SheCare: A Real-Time Intelligent Women Safety System with Automated Emergency Response and Location Tracking

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Abstract — The Women Safety App is a smart, AI-enabled security application designed to enhance the safety and protection of women in emergency situations. The system integrates multiple modules — User, Admin, and Pink Police — to provide real-time response, monitoring, and support. The app allows users to trigger emergency alerts using a volume button or SOS triggers. Once activated, the system automatically shares the user's live location with emergency contacts and the nearest Pink Police unit. It also initiates audio and video recording for evidence collection and sends danger zone alerts based on geolocation data. On the administrative side, the Admin Module manages user registration, permissions, incident reporting, and server/database maintenance, while the Pink Police Mod-ule enables real-time tracking, emergency dispatch, and case logging. Additional features include OTP verification, anonymous reporting, and misuse prevention mechanisms to ensure data integrity and responsible usage. Overall, the Women Safety App provides a holistic and technology-driven safety ecosystem that bridges users, law enforcement, and administrators through automation, AI, and se-cure communication—empowering women with immediate assistance and reliable protection anytime, anywhere.

Keywords: Women Safety, Emergency Alert System, Real-time Location Tracking, AI-enabled Security System

I. INTRODUCTION

Women's safety remains a critical concern due to the increasing number of incidents in both public and private spaces. Although several mobile applications have been developed to address this issue, most existing solutions rely on a single emergency trigger, which may not be effective in all situations. This paper presents "SheCare," a multi-modal women safety system that integrates multiple triggering mechanisms such as SOS button, shake detection, volume button activation, and voice recognition. The system is designed to provide quick and reliable emergency assistance by enabling users to initiate alerts under different conditions.

The proposed system also incorporates real-time location tracking and a structured communication framework involving User, Admin, and Pink Police modules to ensure faster response. By combining multiple triggers with real-time communication, the system aims to enhance reliability, reduce response time, and improve overall user safety.

II. LITERATURE REVIEW

The landscape of women's safety technology has undergone a rigorous transformation, evolving from simple manual alert systems to complex, multi-layered security architectures. Early contributions to the field focused primarily on the Android platform, where researchers such as Acharya [b5], Bhadre et al. [b7], and Choudhary et al. [b11] developed frameworks for real-time GPS tracking and emergency SMS dissemination. While these systems established a foundation for situational awareness, they were primarily reactive and relied heavily on the user's ability to physically interact with the device during a high-stress crisis. To address this limitation, recent research has pivoted toward automation through Artificial Intelligence and Ma-chine Learning. Studies by Jewani et al. [b6] and other contemporary researchers [b2] explore the use of intelligent algorithms to identify distress patterns and environmental anomalies, allowing a system to detect danger and initiate preventative measures without direct human intervention.

The reliability of these safety mechanisms has been further enhanced through the implementation of multi-modal triggers. While earlier applications depended on a single SOS button, recent developments by Sonvane et al. [b8, b10] and general An-droid safety research [b1] advocate for diverse inter-action methods, including volume button sequences and shake detection. These techniques ensure that assistance can be summoned even if the user cannot unlock their phone. Furthermore, the integration of voice-activated keywords and secret code words has become a focal point, particularly in scenarios where physical interaction is impossible. Beyond immediate alerts, the concept of "precautionary safety" has emerged, as demonstrated by Agrawal et al. [b3]. Their "SafeRoutes" methodology utilizes advanced clustering and GPS data to suggest secure navigation paths, preventing potential incidents by analyzing historical safety data of specific geo-graphic areas.

The integration of the Internet of Things (IoT) has introduced a hardware-centric dimension to these safety frameworks, addressing the inherent vulnerabilities of software-only solutions. Research by Golande et al. [b9] highlights how IoT-enabled devices can facilitate automated evidence gathering, capturing ambient audio and precise location data to support legal accountability. This shift is critical because physical devices, such as the prototypes featuring biometric fingerprint authentication dis-cussed by Alam et al. [b4], offer a more reliable trigger mechanism than smartphones, which may be snatched or damaged during an assault. By leveraging IoT, current systems are moving toward a model where the environment itself becomes a witness, ensuring that data is securely logged and accessible for subsequent investigation.

Despite the technical sophistication of these emerging systems, a significant research gap persists in the seamless coordination between mobile alerts and institutional response units. While many studies focus on a "user-to-contact" notification model, true empowerment requires a holistic ecosystem that connects the victim directly to specialized law enforcement. Most existing frameworks lack a robust administrative backend capable of managing high volumes of data or coordinating with specific units, such as the Pink Police, in real-time. Consequently, the transition from a simple ”app notification” to a ”coordinated emergency response” remains an active area of investigation. This highlights the necessity for a unified platform that not only incorporates diverse trigger methods—such as shake detection and secret codes—but also provides a dedicated interface for authorities to manage incidents with maximum efficiency and security.

III. PROPOSED SYSTEM

The proposed system, "SheCare," is a mobile-based women safety application designed to provide immediate assistance during emergency situations through a multi-modal triggering mechanism and real-time communication. The system addresses the limitations of existing safety applications by incorporating multiple activation methods and a structured response framework to ensure reliability and rapid alert generation.

The application integrates various triggering techniques, including an SOS button, shake detection using accelerometer data, volume button activation, and voice keyword recognition. This multi-modal approach ensures that users can initiate emergency alerts under different conditions, even when direct interaction with the device is not possible. By providing multiple alternatives, the system increases accessibility and reduces the chances of failure during critical situations.

The architecture of the system is divided into three primary modules: User, Admin, and Pink Police. The User module is responsible for detecting emergency events and initiating alerts through the available triggers. It also handles real-time location tracking using GPS services. The Admin module manages user data, monitors system activities, and maintains alert records for efficient system operation. The Pink Police module acts as the response unit, receiving emergency alerts along with user location details and enabling faster intervention.

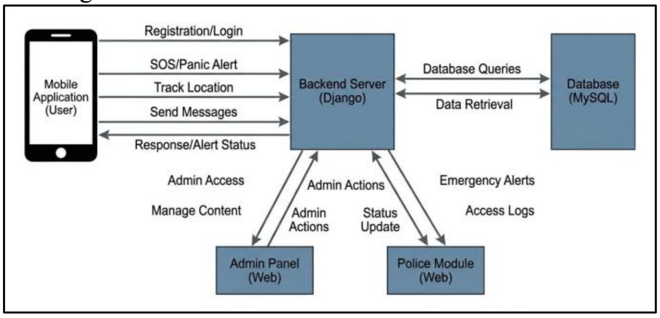

Fig. 1: System Architecture

Upon activation of any trigger, the system follows a structured workflow. Initially, the application captures the user's real-time location and relevant details such as timestamp and identification information. An alert message is then generated and transmitted to predefined emergency contacts and authorities. The system may also initiate additional actions such as phone calls and continuous location tracking to ensure ongoing monitoring of the user's situation.

To support real-time communication, the system utilizes cloud-based backend services that enable instant data synchronization and reliable message delivery. This ensures that alerts are transmitted with minimal delay, even when multiple users are active simultaneously. The backend also stores alert logs and user information, allowing for efficient data management and future analysis.

The proposed system is designed with a focus on usability, efficiency, and scalability. The user interface is kept simple to allow quick access during emergencies, while the backend infrastructure ensures consistent performance. Compared to traditional safety applications that rely on a single trigger mechanism, the SheCare system offers improved reliability, faster response time, and enhanced flexibility.

Overall, the proposed system presents a comprehensive solution for women's safety by combining multi-modal triggering, real-time tracking, and efficient communication. Its modular architecture and integration with authorities make it a practical and scalable approach for improving emergency response and personal security.

IV. CHALLENGES AND LIMITATIONS

1) Audio and Video Recording Constraints

Implementing real-time audio and video recording during emergency situations presents significant challenges. Continuous recording can lead to high battery consumption and increased storage usage on mobile devices. Additionally, accessing camera and microphone resources in the background is restricted by modern mobile operating systems due to privacy and security policies. As a result, recording functionality is limited and may not be consistently available across all devices.

2) Simultaneous Call and SOS Trigger Limitations

One of the major challenges encountered is the inability to efficiently perform multiple actions, such as initiating a phone call and sending SOS alerts simultaneously. Mobile operating systems often prioritize call functionality, which can interrupt or delay background processes like message transmission or location updates. This limitation can affect the speed and reliability of emergency communication.

3) Dependency on Internet Connectivity

The system relies on internet connectivity for real-time data transmission, including sending alerts, updating location, and notifying authorities. In areas with poor or no network coverage, the effectiveness of the application is significantly reduced. This dependency limits the usability of the system in remote or low-connectivity regions.

4) Limited Trigger-Based Recording Activation Currently, audio and video recording features

are activated only during specific triggers, such as shake detection. While this approach helps conserve device resources, it restricts the system's ability to capture critical evidence in other emergency scenarios where different triggers (e.g., voice or SOS button) are used. This limitation reduces the overall flexibility of the recording mechanism.

5) Sensor Sensitivity and False Triggers

The shake detection mechanism relies on accelerometer data, which may sometimes result in false positives due to normal device movement. Conversely, insufficient sensitivity may fail to detect actual emergency situations. Achieving an optimal balance between sensitivity and accuracy remains a challenge.

6) Battery Consumption

Continuous monitoring of sensors (such as accelerometer and microphone for voice detection) can lead to increased battery usage. This may impact the usability of the application over extended periods, especially in critical situations where battery life is essential.

7) Privacy and Security Concerns

Handling sensitive user data, including real-time location and emergency recordings, raises privacy concerns. Ensuring secure data transmission and storage is essential, but implementing strong security mechanisms can increase system complexity.

V. ADVANTAGES AND WORKING

A. System Design Approach

The system follows a modular and event-driven architecture, where emergency events are detected through multiple input mechanisms and processed in real time. Each trigger mechanism operates independently while sharing a common alert generation and communication pipeline.

The overall workflow consists of three stages:

1) Detection of emergency trigger
2) Processing and validation of the trigger event
3) Alert generation and communication

B. Multi-Modal Trigger Detection

1) SOS Button Activation: The SOS button provides a manual method for users to initiate emergency alerts. When pressed, the system immediately triggers the alert sequence without additional vali-dation, ensuring minimal delay in critical situations.
2) Shake Detection Mechanism: The shake detection feature utilizes the smartphone's accelerometer sensor to identify sudden or repetitive movements. The system continuously monitors acceleration values along the x, y, and z axes. When the acceleration exceeds a predefined threshold, it is interpreted as a distress signal.
   To reduce false positives, the system applies:
   – Threshold-based filtering
   – Time-window validation to detect repeated shakes
3) Volume Button Trigger: The system monitors hardware button interactions, specifically repeated presses of the volume button. A predefined pattern (e.g., multiple presses within a short duration) is used to activate the emergency alert. This allows users to trigger alerts without unlocking the device.
4) Voice Keyword Recognition: The voice activation module listens for predefined keywords using the device microphone. Upon detecting the keyword, the system validates the input and triggers the alert mechanism. This feature is particularly useful in situations where physical interaction with the device is not possible.

C. Data Acquisition and Processing

Once an emergency trigger is detected, the system collects relevant data, including:

– Real-time GPS coordinates (latitude and longitude)
– Timestamp of the event
– User identification details

The GPS module is activated to obtain accurate location data. In cases where GPS signals are weak, the system may use network-based location services as a fallback.

D. Alert Generation and Communication Workflow

After data acquisition, the system initiates the alert process, which follows a structured sequence:

1) Generate an emergency alert message contain-ing user details and location.
2) Send notifications to predefined emergency contacts.
3) Forward alert data to the Pink Police module.
4) Initiate optional phone call to primary contact.
5) Enable continuous location tracking for real-time monitoring.

The system ensures that alerts are transmitted with minimal delay using cloud-based messaging services.

E. Backend Integration

The SheCare system utilizes a real-time backend infrastructure to manage data synchronization and communication between modules. The backend is responsible for:

– Storing user data and emergency contacts
– Maintaining alert logs and history
– Enabling real-time updates to authorities

Technologies such as Firebase Realtime Database or Firestore can be used to support low-latency data transmission and scalability.

F. Working of the System

The overall working of the system can be summarized as follows:

– The application continuously runs in the back-ground, monitoring sensor inputs and user interactions.
– When any trigger condition is satisfied (SOS, shake, voice, or volume button), the system activates the emergency protocol.
– The user's location is captured instantly using GPS services.
– Alert messages are generated and transmitted to contacts and authorities.
– The system logs the event and enables continuous tracking if required.

This workflow ensures that emergency alerts are generated quickly and efficiently, minimizing response time.

G. Algorithmic Flow (Simplified)

The operational logic of the system can be rep-resented as:

1) Initialize sensors and services
2) Continuously monitor trigger inputs
3) If trigger *detected:*
   – Validate trigger condition
   – Capture location data
   – Generate alert message
   – Send alerts to contacts and authorities
4) Log event in database
5) Repeat monitoring process

The proposed methodology combines sensor-based detection, user interaction, and real-time communication to create a reliable emergency response system. By integrating multiple triggering mechanisms and a structured alert workflow, the system enhances the effectiveness and responsiveness of women safety applications.

VI. RESULTS AND ANALYSIS

A. Performance Evaluation

The response time of the system was measured from the moment a trigger was activated to the successful delivery of alert messages. Experimental observations indicate that the system is capable of sending alerts within an average time of 2–5 seconds, depending on network conditions. This demonstrates the efficiency of the cloud-based communication framework in ensuring rapid emergency response.

The accuracy of the multi-modal triggering mechanisms was also analyzed. The SOS button achieved near 100% reliability due to its direct activation. Shake detection showed an accuracy of approximately 90–93%, with minor variations caused by unintended device movements. Voice key-word recognition achieved an accuracy of around 85–90%, depending on environmental noise levels. The volume button trigger was found to be highly reliable, functioning consistently across multiple test cases.

B. Location Tracking Analysis

The system utilizes GPS services to capture real-time location data. During testing, the location accuracy was observed to be within a range of 5–10 meters in outdoor environments, while slightly reduced accuracy was noted in indoor or low-signal conditions. The use of network-based location services as a fallback helped maintain acceptable performance in such scenarios.

C. Comparative Analysis

Compared to traditional single-trigger safety ap-plications, the proposed system demonstrates im-proved reliability and usability due to its multi-modal triggering approach. While existing systems may fail when a single trigger is inaccessible, the SheCare system provides multiple alternatives, in-creasing the probability of successful alert activation.

Further analysis of the system highlights its usability and robustness under different real-world conditions. User testing conducted with a small group indicated that the multi-modal triggering mechanism significantly improves accessibility, as users were able to successfully activate alerts using at least one method in nearly all test scenarios. The redundancy provided by multiple triggers reduces the risk of failure compared to single-trigger systems.

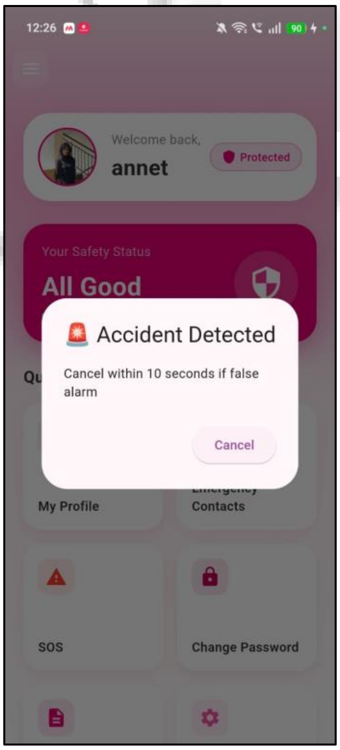

Fig. 2: Shake Detection Message

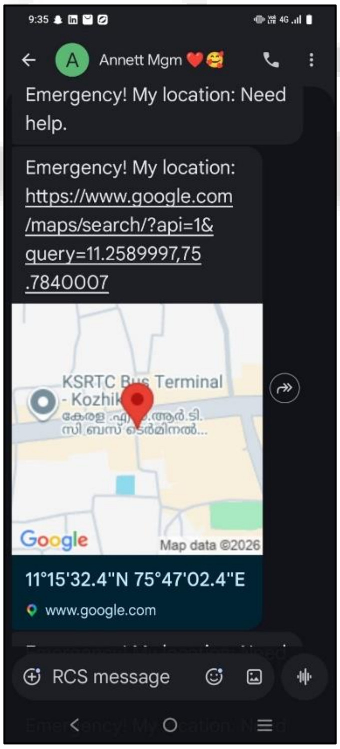

Fig. 3: Contact Receiving User Location

Additionally, the system maintained consistent performance across different devices, although mi-nor variations were observed due to hardware differences and network conditions. These observations confirm that the proposed system is not only technically effective but also practical for real-world deployment, offering a reliable and user-friendly solution for emergency response.

VII. FUTURE ENHANCEMENT

Although the proposed SheCare system provides an effective solution for women's safety, several enhancements can be incorporated to improve its performance, usability, and scalability in real-world scenarios. These future developments aim to ad-dress current limitations and extend the system's capabilities to provide a more comprehensive safety solution.

One of the major enhancements is the implementation of a unified emergency trigger mechanism. In the current system, different triggers activate specific functions; however, future versions can ensure that activation of any trigger—such as SOS button, shake detection, voice command, or hardware button—simultaneously initiates all emergency responses. This includes audio and video recording, automatic phone calls, SMS alerts, and real-time location sharing. Such integration will significantly improve reliability by ensuring that all critical actions are executed without delay during emergencies.

Integration with wearable devices such as smart rings, bracelets, or smartwatches can further im-prove usability. These devices can act as external triggers, allowing users to activate emergency alerts discreetly without accessing their smartphones. This feature is particularly useful in situations where using a mobile device is not feasible.

The incorporation of artificial intelligence can significantly enhance the system's intelligence and responsiveness. AI techniques can be used for advanced voice recognition, detection of abnormal motion patterns, and predictive analysis of potentially unsafe situations. This would transform the system from a reactive solution into a more proactive safety platform.

Future versions can also improve evidence col-lection mechanisms by enabling audio and video recording across all trigger types and storing the data securely in cloud servers. This would ensure that critical information is preserved for legal and investigative purposes while maintaining data security and privacy.

Optimizing battery consumption is another key area for enhancement. Continuous monitoring of sensors and background processes can be resource-intensive; therefore, implementing efficient algorithms and adaptive sensing techniques can reduce power usage without affecting performance.

Finally, expanding the system to support multiple languages and regional customization can in-crease accessibility and usability among diverse user groups. This would enable wider adoption and make the system more inclusive.

In conclusion, these future enhancements aim to transform the SheCare system into a more intelligent, reliable, and user-centric safety solution. By addressing current limitations and incorporating advanced technologies, the system can evolve into a comprehensive platform capable of providing faster, smarter, and more effective emergency response.

VIII. CONCLUSION

This paper presented "SheCare," a multi-modal women safety system designed to provide quick and reliable emergency assistance using multiple triggering mechanisms such as SOS, shake detection, voice activation, and hardware buttons. The system integrates real-time location tracking and communication with contacts and authorities to ensure faster response.

By combining multiple triggers with a structured architecture, the proposed system improves reliability and usability compared to existing single-trigger solutions. Although certain limitations exist, the system provides a practical and scalable approach for enhancing women's safety using mobile technology.

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