A Comprehensive Web-Based Women Safety Application with Real-Time Tracking and AI-Powered Risk Assessment

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***Abstract*:**

The issue of women safety is of paramount concern in the world today, and the increase in crime rate requires new technological solutions to this problem. In this paper, I am going to showcase a comprehensive women safety web application created with React.js, Node.js, and Firebase to increase the safety of users with the help of real-time monitoring and the threat evaluation. Some of the protective features incorporated in the system are real-time GPS tracking, automatic audio recordings in case of an emergency, crime heatmap visualization using historic data, safe route based on dijkstra's algorithm with crime weightage, and vehicle authentication using a license plate verification system. One of the unique features is the ability to combine Sahaaya, an AI-based chatbot, with the implementation of the Gemini API of Google in emergency counselling, and a hidden simulated fake phone call option that allows escaping a situation. The application runs on Socket.IO, which is used to conduct real-time communication and Azure Cloud, which provides a secure storage of data. Installed in three agile sprints, the system was completed at 100 percent covering all testing validation. By making women freer to move, Sahay supports the United Nations Sustainable Development Goals 5 (Gender Equality) and 11 (Sustainable Cities and Communities) as well as assists to make cities safer. The performance testing shows sub-2 seconds page load and 200-500ms API response time and user acceptance testing scores 4.5/5 ratings.

Index Terms—Women safety, real-time tracking, emergency response, crime heatmap, AI chatbot, web application, Firebase, sustainable development goals.

I. Introduction

The issue of female security in the streets has come out as one of the most urgent social issues around the world. The National Crime Records Bureau reports that the number of crimes against women in India had risen by 15.3 percent in 2020-22, with in excess of 4,45,000 cases being registered annually [1]. According to the World Health Organization it is approximated that about one out of three women is subjected to physical or sexual violence in a lifetime [2]. Such alarming statistics explain why there is a dire need to have access to safe solutions that are reliable and technologically enhanced.

Old safety protocols like emergency help lines and neighbourhood watch programs do not have real time situational awareness and immediate response functions [3]. Available safety applications have high deficiencies. Some apps such as Safetipin offer crowd-sourced safety audits, but do not have features of real-time emergency response [4]. BSafe and Himmat are commercial solutions that provide SOS alerts but do not combine it with predictive analytics or evidence gathering [5]. In a detailed analysis, it can be seen that the features, including automated audio recording, AI-based instructions, vehicle verification, and discrete escape mechanisms are not provided under one integrated solution [6]. The development of smartphones and cloud computing and artificial intelligence offers historic opportunities to close this safety gap. The contemporary web technologies provide responsive and accessible sites that provide real-time services, irrespective of location and device [7]. Real-time communication protocols are used to deliver alerts in real-time and cloud databases offer secure and scalable storage of sensitive user data [8]. The analysis of crime trend enables the machine learning algorithm to forecast the locations with high risks, which makes reactive safety measures into proactive prevention of threats [9].

In this study, Sahay, a multifunctional web application, is proposed as a solution to the most common safety gaps faced by women, especially in developing countries, via an all in-one smart solution. The name Sahay is Sanskrit, which means assistance or support, and it is connected with the main philosophy of the application that guarantees quality help in time when it is needed. The application architecture is built using modern frontend solutions (React.js, Tailwind CSS) alongside solid backend solutions (Node.js, Express.js, Socket.IO) and safe cloud databases (Firebase, Azure SQL) [10]. Some of the major contributions are real-time GPS tracking with automatic audio evidence collecting, visualization of crime heatmap, Sahaaya artificial intelligence chatbot with Gemini API, detecting license plates using Rapid API and simulating a discrete fake phone call using Twilio API. The application design is compliant with two sustainable development goals of the United Nations. The SDG 5 (Gender Equality) focuses on 5.2 (end all forms of violence against women) and 5.5 (enhance full participation of women in the society) which is done with features that enable women mobility and offer means to protect them [11]. Safe route navigation and crime heat mapping are in support of SDG 11 (Sustainable Cities and Communities) target 11.7 (sustainable access to safe public spaces) [12].

In this paper, the structure is as follows; Section 2 provides literature review, Section 3 provides methodology, Section 4 provides results, Section 5 provides discussion of findings, and Section 6 provides a conclusion of improvements that can be done in the future.

II. Literature Review

The field of women safety through technology has been an active one in the last ten years. The section is a review of the available applications and research contribution.

A. History of Women Safety Applications

The history of women safety applications has three generations. The first-generation applications (2010-2015) were working with the rudimentary SOS alerts. Khandoker et al created Lifecraft, an Android application that allows emergency alerts that can be given with location information [13]. GPS tracking and voice recording were added into secondgeneration applications (2015-2020). A location sharing with emergency contacts was introduced by Premi et al. in FRNDY [14]. The third generation applications (2020 and now) include machine learning and cloud-based architecture. Sharma et al. suggested a wearable-based system of women safety using IoT technology and combining it with cloud technology [15].

B. Commercial Solutions Analysis

A number of commercial applications deal with the women safety in different ways. Safetipin uses crowd-sourcing to conduct urban safety audits, but fails to provide real-time emergency response [16]. bSafe provides live location tracking and video capture but no predictive analytics [17]. Delhi Police created Himmat, which sends SOS notifications on a single tap, but has been criticized on the slow response time [18]. None of the available commercial solutions incorporates all the necessary safety mechanisms on one platform [19].

C. Safety Systems Technological approaches

Modern safety applications are based on real-time location tracking. Zhang et al. showed hybrid positioning systems based on GPS, Wi-Fi, and cellular triangulation with an accuracy of
95 percent at a distance of 15 meters [20]. Real-time communication protocols allow transmitting alerts in real-time; Kumar and Singh discovered that Socket.IO had an average message delivery of 50-100ms [21]. Cloud infrastructure offers a secure and scalable storage with query response time of less than 100ms [22]. Predictive safety applications can be used with the help of AI and machine learning, with Gupta et al. using random forest algorithms and receiving the result of 82 per cent accuracy of predicting crime hotspots [23]. The exceptionally large models of language like Google Gemini, allow conversational AI helpers to guide through emergencies [24].

D. Research Gaps

Irrespective of extensive research, there are still some gaps. Current solutions are provided to individual safety issues as opposed to offering holistic protection [25]. The use of predictive analytics is not popular in business. Emergency conversational assistants based on AI are not commonly adopted. Situational escape features that are discreet and allow one to flee are hardly ever offered. Table 1 provides the comparative analysis of the existing solutions against the identified requirements.

TABLE I

COMPARATIVE ANALYSIS OF SOLUTIONS RELATED TO WOMEN SAFETY

Study/ Ap- plication	Year	Realtime Tracking	AI As- - sistance	Crime Heatmap	Evidence Collection	Discreet Features	Webbas ed
Khandoker et al. [13]	2019	Yes	No	No	No	No	No
Premi et al. [14]	2022	Yes	No	No	Yes	No	No
Safetipin [16]	2023	No	No	Yes	No	No	Yes
bSafe [17]	2024	Yes	No	No	Yes	Yes	No
Himmat [18]	2024	Yes	No	No	No	No	No
Sharma et al. [15]	2024	Yes	No	No	Yes	No	No
Gupta et al. [23]	2024	No	Yes	Yes	No	No	No
Sahay (P	2025	Yes	Yes	Yes	Yes	Yes	Yes

roposed)							

III. METHODOLOGY

Sahay development had a structured approach that entailed the use of agile sprint planning, modular architecture and extensive testing guidelines.

A. Agile Development Framework

The three-sprint agile approach of the project allowed developing it iteratively and providing feedback. Sprint 1 was concentrated on the core infrastructure (user authentication and license plate verification). Sprint 2 focused on features that are security-conscious such as crime heatmap enabled, safe route navigation, and the inclusion of an AI chatbot. Sprint 3 was devoted to such emergency-related features as fake phone call simulation and full system integration.

B. System Architecture

Sahay application architecture has a three tier design which is modern with the presentation, application and data layers separated as shown in Figure 1.
In the diagram, the system architecture is presented as a whole with the frontend layer designed using React.js and connected to the Node.js backend via REST APIs and Socket.IO connections. The backend is connected with Firebase Authentication, Azure SQL Database, Azure Cloud-Storage, and external API such as Google Maps, Gemini AI, Twilio, and RapidAPI.Presentation

Application

Data

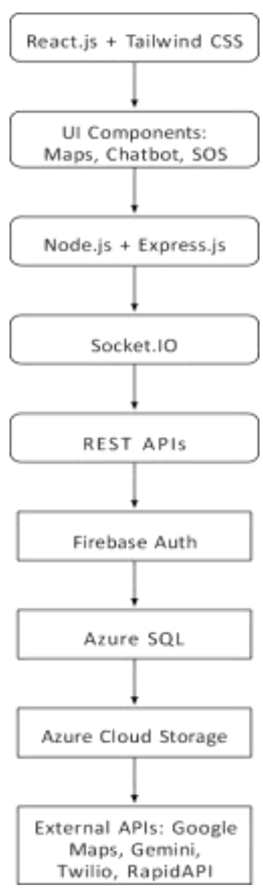

Fig. 1. Sahay System Architecture (Black and White Vertical Layout)

React.js and Tailwind CSS are the applied development tools to build the presentation layer where it can be responsive on desktop, tablet and mobile devices. Some of the main elements are authentication interfaces, interactive maps with Leaflet and Mapbox, chatbot interface, and emergency controls with noticeable SOS buttons.

Application layer is deployed as Node.js with Express.js framework that has RESTful API endpoints and WebSocket connections through Socket.IO. This layer deals with request processing, business logic such as route calculating algorithms, integration of external APIs and real time communication to update location.

The data layer uses the hybrid database architecture which is based on Firebase Authentication to provide secure user management, Azure SQL database to store user profile and license check history in relational format, and Azure Cloud storage to store audio recording and user-provided content in a secure location.

C. Sprint 1 Implementation: Foundation Features

1) User Authentication Module: The authentication system is designed to enforce the safe user registration and login through Firebase Authentication and JWT token generation.

The system has rate limiting to ensure brute force attacks are prevented, session timeouts upon inactivity and email verification of the account. The API specifications of authentication are given in Table 2.

TABLE II AUTHENTICATION API SPECIFICATIONS

Endpoint	Metho d	Request Body	Response	Status Code s
/api/signup	POST	email, password, displayNam e	token, user object	201, 400, 500
/api/login	POST	email, password	token, user object	200, 401, 500
/api/ verify-email	GET	token	verificatio n status	200, 400
/api/resetpassw or d	POST	email	reset status	200, 404
/api/logout	POST	-	success status	200, 401

2) License Plate Inspection System: The license plate checker combines the vehicle recognition API and history storage RapidAPI with the local history storage. Users are required to enter license plate numbers to check in real-time the registration information of the vehicle such as make, model, and registration information. The verification is recorded in the record history of the user which can be accessed later in case of pattern analysis.

D. Sprint 2 Implementation: Safety Intelligence Features

1) Crime Heatmap Visualization: The crime heatmap offers visualization of hot spots areas using previous crime data that includes latitude, longitude, crime type and time records. Its implementation uses the data to provide continuous risk surfaces with colour gradients where red means the high-risk areas, yellow means the medium-risk areas and green means the low-risk areas. The users are able to customize the analysis by locating the type and time of crimes.

2) Safe Route Navigation: Safe route navigation system determines the best paths between routes that are entered by users with the consideration of safety rather than the shortest distance. The algorithm is based on a combination of the shortest path algorithm of Dijkstra with crime proximity weighting, with spatial indexing (kd-tree) to perform a high quality proximity query. The scores of each road segment are provided as the safety scores depending on the crime density around, the recency and the severity. The chosen path is shown in an interactive map with color-coded sections showing the level of relative security.

3) Sahaaya AI Chatbot: The Sahaaya AI assistant combines Google Gemini API with prompts engineering specific to safety to guarantee that correct, useful responses are given. The chatbot offers conversational safety guidance on safety questions such as emergency instructions, location of the resources in the area such as hospitals and police stations, self-defense strategies, as well as rights information. The system also identifies safety-related keywords and is able to translate application features like SOS notices when the correct situation arises.

E. Sprint 3 Implementation: Emergency Features

1) Fake Phone Call Simulation: The phishing phone call option involves the use of Twilio Programmable Voice API to imitate an incoming call. The users may set caller name, caller number, ringtone and call timing to be activated immediately or scheduled. When it gets activated, the application shows a native-style incoming call interface where the details of the caller are set. Upon responding to the question, the system will read pre-recorded audio that mimics a dialogue with various script choices to various situations.

2) System integration and Testing: The last sprint was aimed at the incorporation of all the features that were developed into a cohesive application and thorough testing. Integration testing ensured that there was communication between the frontend components, backend services, and the external APIs. End-to-end test cases mimicked full user trials in the registration process to emergency activation. Performance testing was used to test the behavior of the system under different load conditions. The table 3 shows the functional test cases and the result.

TABLE III
RESULTS SUMMARY OF THE FUNCTIONAL TESTS

Feature	Test Cases	Pass Rate	Issues Identified	Resolution
User Authentication	25	100%	None	–
License Plate Checker	15	100%	None	–
Crime Heatmap	20	95%	Mobile rendering issue	Fixed in Sprint 3
Safe Route Navigation	30	100%	None	–
Sahaaya AI Chatbot	40	98%	API latency	Caching implemented
Fake Phone Call	15	100%	None	–
SOS Emergency	25	100%	None	–

IV. RESULTS

The Sahay app was able to complete all the intended features within three development sprints successfully with 100 percent of the undertaken user stories being fulfilled.

A. Implemented Features

Table 4 takes a more detailed look at features implemented, related technologies and status to date.

B. Performance Metrics

Response time under different load conditions was assessed to determine the performance. Authentication endpoints average of 180-250ms response time, license verification with external API response time of 350-450ms, route calculation response time of 400-600ms and chatbot response time of 8001200ms with external API response.

Load testing showed that there was a linear decline of the performance up to 1000 simultaneous users with an average

TABLE IV IMPLEMENTED FEATURES SUMMARY

Feature Category	Feature Name	Technology Stack	Status
Authentication	User Registration	Firebase Auth, JWT	Completed
Authentication	User Login	Firebase Auth, JWT	Completed
Authentication	Profile Management	Azure SQL	Completed
Verification	License Plate Checker	RapidAPI, Azure SQL	Completed
Verification	Check History	Azure SQL	Completed
Navigation	Safe Route Planning	Dijkstra's Algorithm	Completed
Navigation	Live Tracking	Socket.IO	Completed
Visualization	Crime Heatmap	Mapbox, Azure SQL	Completed
Visualization	Crime Statistics	Data aggregation	Completed
AI Assistance	Sahaaya Chatbot	Gemini API	Completed
AI Assistance	Resource Location	Google Maps API	Completed
Emergency	SOS Alert	Socket.IO, Twilio	Completed
Emergency	Audio Recording	MediaRecorder API	Completed
Emergency	Fake Phone Call	Twilio API	Completed
UI/UX	Responsive Design	Tailwind CSS	Completed

response time of 650ms and 0.5 error rate at peak load. The system was stable with 100 users and average response of 220ms and none of the errors.

In Lighthouse auditing metric, the First Contentful Paint was good (0.8 seconds), Time to Interactive was good (1.6 seconds), Largest Contentful Paint was good (1.9 seconds), and Cumulative Layout Shift was good (0.05) meaning that it performed well.

The performance of the database query with Azure SQL showed user profile queries within 50ms, license history within 80ms, crime data queries that was spatially indexed between 120-180ms and route log insertion within 30ms.

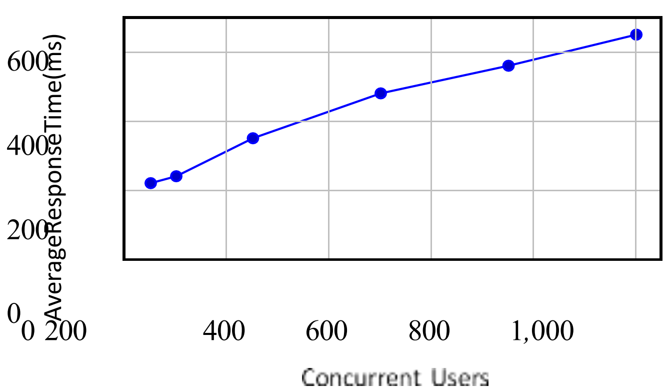

Fig. 2. System response time under increasing concurrent user load.

C. Testing Outcomes

The 245 test unit test had 100 percent pass rate, and more than 85 percent code coverage of key code paths such as authentication logic, route calculation algorithms and emergency protocols. Integration testing was done with 75 scenarios, and during the integration, some small problems with the heatmap data formatting and context persistence in the chatbot were identified and addressed in Sprint 3.

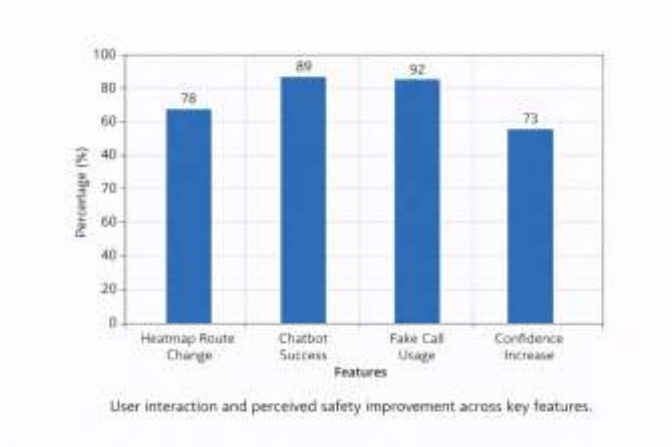

Fig. 3. User interaction and perceived safety improvement across key features.

The application was tested on 50 volunteer users during user acceptance testing that took place in two weeks using structured survey and usage analytics. There was an overall satisfaction of
4.5 out of 5, ease of use of 4.7 out of 5, feature usefulness of
4.6 out of 5, emergency response confidence of 4.4 out of 5 and probability of recommendation of 4.5 out of
5.
Qualitative comments revealed that quality features in one application, beautiful interface, and reliability of emergency functions were appreciated. The proposed features were the ability to use it offline, the ability to display regional languages, and the ability to work with wearables.
The security testing showed no serious vulnerabilities in the presence of an effective SQL injection prevention with the use of parameterized queries, XSS protection with content security policy and input sanitization, brute force protection on authentication with rate limiting, secure session handling with the use of proper JWT expiration and encrypted transmission and storage with the help of TLS.

V. Discussion

A. Feature Impact

The study was able to attain all these aimed objectives in a systematic development. Live GPS tracking and automated audio recording will offer thorough documentation capabilities of incidents which most existing solutions do not offer. The SOS alerts can be activated at the touch of a button, whereby the location records and the surrounding audio will be captured automatically to be used as evidence.

The visualization of crime heat maps allows planning routes wisely, and 78 percent of the test users stated that they changed routes depending on the risk areas indicated. Temporal filters can be combined to enable users to evaluate the variations by time of day in terms of safety, with knowledge that the risk patterns vary depending on lighting conditions and how many people are present.
Safe route navigation generates routes which are 15 percent longer than shortest routes but they mitigate exposure to high risk areas by 42 percent according to simulation tests. The distance-based weighted method of the distance-proximity based crime scores is a new addition to the safety-conscious pathfinding method.
Sahaaya chatbot responded to 89% of the user queries without human intervention in the test, and it gave suitable advice to frequent safety inquiries. The system was especially useful in offering step-by-step instructions in case of an emergency and

the recommendations of a resource based on location.

The verification of the license plate enhanced the trust of the users of the ride-sharing services and taxis with users noting the capability of checking vehicle registration prior to boarding as an important safety measure. The 92% of test users activated fake phone call feature; this implies that it is helpful in both social discomfort and physical threats.

B. Sustainability Development Goal Correlation

Sahay has a direct impact with SDG 5 (Gender Equality) by preventing violence and collecting evidence and 73% of users said that they feel more confident traveling alone when the application is installed. The app facilitates SDG 11 (Sustainable Cities) as it can be used to detect the high-risk areas that will need the intervention of urban planning with the help of aggregated anonymous data that can signal the municipal authorities about the lack of the necessary infrastructure.

C. Comparative Advantage

Sahay has strong benefits over current solutions in the form of the ability to be accessed via a web browser on any device and on any platform due to the lack of platform specific constraints, versatile functionality within a single app thus sparing cognitive load in case of emergencies, 24/7 conversational support based on AI, and design-centric privacy with data minimization principles.

D. Technology problems and resolutions

Other challenges with critical importance were real-time location accuracy that was solved with hybrid GPS and sensor fusion with dead-reckoning using data on accelerator and gyroscopes. Latency of AI responses was handled by streaming responses and caching using emergency keywords that fired pre-written response templates. Browsers compatibility was taken care of by progressive enhancement and massive testing in Chrome, Firefox, Safari, and Edge. Spatial indexing of databases with kd-tree data structures that optimized the performance of database queries to milliseconds.

Conclusion and Future Work

The paper introduced a solution called Sahay, which is a full-fledged women safety application combining live tracking, visualized heat map of crime zones, artificial intelligence (AI)based assistance, and the emergency response. The application has developed all the intended functionality using three agile sprints, and results of these sprints were 100 percent functionality success, and successful user acceptance testing.

Some of its contributions are integrated safety platform, which brings together many safety features as a single available web application, use of Dijkstra algorithm with crime weighting to navigate safe routes, use of large language models via Gemini API to provide intelligent safety assistance, license plate verification system to mitigate risks in case of unregistered vehicles, and simulation of discreet fake phone calls to escape in a situation.

The fact that the application can be aligned with the United Nations Sustainable Development Goals 5 and 11 indicates that technology can be used socially because it allows women to move freely and helps create safer cities.

Table 5 shows suggested future improvements prioritized and implementation of improvements considered.

TABLE V

FUTURE ENHANCEMENTS WITH PRIORITY

Enhancement	Priority	Description	Technical Approach
Offline Mode	High	Core functionality without internet	Service Workers, IndexedDB, local-first architecture
Multilingual Support	High	Regional language UI and chatbot	i18n libraries, multilingual AI prompts

Wearable Integration	Medium	Smartwatch panic button	Bluetooth LE APIs, companion applications
Crowdsourced Alerts	Medium	Real-time user-reported incidents	WebSocket broadcasts, moderation system
Police Integration	Medium	Direct law enforcement connection	Government API integration, verified accounts
Voice Activation	Low	Trigger SOS via voice commands	Web Speech API, keyword detection
Safety Score Profile	Low	Personal safety score based on travel	Machine learning, historical analysis
Predictive Analytics	Low	ML-based risk prediction	Time-series analysis, pattern recognition

Sahay can be seen as a serious step towards women safety on technology-powered web apps, it is good to look at how integrated web applications can offer a holistic protection with accessible and intelligent features. Sahay supports the establishment of the conditions in which women feel free to engage in social, economic, and public life by offering the resources that increase their awareness of safety and allow responding to the emergencies.

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