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Spark Women: Mobile Safety Application for Real-Time Emergency Assistance

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***Abstract*-Women's safety remains a major concern in today's society, particularly in urban environments where travel during late hours or through isolated routes poses significant risks. This paper presents Spark Women, a smart mobile safety application designed to provide instant emergency assistance using SOS alerts, live GPS tracking, safe route analysis, and hardware-based activation through a Bluetooth buzzer. Unlike traditional safety applications, the proposed system enables SOS triggering without unlocking the phone. Emergency alerts can be activated using side-button taps, phone shake, or a buzzer connected through a hardware emulator. Once triggered, the application automatically sends SOS messages with live location, initiates emergency calls, and activates continuous tracking. Additionally, the system includes a Safe Route module that identifies safer travel paths using location-based analysis. The application is designed to function effectively in low-interaction situations where manual phone usage may not be possible. Hardware implementation is simulated using an emulator to ensure feasibility without requiring physical devices. The proposed solution focuses on practical usability by ensuring fast response, discreet activation, and reliable emergency communication.**

Keywords:- Women Safety, Mobile Application, SOS Alerts, GPS Tracking, Emergency Assistance, Bluetooth Buzzer, Safe Route Detection, Artificial Intelligence, IoT, Real-Time Tracking

I. INTRODUCTION

Women's safety has become a significant social and tech-nological concern due to the increasing number of incidents involving harassment, assault, and violence against women. Despite advancements in law enforcement systems and mo- bile technologies, ensuring real-time protection and timely emergency response remains a major challenge. In many emergency situations, victims are unable to seek immediate help due to fear, physical constraints, or lack of accessible communication channels, resulting in delayed assistance and severe consequences. To address this issue, this paper presents *Spark Women*, a smart mobile safety application designed to enhance women's safety through technology. The proposed system integrates instant SOS alerts, real-time GPS-based location tracking, one-tap emergency calling, and AI-powered legal assistance within a single, user-friendly platform. The primary aim of the application is to enable women to quickly and discreetly alert trusted contacts or authorities during distress situations. The Spark Women application supports both manual and automatic emergency activation mechanisms. SOS alerts can be triggered through multiple methods such as pressing an SOS button, detecting a phone shake, or activating a Bluetooth-enabled wearable device. This multi-trigger mechanism ensures that emergency alerts can be generated even when the user is unable to directly access her mobile device. A key feature of the system is the integration of Artificial Intelligence (AI) and Natural Language Processing (NLP), which assists users in understanding their legal rights and protections. By processing user queries related to harassment or abuse, the system identifies relevant legal provisions and provides appropriate guidance. In addition, the application offers safe route guidance using location-based data to help users avoid high-risk areas, thereby enhancing preventive safety.

Overall, Spark Women is designed as an integrated safety solution that combines GPS, AI, NLP, and IoT-based technologies to deliver rapid emergency assistance and continuous situational awareness.

A. Motivation

Women frequently encounter situations that pose risks to their personal safety, such as traveling alone, working late hours, or moving through isolated areas. In such scenarios, the ability to request help quickly and effectively can be life- saving.

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However, existing safety measures often require manual operation or continuous internet connectivity, limiting their effectiveness during real-world emergencies. This concern motivated the development automated mobile safety system that prioritizes ease of use, reliability, and rapid response. Another important motivation behind this work is the lack of awareness among many women regarding legal rights and protections available in cases of harassment or assault. By integrating AI- and NLP-based legal assistance, the proposed system aims to empower users with timely information, enabling informed decision-making during critical situation.

B. Problem Statement

Despite the availability of several women safety applications, most existing systems suffer from significant limitations. Many solutions rely heavily on continuous internet connectivity, require manual user interaction, or fail to provide accurate real-time location tracking. Additionally, discreet activation mechanisms and intelligent decision-support features are often absent, reducing the effectiveness of these systems during emergencies. Therefore, there is a need for a smart, reliable, and easily accessible safety solution that ensures instant alert generation, real-time location sharing, and direct communication with emergency contacts. Such a system should support multiple emergency triggers, operate effectively under limited connectivity conditions, and provide intelligent assistance to users when manual interaction is not feasible.

C. Objectives

- To design an emergency safety application that works without unlocking the phone
- To provide instant SOS alerts with live GPS location
- To enable automatic emergency calling during distress
- To integrate buzzer-based triggering using hardware emulator
- To allow SOS activation through side button / shake detection
- To implement Safe Route detection for safer navigation
- To ensure discreet and fast emergency response

II. LITERATURE SURVEY

Women's safety has emerged as a critical social and techno-logical concern due to the increasing number of harassment, assault, and violence-related incidents worldwide. With the widespread adoption of smartphones and wearable devices, technology has played a vital role in the development of safety-oriented solutions. Several mobile applications and intelligent systems have been proposed to provide emergency assistance using features such as SOS alerts, GPS-based location tracking, and emergency communication mechanisms.

The objective of this literature survey is to analyze existing women safety systems, examine the technologies employed, and identify their limitations. A comprehensive review of previous work helps in understanding current trends, challenges, and gaps, which form the foundation for designing a more reliable and intelligent safety solution.

A. Existing Systems

An Android-based women safety application proposed in 2025 provides a one-touch SOS feature for sending distress messages along with real-time GPS location tracking [1]. While effective for quick alerts, the system relies heavily on manual activation and lacks automation, artificial intelligence, and IoT-based integration.

The *Secure Her* AI-enabled women's safety application (2025) introduces contextual risk detection using behavioral analysis and artificial intelligence [2]. Although it supports intelligent alert mechanisms and live tracking, the system requires continuous internet connectivity, and several AI modules remain under experimental evaluation. A machine learning–based women safety system developed in 2024 focuses on automatic danger detection and shares live location details with police authorities and emergency contacts [3]. Despite its innovation, the system suffers from high data consumption and false alert generation due to non- threatening environmental triggers.

The *Women Safety Analytics* system (2025) integrates AI-driven analytics with SOS activation through phone shake, button press, and voice commands [4]. However, the system depends significantly on camera surveillance and persistent internet connectivity, raising privacy and usability concerns.

An Android-based safety application proposed in 2023 provides real-time location sharing via Google Maps and sends alerts through SMS and calls [5]. Its dependence on internet connectivity and server-based infrastructure limits reliability in low-network regions.

Earlier women safety systems developed between 2021 and 2022 introduced features such as panic buttons, battery-level sharing, and self-defense guidance videos [6]. These systems rely entirely on GSM or internet connectivity and require manual activation.

Recent initiatives such as *SafePath* (2024) emphasize continuous GPS tracking and SOS activation using wearable devices [7]. Although promising, these systems remain in the prototype stage and face challenges related to battery efficiency and hardware integration.

B. Limitations of Existing System

Despite continuous advancements, most existing women safety systems exhibit several technical and functional limitations that

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reduce their effectiveness during emergencies.

Dependence on Internet Connectivity: Many applications require continuous internet access for alert trans- mission and location tracking, making them unreliable in areas with weak or no network coverage.

Limited Communication Channels: Several systems rely on a single communication medium such as SMS or calls, reducing the probability of successful alert delivery during network failures.

High Power Consumption: Continuous GPS usage and background services lead to rapid battery drain, affecting long-term usability.

Lack of Intelligent Integration: Limited use of AI, NLP, and Bluetooth-enabled wearable devices restricts automation, contextual understanding, and discreet activation.

Privacy and Security Concerns: Inadequate encryption and data protection mechanisms in some systems pose risks to sensitive user data, including real-time location information. These limitations highlight the need for a robust, intelligent, and multi-trigger safety system that operates reliably under both online and offline conditions.

The proposed *Spark Women* system aims to address these challenges by integrating GPS-based tracking, safe route analysis, Bluetooth – enabled activation and secure emergency communications mechanisms to ensure fast and reliable assistance during emergencies.

III. METHODOLOGY

A. Proposed System Overview

The proposed system, *Spark Women*, is a smart mobile safety application designed to provide rapid emergency assistance, real-time monitoring, and legal awareness for women. The system integrates GPS, Artificial Intelligence (AI), Natural Language Processing (NLP), Bluetooth, and IoT-based triggers to ensure reliable operation in both online and offline environments.

Unlike conventional safety applications that rely primarily on manual activation and continuous internet connectivity, the proposed system supports multiple discreet activation mechanisms such as SOS button press, phone shake detection, side-button taps, and Bluetooth-based wearable triggers. Upon activation, emergency alerts containing real-time location data are immediately shared with registered emergency contacts.

B. Key Features of Proposed System

- SOS Activation without unlocking phone
- Buzzer-triggered emergency alert (via emulator)
- Side-button multi-tap activation
- Phone shake detection
- Automatic emergency calling
- Live GPS location sharing
- Continuous tracking mode
- Safe Route guidance
- Works in real-time emergency situations
- Hardware simulation using emulator

C. System Architecture

The overall architecture of the proposed system is illustrated in Fig. 1. The application initializes by activating core services such as GPS, Bluetooth, and background monitoring modules. User actions are continuously monitored, and based on the detected trigger, appropriate system modules are activated.

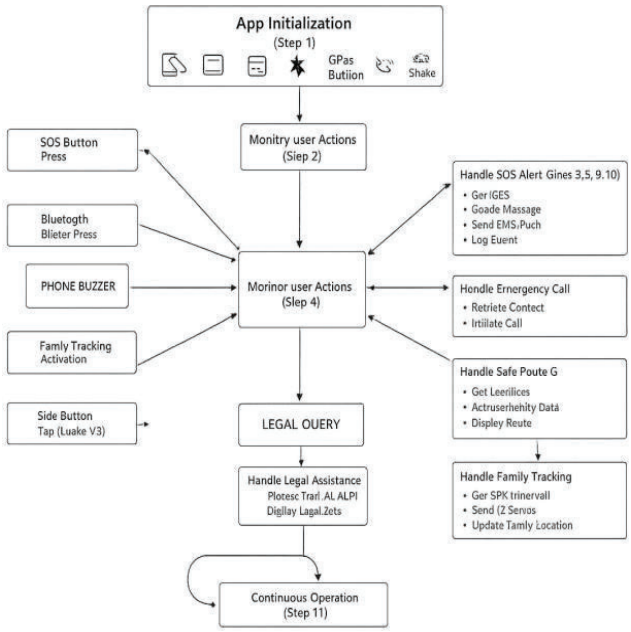

Fig. 1. System Architecture of Spark Women

The architecture supports SOS alert handling, emergency calling, family tracking, safe route navigation, and AI-driven legal assistance. The system is designed to operate continuously in the background, ensuring uninterrupted protection.

D. Data Flow Diagram

To better understand system interactions, data flow diagrams (DFD) are used to represent information movement within the system.

1) *Level 0 Data Flow Diagram:* Fig. 2 illustrates the Level 0 DFD, which provides a high-level view of the interaction between the user, the safety application, emergency services, family members, and the legal database.

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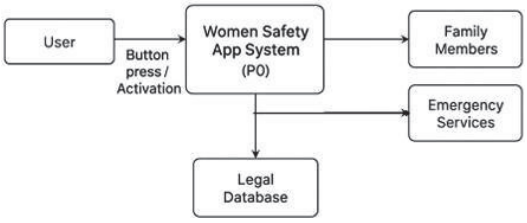

Fig. 2. DFD Level 0

2) *Level 1 and Level 2 Data Flow Diagram:* Fig.3 and Fig. 4 present detailed representations of system processes such as SOS alert handling, emergency calling, family tracking, and legal assistance. These diagrams demonstrate how different triggers activate corresponding modules and how data flows between them.

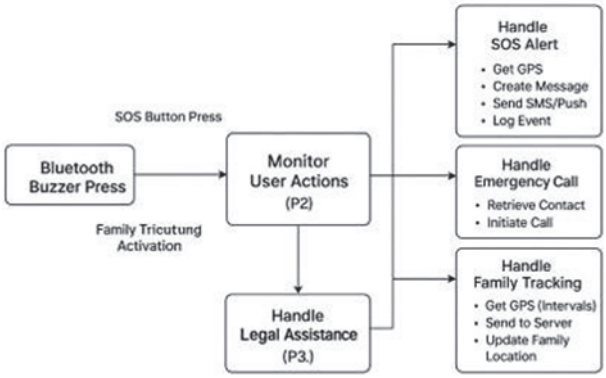

Fig. 3. DFD Level 1

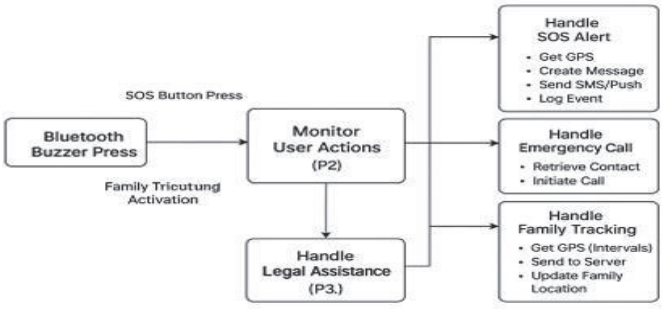

Fig. 4. DFD Level 2

D. System Development Approach

The development of the *Spark Women* application follows the Software Development Life Cycle (SDLC) methodology to ensure reliability, scalability, and maintainability. The major phases include requirement analysis, system design, implementation, testing, deployment, and maintenance.

The system adopts a modular architecture where components such as SOS alert handling, GPS tracking, Bluetooth connectivity, and AI-based legal assistance operate independently while maintaining seamless coordination.

E. Operational Algorithm

The operational flow of the proposed system is summarized as follows:

1) The application initializes core services including GPS, Bluetooth, and background monitoring.
2) User actions such as SOS button press, phone shake, side- button tap, or Bluetooth buzzer activation are continuously monitored.
3) Upon trigger detection, the system retrieves real-time location data.
4) SOS alerts are transmitted to registered emergency contacts via available communication channels.
5) Emergency calls are initiated automatically when required.
6) AI and NLP modules process user queries to provide relevant legal guidance.
7) Family tracking and safe route guidance operate concurrently for continuous protection.

The system runs persistently in the background to ensure uninterrupted monitoring and immediate response during emergencies.

F. Operational Flow

Step 1: Application runs in background
Step 2: Trigger detected through:
Side-button tap
- Phone shake
- Buzzer (via emulator)

Step 3: SOS activated automatically
Step 4: System sends location-based alert
Step 5: Emergency call initiated
Step 6: Continuous tracking starts
Step 7: Safe route guidance activated if user is moving

G. Results

The system was tested under different simulated emergency scenarios.

- SOS alerts were successfully triggered without unlocking the phone
- Buzzer activation using emulator worked reliably
- Emergency calls were initiated automatically
- Live GPS tracking functioned in real-time
- Safe Route feature provided alternative safer paths.

Response time was significantly reduced due to multi-trigger activation. The emulator-based hardware simulation proved effective in replicating real-world emergency conditions.

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IV. RESULTS AND DISCUSSION

The Spark Women system performed effectively during testing by quickly sending SOS alerts with accurate location details to emergency contacts. It worked well in both online and offline conditions, using SMS when internet was not available. Features like multiple alert triggers and emergency calling improved response time and usability. The AI module provided basic legal guidance, helping users understand safety-related issues. Overall, the system is reliable, easy to use, and enhances user safety in emergency situations.

Response

- Alerts are sent very fast with internet.
- Without internet, it uses SMS, so it still works.
- The AI gives simple legal advice for safety-related problems.
- Works better than normal apps because it is fast, easy, and reliable.
- Can be improved further with wearable devices.

A. Discussion

The results indicate that integrating GPS, AI, NLP, Blue- tooth, and IoT-based triggers into a unified safety platform significantly enhances system effectiveness. While the current implementation focuses on mobile-based deployment, further optimization and integration with wearable devices can improve accessibility and adoption.

Overall, the Spark Women system demonstrates strong potential as a reliable, intelligent, and user-centric safety solution for women

V. CONCLUSION AND FUTURE WORK

The *Spark Women* app is developed to enhance women's safety using advanced mobile technology. It provides important features such as instant SOS alerts, live location tracking, safe route navigation, AI-based legal assistance, and Bluetooth buzzer support. During testing, the app performed effectively by detecting emergencies and quickly sending accurate location details to family members and authorities. The integration of AI and NLP helps users by giving relevant legal information and quick guidance in critical situations. The user interface is simple, responsive, and easy to use, even during stressful moments. The app also supports offline functionality through SMS alerts, ensuring help can be reached without internet access. This makes the system more reliable and practical in real-world scenarios. It helps users feel more safe and confident while using the application. It also reduces response time during emergencies. It combines modern mobile technology with real-time safety measures to create a secure and trustworthy digital companion for every woman Overall, the Spark Women app is a smart, efficient, and user-friendly safety solution that empowers women to act quickly in emergencies. Future improvements may include integration with smart wearables, use of machine learning for risk prediction, and direct communication with police for faster emergency response.

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