Review on Safe Route Recommendation System

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Abstract — The Safe Route Recommendation System is an intelligent app designed for navigation to provide safety route options. It improves personal safety, especially the female population, through analysis of real-time data crime reports, traffic patterns, and crowd density. The AI-based system advises on a safest route with a reduced chance of meeting risky situations. Features from emergency assistance, predictive analytics, and even a socially connected integration mean users are assured of safety at all times. This paper details the main features of the system and its prospects for enhanced safety in urban environments.

Keywords: Safe Navigation, Personal Safety Preference, Live Location Sharing, Real Time Data, Emergency Assistance

I. INTRODUCTION

Urban environments present varying levels of insecurity for individuals, especially when traveling alone or wandering in unknown territories. While numerous existing navigation systems focus on optimizing routes mainly based on distance or travel time, hardly any of these systems dedicate their efforts to ensure safety. The system suggested in this paper aims to fill these gaps by pointing a route recommendation that takes into account real-time information emphasizing safety issues.

Such analysis encompasses several different areas of concern, from crime reporting, the number of people out in public spaces, and common traffic patterns. It will utilize artificial intelligence and machine learning to provide adequate decisions based on the respective risks associated with urban travel. Apart from securing the safety of the user, the system could keep pace with shifting dynamics in real-time and update the users on any information that may seem pertinent.

The Safe Route Recommendation System was built with a robust structure and features that enable it to be integrated into law enforcement databases. Such integration can provide users with added information on areas to avoid due to recent criminal activity.

II. LITERATURE SURVEY

Shah et. al.[1], CROWDSAFE, which is the first to crowdsource the reporting of crime incidents and recommend safe routes on mobile devices. This was one of the first user-generated data-based work as far as real-time safety assessment of the geographic information system is concerned. Another example is Islam et al [2], who have worked on the personalized safe route planner, which includes privacy features. Here, not only does the system ensure privacy by using anonymized crowdsourced data, but also it is able to provide uniquely recommended route alternatives based on the user's preference. His crowd data orchestration ability outmatched any algorithm. For instance, the project by Goel et al. [3] reveals that in their case a crowd-inspired smart cities model for the adaptive navigation system was set up. The study is based on the notion of a more secure way to navigate the city by changing the existing route based on real-time information obtained from the crowd (the so-called adaptive navigation system) and consequently safety and best traffic dispersion.).

CrowdSPaFE by Zaoad et al [4], on the other hand, is a transportation service that caters to high-speed rail, metro, and local line users by providing multidimensional route safety suggestions. The product integrates crowdsourced data-anonymized and aggregated as much as possible-from the community through sensors, social media, and other sources with the vehicular ad hoc network to provide real-time security information and on the other hand to enhance traffic management by allowing self-regulation using data aggregation. Furthermore, the concept of similar to the CrowdSPaFE by Zaoad et al [4] was introduced by Kim et al [5] in their Urban Safety Route Recommendation (USRR) Model that makes decision-making about safe commuting route options easier through the integration of crime simulation and urban dynamics data. With the help of crime database and urban data assessment, their framework guides users in finding the least dangerous path while navigating the city and thus makes them safer.

Jiang et al. [6] (4,6) however, employed the concept of safe route mapping of roadways using multi-source data like traffic conditions and infrastructure quality in different regions to travel safely. This is majorly beneficial for the roadways prone to the most common risks. (Wan et al. 2021) The base of this system was taken by Wan who created an Android based system that uses mobile crowd-sourced data for urban navigation. Their system is the one that dynamically adjusts route recommendations based on the data from the mobile devices received in real-time, thus making sure the users are provided with the safest and most current route options. In the last part of the manuscript, Teng et al. [9] puts forth a reliability-based safest-path-finding quality that takes into account travel time uncertainties on crowded road networks. Their method is employing probabilistic models to identify the safest and most reliable routes in the situations where congestion or delays can occur and is therefore a more robust solution for the safe navigation.

III. FEATURES OF THE SYSTEM

A. Safe Route Direction

It is destined to provide real-time safe route guidance from multiple data sources. Users will get route suggestions that avoid areas of high crime likelihood based on crime statistics, road conditions, crowd density, and so on. This system provides alternative routes in a situation where the normal route needs alteration, something that mapping systems have tried to do for ages but only in terms of speed.

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B. Personal Safety Preferences

The system also has personalization based on individual safety needs. Each user is presumed to have unique safety needs, and the system caters for personalization. The Personal Safety Preferences feature enables users to set preferences in avoidance of dimly lit areas, crowded areas, or less travelled routes. It enables the users to personalize the app to suit their best needs, ensuring that the safest route is one that makes them feel comfortable as well.

C. Emergency Assistance

The Emergency Assistance feature provides safety through access to an SOS button operated using just one touch, automatically alerting local authorities or contacting preselected emergency numbers. In addition, when the user does nothing and remains in the dangerous location for a very long time, the system automatically calls and alerts contacts or authorities about the user's location.

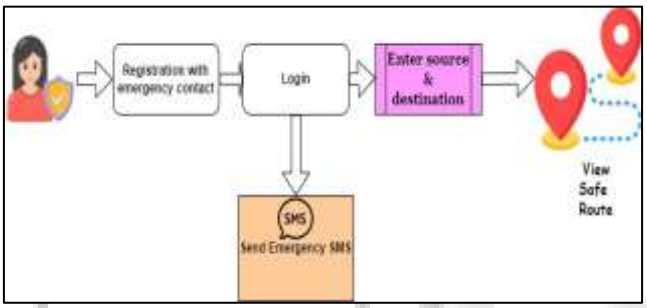

Fig. 1: Architecture

IV. PREDICTIVE ANALYTICS AND INCIDENT REPORTING

A. Predictive Analytics

The heart of its innovation lies in its Predictive Analytics module making use of AI algorithms to predict risk examples that are likely to emerge in the future based on historical data and trends. Based on such predictions, the system predicts unsafe areas that are likely to emerge in the near future and suggests route modifications in time to avoid these risks. This proactive approach allows the users to avoid a threat when it hasn't emerged yet, enhancing security factors altogether.

B. Incident Report and Heatmap

Users constantly update the dynamic database by raising safety concerns through the Incident Reporting feature. From muggings and suspicious activity to road closure, user reports keep the system updated in real time. These incident reports are represented as an Incident Heatmap, where other users can see recent safety concerns in their area. The Heatmap is, in fact, a rich source to spot and avoid "hot" crime areas.

V. SOCIAL INTEGRATION

A. Social Integration

The Safe Route Recommendation System has Social Integration functionalities that can be designed as community based for promoting safety. Users can make their journey live location sharable with trusted contacts at times, so their loved ones get informed of the current status of their travel. It is very useful when traveling alone or in a seamy area as there would be a kind of additional security involved in it.

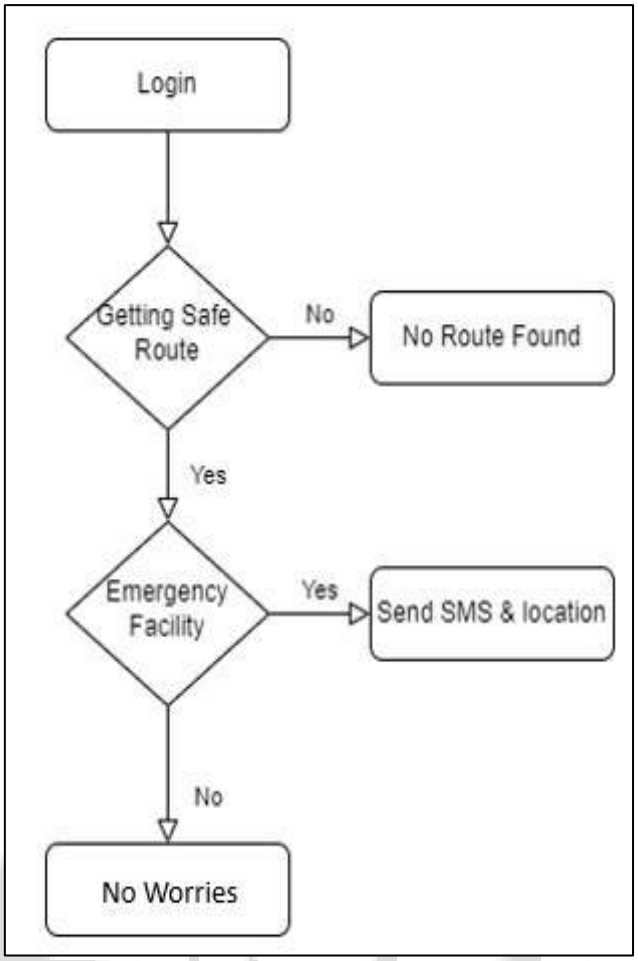

Fig. 2: Flowchart

VI. CONTINUED IMPROVEMENT THROUGH USER FEEDBACK

Evolution of the system is through User Feedback and through local law enforcement agency data. Incident reports and feedbacks provided regarding the recommended routes by users enhance the algorithms of the system for future recommendations. In addition to the above, data integration from Local Police Databases ensures that users' safety data and the latest crime reports can be updated in the system.

This cycle of user interaction, live data analysis, and machine learning places Safe Route Recommendation System into an operational system in response to changes in real-time, thereby being an invaluable tool for personal safety in urban settings.

VII. CONCLUSION

The Safe Route Recommendation System uses AI and live data to provide navigation solutions to the users with safety above speed.

The system, with its advanced predictive analytics, emergency assistance, and social sharing features, offers more than a comprehensive approach to personal security. The system has much potential for enhancing continuously by means of user feedback and collaboration with law enforcement to adapt to the changes of urban safety challenges. Not only does this AI powered system empower users but also help create safe communities.

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ACKNOWLEDGMENT

It was designed based on collaborations with local law enforcement agencies, user focus groups, and constant inputs by safety experts. We would like to extend special thanks to the many contributors who added their insights.

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