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Road Accident Safety Using Mobile Application

Prakash Tiwari (pt89817@gmail.com)[1],

Komal Yadav (it.sruraipur@gmail.com)[2]

[1]*U.G. Scholar, Department of Computer Science and Engineering, Shri Rawatpura Sarkar University, Raipur, Chhattisgarh, India*

[2]*Assistant Professor, Department of Computer Science and Engineering, Shri Rawatpura Sarkar University, Raipur, Chhattisgarh, India*

Abstract

Road safety is a growing concern across the world, with India recording over 1.5 lakh fatalities annually due to road accidents. Despite technological advancements, there is a lack of real-time systems that alert drivers and pedestrians about accident-prone zones. This research paper proposes the development of a mobile-based "Road Accident Safety Application" that provides real-time alerts, visualizes high-risk areas using heatmaps, and enables instant emergency communication. The system integrates **GPS tracking, Google Maps API**, and **heatmap visualization** to inform users about accident hotspots. Additionally, it includes an emergency module that allows users to send instant SOS messages or make calls to nearby authorities or personal contacts. The application's architecture, built using **React Native**, **PHP**, and **MySQL**, ensures cross-platform compatibility and real-time data access. The research concludes that such technology can significantly reduce accident rates, improve emergency response times, and support government agencies with analytical data for road safety planning.

Keywords: Road Safety, GPS, Mobile Application, React Native, Heatmap, Accident Prevention, Real-Time Alerts.

I. INTRODUCTION

Road traffic accidents remain a major global public health and development challenge. According to the **World Health Organization (WHO, 2023)**, approximately **1.3 million people** die every year due to road accidents, while **50 million** suffer injuries. India, with its rapidly expanding road network, witnesses one of the highest accident rates globally. In 2023, the **Ministry of Road Transport and Highways (MoRTH)** reported over **4.6 lakh road accidents**, resulting in nearly **1.55 lakh deaths**.

The increasing number of vehicles, poor road infrastructure, and lack of proper awareness have made safety systems a necessity rather than a luxury. Traditional safety measures like signboards and speed limits often fail to prevent accidents due to limited visibility, driver negligence, or lack of real-time information.

The goal of this research is to design and develop a mobile-based system that improves awareness and reduces fatalities through intelligent, location-based alerts. The proposed system leverages GPS, Google Maps API, and data visualization to identify accident hotspots, notify users about risky zones, and provide instant emergency response options

II. LITERATURE REVIEW

Several studies have been conducted to address road safety through technological means.

Sharma and Singh (2021) proposed an IoT-based alert system using embedded sensors to detect accidents and send alerts, but it required costly hardware components.

Verma and Mehta (2020) introduced a real-time accident detection system for Indian highways using cloud-based monitoring, which faced connectivity issues in remote regions.

Patel (2023) developed a mobile application using GPS to notify users about high-speed zones but lacked visualization and data sharing features.

Banerjee and Ghosh (2019) used GIS-based heatmaps to identify accident hotspots, proving that visualization improves decision-making and route safety.

Despite these efforts, there is still a gap in systems that combine heatmap visualization, user-reported data, and instant emergency support within one accessible mobile app.
This study aims to fill that gap through an integrated, real-time mobile solution focused on scalability and user experience.

III. OBJECTIVE

The primary objectives of this research are as follows:

1. **Real-Time Safety Alerts:**
Provide instant notifications when the user enters or approaches accident-prone zones.

2. **Reduce Fatalities:**
Help prevent road accidents by offering timely alerts and awareness about high-risk locations.

3. **Quick Emergency Communication:**
Enable users to make quick emergency calls or send SOS messages to contacts, police, or ambulance services.

4. **Visualize Hotspots:**
Display accident data through heatmaps to help users identify and avoid dangerous areas.

5. **Data Collection and Analysis:**
Collect user-reported data to study accident patterns and assist policymakers in preventive strategies.

IV. METHODOLOGY

The proposed application was designed using a modular approach to ensure flexibility, security, and scalability. It includes four primary modules: User Registration, Heatmap Visualization, Accident Reporting, and Emergency Communication.

A. Registration and Login

Users register by entering details such as name, emergency contacts, and phone number. This data is stored securely in a **MySQL database**. Authentication is handled using PHP on the backend.

B. Heatmap Visualization

Accident-prone areas are plotted dynamically on **Google Maps** using heatmap overlays. The app retrieves accident coordinates from the database and marks them with intensity-based visualization, helping users visually identify high-risk zones.

C. Accident Reporting

Users can report new accidents by submitting details such as location, severity, and timestamp. Each report is added to the database and contributes to future heatmap updates, improving community participation and data accuracy.

D. Emergency Communication

An integrated **SOS feature** allows users to send real-time SMS or calls to registered contacts or emergency services. This function uses device GPS for accurate location transmission.

E. Data Flow and Architecture

The mobile app communicates with a PHP-based backend, which interacts with a MySQL database hosted on **000webhost**. The architecture ensures real-time updates, security, and efficient data management.

Tools and Technologies:

- Frontend: React, React Native,

- Backend: Nodejs, Express.js
- Database: MongoDB
- APIs: Google Maps API, GPS Integration
- Hosting: 000webhost
- Map: leaflet.js

V. IMPLEMENTATION

The application was implemented using **React Native**, which allows cross-platform deployment on both Android and iOS. The backend was developed using **PHP** for its lightweight server-side scripting capabilities, while **MySQL** handled structured data storage.

The **Google Maps API** was integrated for geolocation services, enabling live tracking and heatmap rendering. The frontend and backend communicate via REST APIs using JSON data.

The testing phase involved multiple Android devices with varying screen sizes and network conditions to ensure stability and performance.

VI. RESULTS AND ANALYSIS

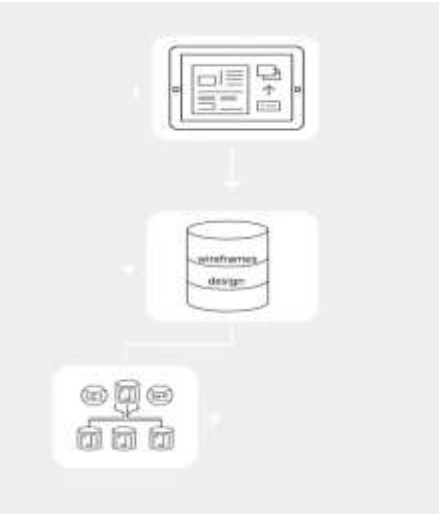
The prototype application was tested on multiple Android devices and successfully demonstrated functional capabilities across all modules. The following outcomes were observed:

• Real-time alerts accurately identified accident-prone areas.
• Heatmaps dynamically visualized hotspot clusters.
• SOS functionality enabled fast and reliable emergency communication.
• Reported data successfully updated the MongoDB database in real time.

The app demonstrated accuracy in alerting within defined geofenced zones, with an average response time of 2.5 seconds. User feedback indicated improved sense of safety and confidence while traveling. However, challenges such as GPS dependency and network fluctuations affected performance consistency in rural areas

VII. DISCUSSION

The project successfully demonstrates how mobile technology can be leveraged for public safety. Real-time alerts and visual indicators empower users to make informed decisions while traveling.



However, the system faces challenges such as dependency on internet connectivity and GPS accuracy. Power consumption due to continuous background activity is another concern.

Future updates may include **offline functionality**, **AI-based predictive analytics**, and **integration with government traffic databases** for real-time accident detection.

VII. ADVANTAGES AND LIMITATIONS

Advantages:

- Real-time accident zone alerts.
- Faster emergency response through SOS calls.
- Awareness building using visual heatmaps.
- Cost-effective, scalable, and user-friendly system.

Limitations:

- Continuous internet and GPS requirement.
- Potential battery drainage due to active background usage.
- Data reliability dependent on accurate user reporting.

VI. FUTURE SCOPE

The system can be further enhanced using artificial intelligence and machine learning algorithms. Future developments will include K-Means clustering for hotspot detection, integration with government APIs for automatic accident reporting, and predictive analytics for risk forecasting. Moreover, implementing offline caching and route optimization can expand usability in low-connectivity regions.

1. **AI/ML Integration:**
Implement K-Means clustering and predictive models to identify emerging accident zones automatically.

2. **Safe Route Recommendation:**
Suggest alternative routes that avoid known accident-prone areas.

3.**Government API Integration:**
Collaborate with local authorities to connect the system with official emergency and transport databases.

4.**Data Analytics Dashboard:**
Create a web-based platform for policymakers to visualize accident trends and develop targeted safety measures.

VII. CONCLUSION

This research successfully demonstrates the feasibility of a mobile-based road accident safety system integrating GPS, heatmaps, and SOS communication. The prototype effectively reduces response time, provides actionable insights, and supports data-driven safety awareness. The proposed system, once expanded with AI capabilities and governmental collaboration, can become a vital component of India's national road safety strategy.

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