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SAHA -Women Safety Application and Device

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Abstract: Women's safety has become a major concern in today's society due to the increasing number of harassment and emergency incidents occurring in both public and private spaces. Many existing safety solutions depend heavily on internet connectivity, which may not always be available during emergencies. To address this issue, this paper presents SAHA, a smart women safety system that combines both hardware and software components to provide immediate assistance and reliable monitoring.

The proposed system includes a portable hardware device along with a mobile application, ensuring functionality in both online and offline conditions. The hardware device is built using an ESP32 microcontroller and includes an SOS button, GSM/GPS module, and a buzzer. When the SOS button is pressed, the system sends emergency alerts along with the user's location to pre-registered guardians through SMS, even without internet access. The buzzer also generates a loud sound to alert nearby people and discourage potential threats.

The mobile application further enhances the system by offering features such as live location tracking, safe zone detection, nearby emergency services, and guardian management. Additional features like fake call, voice-activated SOS, and safety awareness resources help users handle uncomfortable or risky situations effectively.

By integrating hardware reliability with intelligent software features, the proposed system provides fast response, improved safety awareness, and user confidence. The solution is portable, affordable, and easy to use, making it suitable for students, working professionals, and travelers. Overall, SAHA aims to improve personal security by offering both emergency support and preventive safety features.

Keywords: Women Safety, ESP32, GSM/GPS, SOS System, Mobile Application, Voice Detection, Safe Zones, Emergency Communication, IoT

I. INTRODUCTION

Women's safety has become an important issue in modern society, with increasing cases of harassment, assault, and emergency situations reported in both urban and rural areas. Although many safety applications are available today, most of them depend entirely on smartphones and internet connectivity. In critical situations, internet access may not be available, making these solutions unreliable when they are needed the most. Therefore, there is a strong need for a system that can provide immediate assistance and work even without internet connectivity.

A. Limitations of Existing Safety Systems

Most traditional safety methods depend on manual actions such as calling for help, sending messages, or contacting authorities. However, these methods may not be practical during emergencies when the user is under stress or unable to access their phone. In addition, many mobile safety applications require stable internet connectivity, which may not always be available, especially in remote areas. These limitations reduce the effectiveness of current safety solutions and highlight the need for a more reliable system.

B. Integrated Hardware-Software Safety Approach

With advancements in embedded systems and mobile technologies, it is now possible to develop more reliable safety solutions by combining hardware devices with mobile applications. Such systems can provide emergency assistance even without internet connectivity while offering advanced features through mobile applications.

The proposed SAHA system follows this approach by integrating a portable hardware device with a mobile application. This combination ensures immediate emergency response along with intelligent monitoring features.

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C. System Architecture and Functional Capabilities

The SAHA system includes a hardware device built using an ESP32 microcontroller, along with an SOS button, GSM/GPS module, and buzzer. When activated, the device sends emergency alerts along with the user's location to registered guardians through SMS. This ensures the system works even without internet connectivity.

The mobile application provides additional features such as:

- Live location tracking
- Safe zone detection
- Guardian management
- Emergency helpline access
- Nearby safe location navigation

This integration improves reliability and enhances overall safety.

D. Preventive Safety and User Empowerment

Apart from emergency response, the SAHA system also focuses on preventive safety. The application includes features such as:

- Voice-activated SOS
- Fake call functionality
- Safety tips and awareness
- Self-defense guidance
- Legal rights information

These features help users stay prepared and reduce the chances of risky situations.

E. Research Objectives and Contribution

The primary objective of this research is to design and implement a reliable, cost-effective, and user-centric safety system that ensures rapid response, operational independence from internet connectivity, and enhanced situational awareness. The proposed approach leverages the strengths of embedded hardware for real-time emergency triggering and mobile computing for intelligent monitoring and user interaction. By integrating these components into a unified framework, this work contributes toward the development of a scalable and practical solution for improving women's safety in diverse real-world environments.

II. LITERATURE REVIEW

Several researchers have proposed different solutions to improve women's safety using mobile applications and embedded systems. These studies highlight the importance of technology in providing quick assistance during emergencies.

The study titled ”Android App for Women Safety” (2021) introduced a mobile-based safety solution that uses GPS and SMS alerts. In this system, a single click on the help button sends the user's location to registered contacts. Although this approach provides quick assistance, it mainly depends on SMS communication, which may sometimes result in delayed responses [1].

Another system, ”Women Safety Device with GPS Tracking and Alerting System” (2022), proposed a hardware-based solution using an AVR microcontroller along with GPS and GSM modules. The system also included a panic button and electric shock generator for self-defense. While this solution improved safety, the device was bulky and required frequent battery charging, making it less convenient for everyday use
[2].

The ”Android-Based Woman Safety App” (2023) introduced additional features such as Google Maps integration and direct contact with nearby police stations. This improved response time but still depended heavily on internet connectivity and user interaction [3].

Similarly, the SURAKSHA Women Safety Application (2023) included features like SOS alerts, location sharing, emergency helplines, and gesture-based activation. Although these features improved usability, the system still required smartphone access and network connectivity [4].

Another research work proposed a Women Safety Device with GPS Tracking and Alerts, which focused on automated emergency detection using sensors and location tracking. However, this system mainly focused on reactive measures and lacked intelligent decision-making capabilities [5].

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From the existing literature, it can be observed that most solutions focus on emergency alerts but lack reliable offline functionality, intelligent monitoring, and preventive safety features. These limitations highlight the need for a more advanced system like SAHA that combines hardware reliability with intelligent software capabilities.

III. SYSTEM ARCHITECTURE

The SAHA system is designed using a three-layer architecture that includes the user layer, hardware layer, and application layer. The user layer consists of the end user along with the registered guardians, who interact with the system through both the mobile application and the hardware device. The hardware layer includes the ESP32-based safety device, which is responsible for triggering SOS alerts, acquiring the user's location, and enabling communication even in offline conditions. The application layer comprises the mobile application and backend services that support advanced features such as real-time location tracking, emergency alerts, and access to various safety resources. This layered architecture helps in maintaining efficient communication between components, ensures a modular system design, and improves overall scalability and reliability.

A. Hardware Architecture

The hardware module is developed to provide immediate emergency assistance, especially in situations where internet connectivity is unavailable. It includes several key components such as the ESP32 microcontroller, SOS button, GSM/GPS module (SIM800 series), buzzer, and power supply. The ESP32 functions as the main controller of the system, managing and coordinating all operations. The SOS button allows users to quickly activate emergency alerts during critical situations. Once activated, the GSM/GPS module collects real-time location information and sends SMS alerts to pre-registered guardians. At the same time, the buzzer produces a loud alarm to draw attention from nearby individuals and help deter potential threats. The power supply supports portable use and ensures that the device continues to operate reliably during emergencies.

B. Software Architecture

The software module improves the overall functionality of the system by offering intelligent features and enabling smooth user interaction through a mobile application and backend services. The mobile application is developed using TypeScript along with modern frontend technologies to ensure a responsive and user-friendly interface. The backend is implemented using Python, which handles data processing, communication, and system operations efficiently. A database is also incorporated to securely store important information such as user details, guardian contacts, safe zones, and system logs. The software is divided into multiple functional modules to provide comprehensive safety support. These include the SOS alert module for emergency notifications, the location tracking module for real-time monitoring, and the safe zone detection module to identify secure and risky areas. In addition, the system includes a guardian management module for managing trusted contacts, an emergency helpline module for quick access to support services, and a training and awareness module to educate users about safety measures. Additional features such as the fake call module and voice detection module further enhance usability and emergency preparedness, making the overall system more reliable, comprehensive, and user-friendly.

C. Communication Flow

The SAHA system is designed to support both offline and online communication modes to ensure reliable performance in different situations. In offline mode, when the SOS button is activated, the GSM module immediately sends SMS alerts to the registered guardians without the need for internet connectivity. This allows the system to function effectively even in areas with limited or no network access. In online mode, the mobile application connects with backend servers to provide additional features such as real-time location tracking, notifications, and enhanced safety services. This dual communication approach improves system reliability and ensures that the system continues to operate efficiently, even in lowconnectivity environments.

D. Data Flow of the System

The data flow of the SAHA system starts when the user activates an SOS alert, either by pressing the SOS button on the hardware device or by using a predefined voice command through the mobile application. Once the alert is triggered, the system captures the user's current location using the GPS module. This location information is then transmitted through the GSM module in the form of SMS alerts and also shared with the mobile application for further processing. The registered guardians receive the emergency alert along with the user's location details, allowing them to respond quickly. At the same time, the mobile application displays the user's real-time location on a map, making it easier to monitor the situation. This organized data flow helps ensure fast response and effective communication during emergency situations.

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IV. EXPERIMENTAL RESULTS AND ANALYSIS

The SAHA system was successfully developed and tested with the aim of improving women's safety through real-time monitoring and emergency alert features. The experimental results indicate that the system is capable of accurately tracking the user's live location and determining whether the user is in a safe or unsafe zone. During the testing phase, the application responded promptly to changes in location and provided quick access to various safety tools. The system also showed reliable performance in sending emergency alerts and sharing location information with registered guardians. Overall, the results demonstrate that the SAHA system offers a practical, efficient, and user-friendly solution for enhancing women's safety.

A. Safe Zone Detection

This page of the SAHA Women Safety Application displays the user's real-time safety status based on live location tracking. The system continuously monitors the user's GPS location and determines whether the user is currently in a Safe Zone or an Unsafe Area. If the user enters a potentially unsafe location, the application immediately alerts the user and provides quick access to emergency tools. In addition, the interface includes features such as Fake Call, Share Location, Nearby Help, and Emergency Contacts, which allow the user to quickly seek assistance when needed.

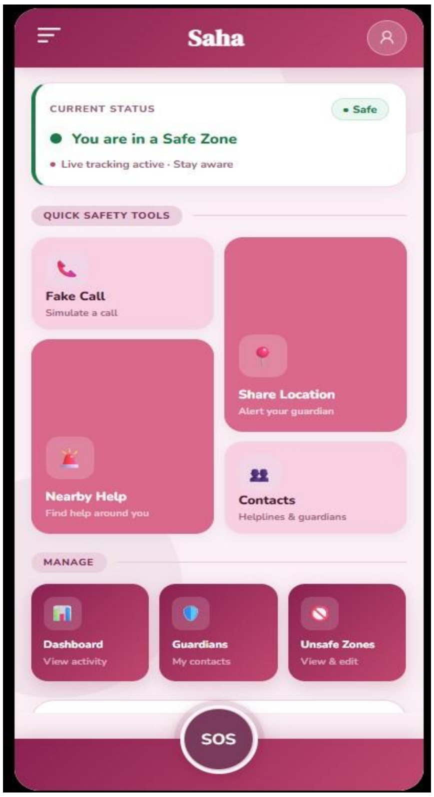

Fig. 1. SAHA Application showing Safe Zone Detection

B. Unsafe Zone Detection

This page of the SAHA application displays unsafe zones on the map along with the user's live location, allowing users to easily understand their surroundings. Unsafe areas are clearly highlighted using red markers and circular boundaries for better visibility and easy identification. In addition to predefined unsafe zones, users are also given the option to manually add new unsafe areas by entering the zone name and specifying the radius in meters. Once the user clicks the Add Unsafe Zone button, the newly defined unsafe area is immediately displayed on the map. This feature helps users recognize potentially risky locations in advance and supports safer travel decisions.

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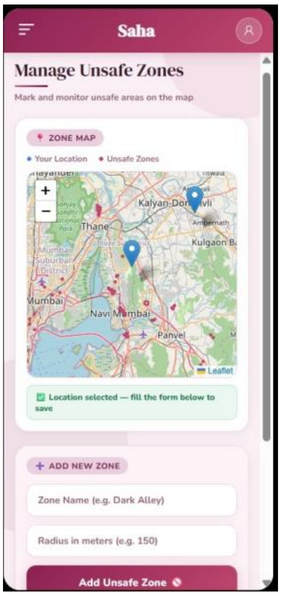

Fig. 2. SAHA Application showing Unsafe Zone Detection and User-Defined Unsafe Areas

C. Manage Guardian

The Manage Guardian page allows users to add guardian details such as name, phone number, and email address, making it easy to register trusted contacts within the system. These guardians are notified during emergency situations through SMS or email alerts, ensuring that help can be reached quickly when needed. The page also displays a list of all added guardians, allowing users to easily view and manage their contacts. This feature supports quick communication with trusted individuals during emergencies and helps enhance overall user safety.

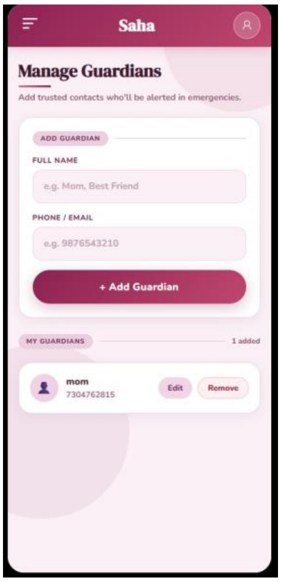

Fig. 3. SAHA Application showing Manage Guardian Feature

D. Hardware Device Implementation

The hardware module is designed to provide instant emergency response, particularly in offline conditions, with the ESP32 microcontroller serving as the central controller for managing all system operations. The system includes an SOS button that enables quick activation during emergency situations, allowing users to send alerts without delay. It also incorporates a GSM/GPS (SIM800) module, which is responsible for obtaining real-time location data and sending SMS alerts to registered guardians. Additionally, a buzzer is included to generate a loud alarm, helping to attract nearby attention and deter potential threats. A portable power supply supports the device and ensures continuous and reliable operation during emergencies.

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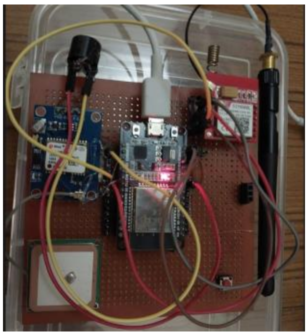

Fig. 4. SAHA Hardware Device for Emergency Response

V. CONCLUSION

The SAHA Women Safety Application and Device presents a comprehensive and reliable solution to address the growing concerns related to women's safety. The system effectively integrates both hardware and software components to provide immediate emergency response, real-time monitoring, and preventive safety features. By incorporating an ESP32-based hardware module equipped with an SOS button, GSM/GPS communication, and a buzzer, the system ensures that emergency alerts can be triggered quickly and efficiently, even in offline conditions where internet connectivity is unavailable.

The mobile application further strengthens the system by providing intelligent features such as live location tracking, safe zone detection, guardian management, and quick access to emergency helpline services. In addition, functionalities like voice-activated SOS, fake call simulation, and safety training resources improve both usability and user preparedness in potentially unsafe situations. The system's capability to operate in both online and offline modes enhances its reliability when compared to conventional solutions that depend entirely on internet connectivity.

The experimental analysis shows that the system provides fast response times, accurate location tracking, and effective communication with guardians during emergency situations. Although some minor limitations were observed, such as reduced GPS accuracy in indoor environments and challenges in voice detection under noisy conditions, the overall performance of the system remains satisfactory. Furthermore, the SAHA system not only focuses on reactive emergency measures but also emphasizes preventive safety and user awareness.

In conclusion, the SAHA system offers a user-friendly, costeffective, and portable solution that enhances personal security and confidence for women. By combining modern embedded systems with mobile technologies, this project contributes toward creating a safer and more secure environment.

VI. FUTURE WORK

The SAHA system can be further enhanced by integrating advanced technologies and incorporating additional features to improve overall performance, usability, and scalability. These potential improvements are intended to make the system more efficient, reliable, and adaptable to different real-world scenarios. By implementing these enhancements, the SAHA system can evolve into a more intelligent and effective safety solution that better addresses the growing need for women's safety.

A. AI-Based Predictive Safety

One possible improvement for the SAHA system is the integration of Artificial Intelligence (AI) and Machine Learning algorithms to enhance its predictive capabilities. By analyzing factors such as user behavior, location patterns, and environmental conditions, the system can identify potentially unsafe situations in advance. This approach would allow the system to generate proactive alerts before a critical incident occurs, helping users take preventive action. As a result, the system would move beyond reactive emergency responses and focus more on preventive safety, thereby improving overall user protection.

B. Wearable Device Enhancement

The hardware device can be further upgraded into a compact and wearable form, such as a smart band or pendant, making it more convenient, portable, and discreet for users in everyday situations. In addition, integrating extra sensors like accelerometers and heart rate monitors can enhance the device's functionality. These sensors can help detect abnormal conditions such as sudden falls, unusual movements, or increased stress levels. When such situations are identified, the

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system can automatically trigger emergency alerts without requiring manual intervention from the user, thereby improving response time and overall safety.

C. Real-Time Monitoring and Cloud Integration

Future versions of the system can be enhanced by incorporating real-time audio or video streaming features, which can provide live evidence during emergency situations. This functionality can help guardians or authorities better understand the situation and respond more effectively. In addition, cloud integration can be further improved to securely store incident data and make it accessible to authorized authorities when required. These enhancements would improve system reliability, enable better data management, and increase overall accessibility.

D. Integration with Emergency Services

Direct integration with law enforcement agencies and emergency response systems can further enhance the effectiveness of the SAHA system by significantly reducing response time during emergencies. Such integration would allow alerts to be automatically shared with the appropriate authorities, enabling quicker action and faster assistance in critical situations. This improvement would strengthen the system's real-world applicability and increase its overall impact in ensuring user safety.

E. Improved Voice Recognition and Accessibility

Improvements in voice recognition technology can further enhance the accuracy of the system, particularly in noisy environments where detecting voice commands may be challenging. This would ensure more reliable activation of voicebased SOS features during emergency situations. Additionally, incorporating multi-language support would make the system accessible to a broader population, allowing users from different regions and language backgrounds to use the application more comfortably and effectively.

F. Battery Optimization and Efficiency

Incorporating battery optimization techniques along with low-power hardware components can help extend the overall usability of the device. These improvements would allow the system to operate for longer durations without frequent charging, thereby increasing reliability and making the device more suitable for continuous use in real-world situations.
Overall, the future scope of the SAHA system lies in transforming it into a fully intelligent, automated, and widely deployable safety ecosystem. Such advancements would enable the system not only to respond effectively during emergencies but also to actively prevent potential risks. By achieving this, SAHA aims to provide greater security, improved confidence, and enhanced safety for women across different environments.

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