lack of continuous location monitoring, insufficient safety verification mechanisms, and dependency on user intervention during critical situations.

To address these challenges, this paper presents **SafeCircle**, a mobile-based women safety application designed to provide immediate assistance and continuous monitoring during emergencies. The application integrates real-time GPS location tracking, one-touch SOS alert generation, trusted contact notification, OTP-based safety confirmation, emergency helpline access, and safety awareness features within a single platform.

The system is developed using Flutter and Firebase technologies, enabling secure authentication, real-time database management, cloud storage, and efficient communication services.

When an emergency occurs, the user can activate the SOS feature through a simple interface, allowing the application to instantly notify trusted contacts and continuously share the user's live location. The system continues monitoring until the user confirms safety through a secure OTP verification process. Additional modules such as safety guidance resources, feedback management, and communication support enhance the overall usability and effectiveness of the application.

Another challenge associated with existing solutions is their dependence on manual intervention. In many applications, users must repeatedly interact with the system to update their status or share their location. During emergencies, such interactions may not always be possible. Furthermore, some applications do not provide a reliable mechanism to verify whether the user has reached a safe location after the emergency has been resolved. These limitations highlight the need for a comprehensive and user-friendly safety platform capable of providing immediate assistance while ensuring continuous communication and monitoring.

To address these challenges, this paper presents **SafeCircle**, a mobile-based women safety application designed to enhance personal security through real-time emergency support and intelligent monitoring. The application integrates multiple safety features into a single platform, including one-touch SOS alert generation, real-time GPS location tracking, trusted contact management, OTP-based safety confirmation, emergency helpline services, safety awareness resources, chat support, and feedback mechanisms. The system is developed using Flutter for cross-platform mobile application development and Firebase services for authentication, cloud storage, and real-time database management.

When an emergency occurs, the user can activate the SOS feature through a simple and easily accessible interface. Upon activation, the application immediately sends alerts to pre-registered trusted contacts and continuously shares the user's live location. The tracking process remains active until the user successfully verifies their safety through a secure OTP-based confirmation mechanism. In addition, SafeCircle incorporates safety-area and risky-area awareness features that provide users with useful information about their surroundings and encourage safer decision-making while traveling.

The proposed system aims to reduce emergency response time, improve communication between users and their support network, and provide a secure, scalable, and reliable safety solution. By combining modern mobile technologies, cloud-based infrastructure, and location-aware services, SafeCircle contributes toward creating a safer environment for women while promoting confidence and independence in daily activities.

2. LITERATURE REVIEW

The increasing concern for women's safety has encouraged researchers to develop mobile applications and intelligent systems that provide emergency assistance, location tracking, and communication support. Various approaches have been proposed to improve personal security through smartphone technologies, GPS services, cloud platforms, and emergency alert mechanisms.

Aggarwal et al. (2022) presented a comprehensive review of Android-based women safety applications and highlighted the importance of GPS tracking, SOS messaging, and smartphone-enabled emergency communication systems. Their study emphasized the growing role of mobile technology in providing immediate assistance during critical situations. However, the work primarily focused on reviewing existing applications and did not propose an implementation framework.

Rodriguez et al. (2021) conducted a systematic review of computer science solutions addressing violence against women and children. Their research categorized existing solutions into safety, detection, prevention, and awareness systems while discussing the potential of Artificial Intelligence (AI), Internet of Things (IoT), and mobile technologies. Although the study provided valuable insights, it lacked practical implementation details for a complete safety application.

Mandapati et al. (2015) developed the I Safe Apps mobile application, which integrated emergency messaging, GPS tracking, and video recording capabilities. The inclusion of video evidence collection improved emergency response effectiveness. However, the system relied heavily on internet connectivity for continuous operation and communication.

Chougula et al. (2014) proposed a Smart Girls Security System based on wearable technology. The system incorporated hardware-based safety features such as alarms and self-defense mechanisms. While the solution reduced dependency on smartphones, the additional hardware requirements increased implementation cost and complexity.

Chand et al. (2015) introduced WoSApp, a mobile application designed to provide rapid emergency notifications and location sharing. The application focused on reducing delays in emergency response through GPS-based communication. However, the system lacked evidence collection and advanced user interaction features.

Recent studies such as those by Patel (2024), Sarma et al. (2023), and Rahman et al. (2025) have explored additional features including shake-based activation, direct police station communication, WhatsApp integration, and systematic evaluations of safety applications. These studies demonstrate significant progress in women safety technologies but reveal limitations related to continuous monitoring, safety

confirmation, data privacy, and intelligent risk assessment.

Based on the analysis of existing systems, it is observed that most applications focus primarily on emergency alert generation and location sharing. Limited attention has been given to integrating continuous real-time tracking, secure safety confirmation mechanisms, user awareness resources, and comprehensive support services within a single platform. To address these limitations, the proposed SafeCircle application integrates SOS alerts, continuous GPS tracking, OTP-based safety verification, trusted contact management, emergency helpline services, safety awareness features, and secure cloud-based communication into a unified mobile safety solution.

3. PROBLEM DEFINITION

Women frequently encounter unsafe situations where immediate communication with family members or emergency contacts becomes difficult. Existing solutions often provide only basic alert functionality and fail to offer continuous monitoring, safety verification, and awareness support. Therefore, there is a need for a mobile application capable of providing instant emergency notifications, real-time location tracking, trusted contact communication, and secure confirmation mechanisms. A comprehensive, user-friendly, and reliable mobile application that can instantly notify trusted contacts, continuously track the user's location, provide emergency support services, and verify the user's safety after the emergency has been resolved. The system should ensure quick communication, minimize response delays, and enhance personal security while maintaining user privacy and data protection.

The proposed **SafeCircle** application addresses these challenges by integrating one-touch SOS alerts, real-time GPS tracking, emergency contact notification, OTP-based safety confirmation, and safety awareness features into a unified mobile platform designed to improve women's safety and emergency response effectiveness.

Objectives

1. To develop a mobile application for enhancing women's safety to provide a reliable and accessible platform that helps women seek assistance during emergencies.
2. To provide an instant SOS alert mechanism for emergency situations and enable users to send emergency alerts to trusted contacts with a single tap.
3. To enable real-time GPS location tracking and sharing, continuously share the user's live location during emergency situations.
4. To notify trusted contacts immediately during emergencies and ensure that family members and friends receive instant emergency notifications.

5. To implement OTP-based safety confirmation after the user reaches a safe location and verify and communicate that the user has safely reached their destination.

6. To provide quick access to emergency helpline services and allow users to contact emergency services without delay.

7. To incorporate safety-area and risky-area awareness features and inform users about potentially unsafe locations and promote safer travel decisions.

8. To ensure secure storage and transmission of user data and protect sensitive user information through secure authentication and data management.

9. To develop a user-friendly and easily accessible interface and ensure that users can operate the application quickly during stressful situations.

10. To reduce emergency response time and improve personal security and facilitate faster assistance and enhance overall user safety during emergencies.

4. PROPOSED METHODOLOGY

The proposed SafeCircle application is designed to provide immediate assistance and continuous monitoring during emergency situations. The system follows a structured approach consisting of user authentication, emergency alert generation, location tracking, safety verification, and communication services. It focuses on minimizing emergency response time, improving communication between users and trusted contacts, and providing a secure, scalable, and user-friendly safety solution for women.

A. User Registration and Authentication

The SafeCircle application begins with a secure user registration and authentication process. Users are required to create an account by providing essential details such as name, email address, and password. Firebase Authentication is utilized to verify user credentials and ensure secure access to the application. After successful registration, users can log in and access all safety-related features. This module prevents unauthorized access and maintains the privacy and security of user information while providing a personalized experience within the application.

B. Emergency Contact Management

The Emergency Contact Management module allows users to add, edit, and manage trusted contacts who can be notified during emergency situations. Users can register multiple contacts, such as family members, friends, or guardians, within the application. These contacts are securely stored in the Firebase database and can be updated whenever required. During an emergency, the system automatically retrieves the stored contact

information and sends alerts along with the user's live location. This feature ensures that help can be reached quickly by notifying the most trusted individuals without requiring additional user interaction during critical situations.

C. SOS Alert Generation

The SOS Alert Generation module serves as the core emergency response feature of the SafeCircle application. When a user encounters a dangerous or uncomfortable situation, they can activate the SOS button with a single tap. Upon activation, the system immediately generates an emergency alert and initiates the safety protocol. The alert contains essential information, including the user's identity and current location details. This emergency notification is instantly shared with the registered trusted contacts, enabling them to respond quickly and provide assistance. The one-touch activation mechanism ensures that the user can seek help rapidly, even during high-stress situations, thereby reducing emergency response time and enhancing personal safety.

D. Real-Time Location Tracking

The Real-Time Location Tracking module continuously monitors and updates the user's geographical location during an emergency. Once the SOS alert is activated, the application retrieves the user's current coordinates using GPS and Google Maps services. The location information is regularly updated and stored in the Firebase Realtime Database, allowing trusted contacts to track the user's movement in real time. Continuous location sharing helps emergency contacts identify the user's exact position and provide timely assistance. This feature enhances situational awareness and significantly improves the effectiveness of emergency response during critical situations.

E. Alert Notification

The Alert Notification module is responsible for informing trusted contacts when an emergency situation occurs. After the SOS button is activated, the system automatically sends emergency notifications containing the user's details and live location information. These notifications enable family members, friends, or guardians to immediately identify the user's situation and take appropriate action. The module ensures fast and reliable communication between the user and their support network, reducing delays in assistance and improving the overall effectiveness of the emergency response process.

F. OTP-Based Safety Confirmation

The OTP-Based Safety Confirmation module is designed to verify that the user has safely reached a secure location after an emergency. Once the situation is resolved, the system generates a One-Time Password (OTP) and sends it to the user for verification. Upon entering the correct OTP, the user's status is updated as safe, and a

confirmation notification is sent to the registered emergency contacts. This mechanism prevents false safety reports and ensures that trusted contacts are informed about the user's well-being. The feature adds an extra layer of reliability and security to the overall emergency response process.

G. Additional Support Services

The Additional Support Services module enhances the functionality of the SafeCircle application by providing users with various safety-related resources and assistance features. The module includes emergency helpline access, chat support, safety awareness content, educational courses, and a feedback system. Emergency helplines enable users to quickly contact relevant authorities when required, while the chat feature facilitates communication and support. Safety awareness resources and courses educate users about precautionary measures and emergency preparedness. The feedback system allows users to share their experiences and suggestions, helping improve the application's effectiveness and user experience. These additional services contribute to creating a comprehensive and user-centric safety platform.

System Architecture:



The architecture of the proposed SafeCircle application follows a cloud-based client-server model designed to provide real-time emergency assistance, location tracking, communication services, and safety monitoring. The system integrates mobile devices, cloud services, emergency response mechanisms, and administrative monitoring into a unified platform to ensure efficient operation during emergency situations.

At the user level, the application runs on smartphones and provides an intuitive interface through which users can access safety features such as SOS alerts, live location tracking, emergency contacts, chat services, and safety awareness modules. The user's device continuously captures GPS location data whenever emergency tracking is activated.

The mobile application communicates with the Backend Server, which acts as the central processing unit of the entire system. The backend manages user authentication, location processing, SOS alert handling, safety-area detection, messaging services, and communication

between different modules. It receives requests from users, processes the information, and distributes alerts and notifications to the appropriate recipients.

The Cloud Services Layer consists of Firebase Realtime Database, Map APIs, and Notification Services. The Realtime Database stores user profiles, emergency contacts, live location data, feedback records, and chat information. The Map API is responsible for retrieving geographical coordinates and displaying locations on maps. Notification services ensure the timely delivery of SOS alerts and emergency messages to registered contacts and emergency responders.

The Authentication Module verifies user credentials and controls secure access to the application. This module ensures data privacy and prevents unauthorized access to sensitive user information. After successful authentication, users can access all available safety services.

The Location Processing Module continuously collects and updates the user's geographical position using GPS technology. This information is transmitted to the cloud database and utilized for real-time tracking, route monitoring, and safety analysis.

The SOS and Alert System is the core emergency component of the application. When a user activates the SOS button, the module immediately generates an emergency alert and sends notifications along with live location details to trusted contacts and emergency services. This mechanism significantly reduces response time during critical situations.

The Safety Area Detection Module analyzes user location data to identify safe zones and risky areas. Based on predefined safety parameters and location information, the system provides awareness and recommendations that help users avoid potentially dangerous locations.

The Chat and Messaging Module facilitates communication between users and their trusted contacts. It supports emergency messaging, location updates, and quick information sharing during critical situations.

The architecture also incorporates a Safety and Risk Analysis Module, which evaluates location-based information to classify regions into safe and risky categories. This analysis helps users make informed travel decisions and enhances situational awareness.

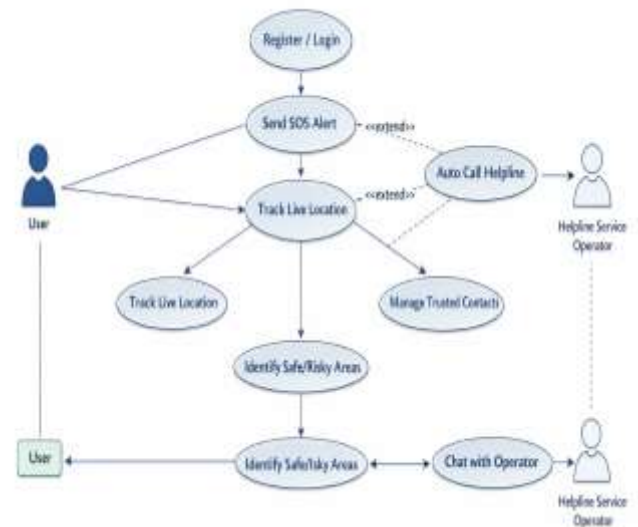
The Admin Dashboard provides administrative control over the system. Administrators can manage users, review feedback, monitor reports, analyze system performance, and maintain safety-related information. This module supports efficient system management and continuous improvement of services.

Additionally, the system establishes communication with Emergency Services, including police stations, ambulance services, and emergency helplines. During emergencies, the backend server can transmit critical information to these services, ensuring timely intervention. Trusted contacts receive emergency alerts, location-sharing updates, and communication messages

through their devices, enabling them to assist the user effectively.

Overall, the proposed architecture provides a scalable, secure, and reliable framework for delivering real-time women safety services. The integration of cloud computing, GPS tracking, emergency communication, and safety analysis enables SafeCircle to offer comprehensive protection and support during emergency situations.

Use case Diagram:



The Use Case Diagram represents the functional interactions between the user, the SafeCircle application, and the helpline service operator. It illustrates how different system functionalities work together to provide safety and emergency support services.

The process begins with the user registering and logging into the application. After successful authentication, the user gains access to various safety features. In case of an emergency, the user can activate the SOS Alert feature, which serves as the primary emergency response mechanism of the system. Once activated, the application immediately initiates Live Location Tracking and continuously updates the user's location in real time.

The tracked location is shared with trusted contacts, allowing them to monitor the user's movement and provide assistance when required. The application also enables users to Manage Trusted Contacts, where emergency contacts can be added, updated, or removed according to user preferences.

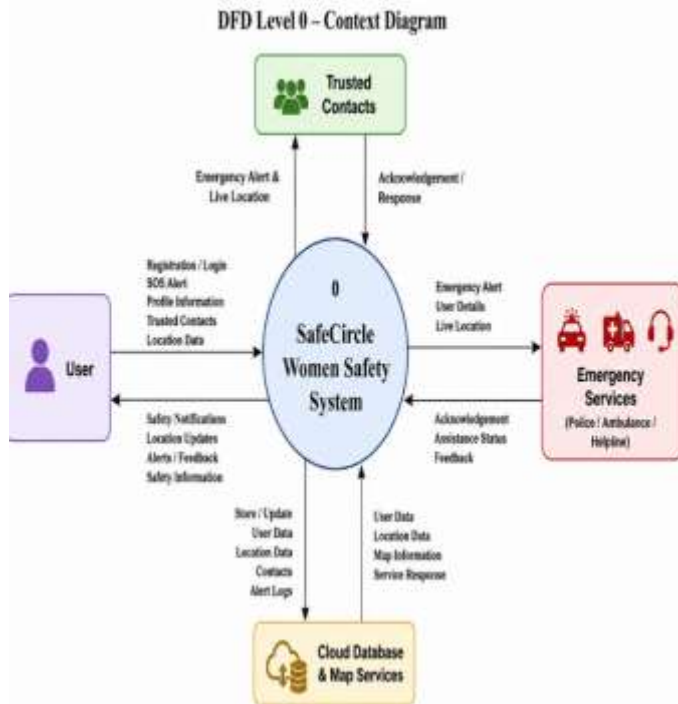
To further enhance user safety, the system includes a Safe and Risky Area Identification feature. This functionality analyzes location data and informs users about potentially unsafe areas, helping them make safer travel decisions. Based on the identified area, the application can provide safety recommendations and alerts.

In critical situations, the system supports an Auto Call Helpline feature that automatically connects the user to emergency helpline services. This reduces response time and ensures that professional assistance can be reached quickly. Additionally, users can communicate directly

with the Helpline Service Operator through the Chat with Operator feature, enabling real-time communication and support during emergencies.

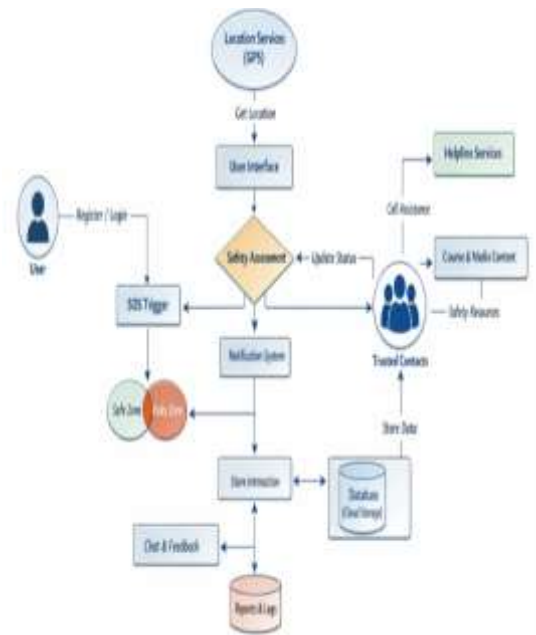
Overall, the use case diagram demonstrates how SafeCircle integrates emergency alerts, location tracking, trusted contact management, helpline communication, and safety awareness into a single platform to provide a comprehensive women safety solution.

Data flow Diagram(DFD) Level 0:



The DFD Level 0 represents the overall functioning of the SafeCircle Women Safety System and its interaction with external entities. The user interacts with the system by registering, logging in, managing contacts, and activating SOS alerts. During emergencies, the system sends alert notifications and live location details to trusted contacts and emergency services. The Cloud Database and Map Services store user information, location data, and alert records while supporting real-time tracking. This high-level diagram illustrates the flow of information between the user, the system, and external services to ensure effective emergency response and user safety.

Data flow Diagram(DFD) Level 1:



The data flow architecture of the proposed system, as illustrated in the Data Flow Diagram delineates the lifecycle of information as it moves from client-side mobile sensors to cloud infrastructure and external communication nodes. The primary data ingestion layer begins with the Location Services (GPS), which continuously stream raw geospatial coordinates (Latitude and Longitude) to the User Interface (UI) using background geolocation streams. Simultaneously, user state transitions—such as registration credentials, login packets, and immediate SOS Triggers—are captured at the presentation layer and routed through state management blocks to initiate active tracking sessions. Once the coordinate data and user states are ingested, they are piped directly into the Safety Assessment Engine. This algorithmic core processes the real-time spatial data packet and evaluates it against geospatial boundaries. The output of this assessment determines the routing logic: it bifurcates the data stream to classify whether the user's coordinate matches a geofenced Safe Zone or a Risky Zone. If a high-risk state or explicit SOS data payload is detected, an event packet is dispatched to the Notification System, which immediately broadcasts push notifications and low-latency payloads to designated external endpoints.

On the backend data persistence side, all runtime transactions pass through a Store Interaction layer (acting as an API Gateway or Repository pattern implementation). This layer handles the asynchronous read/write streams with the Cloud Storage Database, retrieving and updating the records of Trusted Contacts. These trusted peers don't just receive data; they can inject an Update Status data payload back into the Safety Assessment loop, creating a bi-directional data flow. Finally, auxiliary data streams—including user messaging payloads, system operational telemetry, and application feedback—are persistently logged into the

Reports & Logs database for real-time auditing and forensic tracking.

5. IMPLEMENTATION

The **SafeCircle** mobile application is implemented using a modular architecture consisting of three core layers: authentication, geolocation monitoring, and automated emergency broadcasting.

5.1. Authentication and Onboarding Module

This module handles user onboarding, identity verification, and initial configuration of country codes and contact lists.

A. Login Interface:

A secure access point requiring user credentials (Email and Password). This interface utilizes standard form validation and integrates with a secure authentication backend (e.g., Firebase).

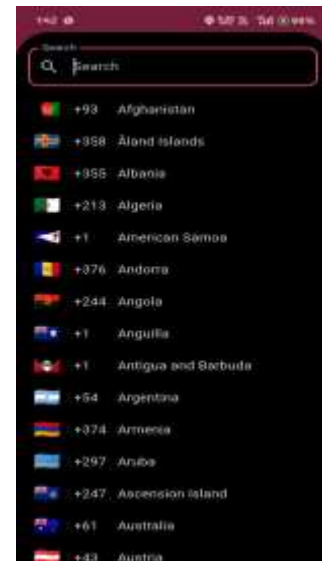


B. Registration Interface (SignUp Now): New users register by providing their Name, Phone number, Email, and Password. Data is validated client-side before being pushed to the cloud database to create a unique user profile.

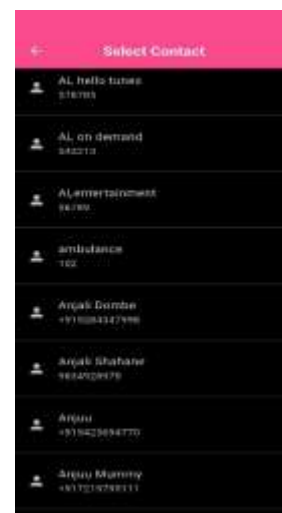


C. Country Code Picker: A searchable selection module populated with international dialing prefixes and country flags. It simplifies user input for global

phone numbers during onboarding or contact addition.



D. Contact Selection: Integrates natively with the device's address book or a custom database cursor via system permissions.



5.2. Core Safety and Real-Time Tracking Module

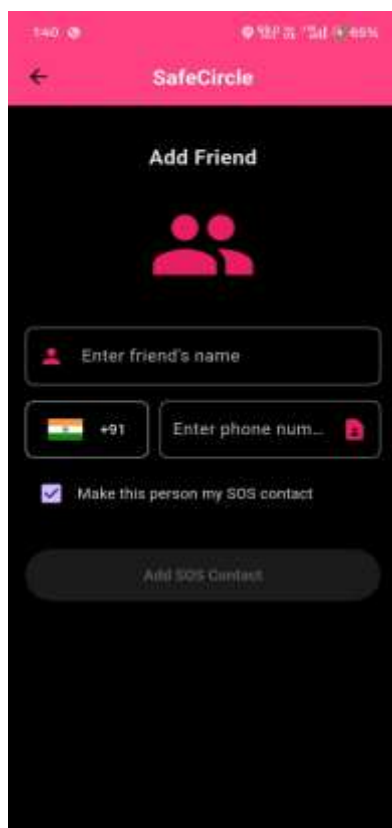
This module forms the functional core of the **SafeCircle** application, handling geolocation tracking and emergency alerts.

A. Geofencing and Real-Time Map Tracking:

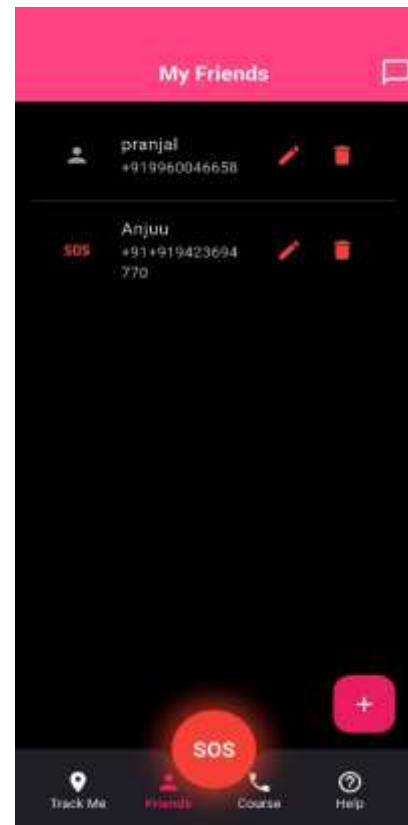
Utilizes the **Google Maps SDK** to render a live map interface. It implements geofencing principles (depicted by the green "SAFE AREA" circular overlay) centered around the user's current coordinates.



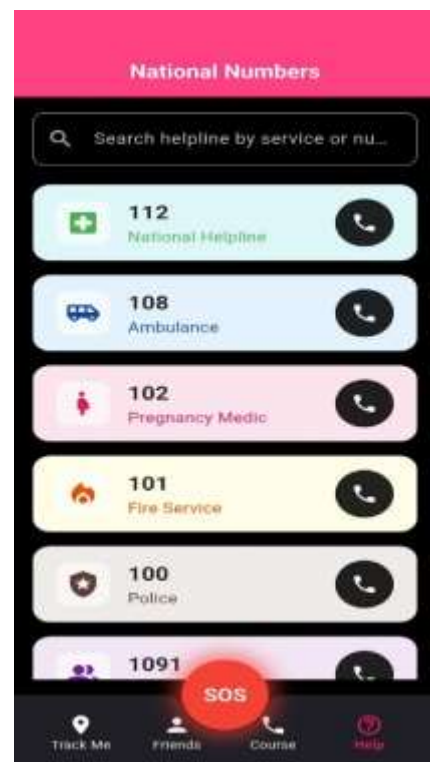
B. Trusted Circle Management (Add Friend): A dedicated sub-module where users can explicitly add a contact by name and phone number.



C. Emergency Contact Directory (My Friends): Displays a structured repository of added contacts. Contacts flagged as SOS targets are explicitly highlighted with an "SOS" badge.



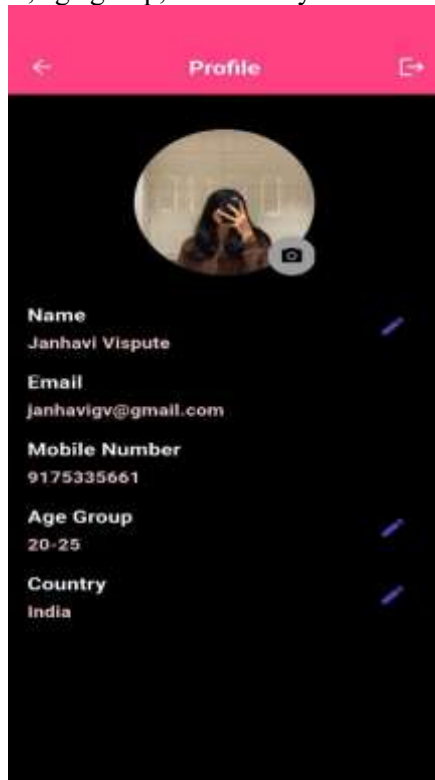
D. National Helpline Integration: A centralized, easily accessible database repository featuring direct dial-action targets for critical services such as the National Helpline (112), Ambulance (108), Pregnancy Medic (102).



5.3. User Profile, Educational, and Alert Dispatch Module

This module focuses on personal user management, proactive security training, and the final programmatic output of the application during emergencies.

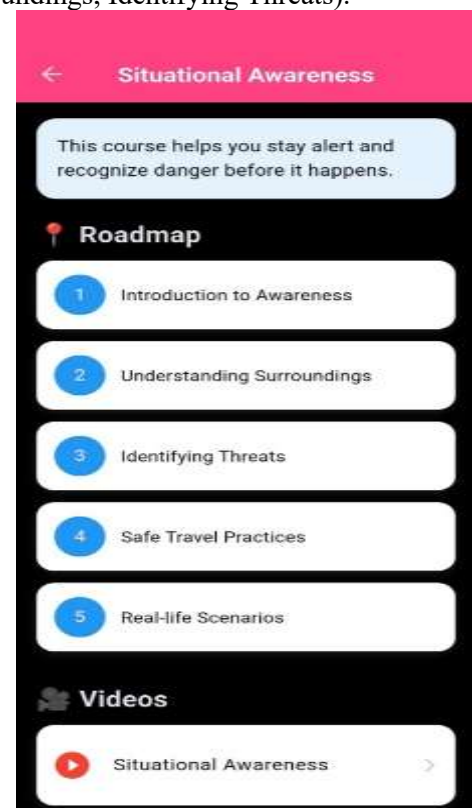
A. Profile Management: Displays the authenticated user's credentials including their profile picture, full name, email address, mobile number, age group, and country



B. Educational Modules (Guardian Courses): A proactive security subsystem offering structured curricula such as Situational Awareness, Digital Defense Mastery, Hands-On Self-Defense, and Emergency First Response.



C. Course Roadmap & Media Player: Clicking into a course unlocks a step-by-step roadmap array (e.g., Introduction to Awareness, Understanding Surroundings, Identifying Threats).

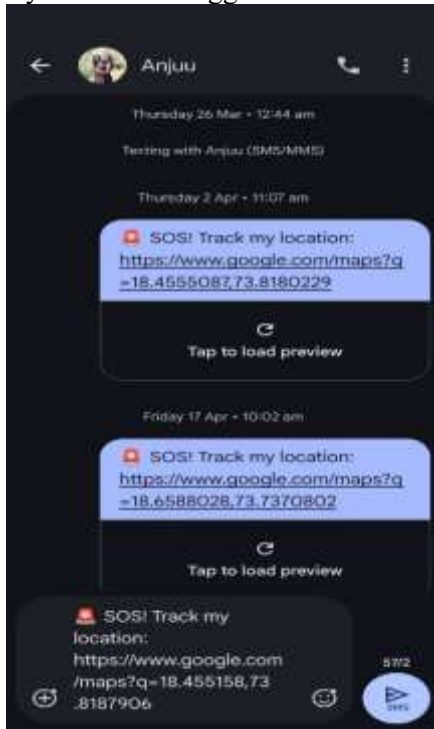


D. SOS SMS Dispatch Engine: The automated operational consequence of triggering the floating **SOS button**. Upon activation, the system fetches the precise current latitude and longitude using the device's location provider, constructs a standardized

Google

URL([https://www.google.com/maps?q=latitude,long itute](https://www.google.com/maps?q=latitude,long+itute)), and uses the device's hardware telephony SMS manager to programmatically dispatch background emergency texts to all flagged SOS contacts.

Maps



6. CONCLUSION

The SafeCircle application was successfully designed and implemented as a comprehensive women safety solution that integrates real-time location tracking, SOS alert generation, trusted contact notification, and emergency support services into a single mobile platform. The system leverages Flutter, Firebase, GPS technology, and cloud-based services to provide fast, secure, and reliable assistance during emergency situations.

The application enables users to instantly share their live location, notify trusted contacts, access emergency helplines, and identify safe and risky areas. The inclusion of OTP-based safety confirmation further enhances system reliability by ensuring that users can verify their safety after an emergency has been resolved. Additionally, features such as chat support, safety awareness resources, and feedback management contribute to a more user-friendly and supportive environment.

The successful implementation and testing of SafeCircle demonstrate its effectiveness in reducing emergency response time, improving communication, and enhancing personal security. By combining multiple safety features within a single platform, the proposed system provides a practical, scalable, and efficient solution for women's safety. Future enhancements such as artificial intelligence-based risk prediction, wearable device integration, and automated emergency service connectivity can further improve the capabilities and impact of the application.

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