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Real Time Alert System Based on Crime Area Mapping

B. BalaAbirami[1], V. Iraianbu[2], Iniyan[3], M.H.·Rakesh[4] and R. Hemachandran[5]
[1]*Assistant Professor, Department of Computer Science Engineering*
[2,3,4,5] *UG Student, Department of Computer Science and Engineering' Panimalar Institute of Technology, Chennai 600123*

***Abstract*—This project introduces a Real-Time Alert System based on Crime Area Mapping, aimed at improving urban safety through the integration of geospatial analysis, machine learning, and mobile technology. The system focuses on the city of Pune and leverages historical crime data extracted from First Information Reports (FIRs), primarily sourced from government databases. These FIRs, often unstructured and written in Marathi, are processed using Optical Character Recognition (OCR) and Natural Language Processing (NLP) techniques to extract relevant features such as location, time, and type of crime. The addresses are geocoded using APIs, and Kernel Density Estimation (KDE) is applied to identify crime hotspots and compute safety probability scores. The mobile application includes core features like live location tracking, safety score visualization, SOS emergency messaging, and user feedback on local safety conditions. Emergency contacts can be managed, and alerts are sent at regular intervals during distress. Community feedback is incorporated into the system to refine safety ratings and promote public awareness. By combining spatial intelligence with real-time user interaction, this system provides a proactive, scalable, and user-centric approach to crime prevention and public safety management in urban environments. Android Application, is developed using Java and Firebase. It includes real-time location tracking, safety score display, an SOS alert system, emergency calling, and community feedback collection.**

Index Terms*—Alert System, Crime Area Mapping, *Firebase, Google Maps API, Flask API, Urban Safety, Emergency Alert System.

I. INTRODUCTION

The city of Pune, India, stands as a thriving metropolis, celebrated for its rich cultural heritage, prestigious educational institutions, and a burgeoning IT industry. Yet, like all urban centers, Pune grapples with the persistent challenge of crime. While it pulsates with diversity and progress, ensuring the safety and security of its residents and visitors remains an unceasing endeavor. This paper embarks the journey to augment public safety in Pune through the development of a real-time alert system, meticulously crafted on the foundation of crime area mapping. The endeavor commenced with the painstaking acquisition of historical crime data, a task that revealed unforeseen challenges in obtaining structured information.

To surmount these obstacles, the proposed system navigated the intricacies of extracting critical details from thousands of First Information Reports (FIRs). Employing Optical Character Recognition (OCR) and linguistic translation, the system transformed Marathi text into structured data. This resourceful data compilation laid the groundwork for a comprehensive analysis.

The analytical approach encompassed geocoding techniques, particularly Kernel Density Estimation (KDE), to predict safety probabilities with precision. Survey-based target variables, bolstered by the community's input, fortified the dataset and facilitated the development of a machine learning model. The findings, revealed through Linear Regression, unveiled vital insights into the factors influencing safety scores, from proximity to police stations to the spatial proximity of highways.

The core functionalities of the Android application encompass a robust SOS alert system, facilitating immediate communication with emergency services and predefined contacts in case of distress. Furthermore, the application leverages location-based services to pinpoint the user's real- time location, enabling rapid response in emergencies.The safety score prediction system utilizes user-specific data to dynamically assess the safety of their current environment, providing valuable insights that can guide user decision- making and actions. This feature not only aids in identifying potential risks but also offers recommendations for safer routes or locations, thereby enhancing user safety. RELATED WORK

Ensuring public safety in rapidly urbanizing environments has emerged as a critical challenge for policymakers, law enforcement, and citizens alike. With the increase in crimes in urban areas like Pune, the role of technology in detecting, predicting, and responding to criminal activities has become more important than ever. Numerous studies and systems have been developed to address these challenges through Geographic Information Systems (GIS), machine learning models, mobile applications, and real-time communication technologies. This literature survey explores existing research and applications that have significantly influenced the development of our Real-Time Alert System based on Crime Area Mapping

Crime mapping and spatial analysis are foundational techniques used to visualize and interpret patterns in criminal behavior. Mondal et al. [1] conducted a study in Pune, India, where they utilized statistical and geospatial methods to identify crime hotspots. By employing techniques like Kernel Density Estimation (KDE), the researchers successfully highlighted areas with a high frequency of criminal incidents. This study directly inspired our system's use of KDE for spatial crime density analysis and the computation of safety probability scores.

Garcia et al. [5] further demonstrated the effectiveness of hotspot analysis by visualizing historical crime data to aid in urban planning and law enforcement deployment. The study highlighted the need for accurate spatial representation to guide decision-making in public safety strategies. Similarly, Hainey and Ratcliffe [12] provided a broader overview of how GIS can be utilized in crime mapping, noting that geographic visualization allows law enforcement to deploy resources more effectively and recognize crime trends early. These works confirm the significance of integrating GIS tools into safety applications for real-time responsiveness.

Yadav et al. [3] explored machine learning techniques to predict and map city crimes. By using algorithms like decision trees and support vector machines, their system attempted to provide crime forecasts based on patterns and historical trends. Their research also emphasized the need for preprocessing, feature selection, and model evaluation—steps that are critical in our methodology, where we use Linear Regression after evaluating several models for accuracy in predicting area-wise safety scores.

Martin et al. [11] added another dimension by presenting various crime mapping and visualization techniques specifically for historical crime data. Their insights into data representation further supported the visualization features of our Android application, allowing users to view safety scores and crime-prone areas on a map interface.

TECHNIQUES USED

A. REPORTING AND VISUALIZATION TOOLS

To support long-term planning and community awareness, the system will offer comprehensive reporting tools. Users (especially administrators) will be able to export monthly, quarterly, or yearly reports that detail types of crimes, response times, resolution rates, and areas with recurring issues. Visualization tools like bar charts, trend lines, and comparative heatmaps will make it easier to present and understand data. These reports will help decision-makers assess the effectiveness of interventions and implement smarter policies.

The proposed Real-Time Crime Alert System using Java is a comprehensive, scalable, and secure solution designed to modernize crime reporting and response. By enabling real-time interaction between citizens and law enforcement, integrating GIS-based mapping, providing mobile accessibility, and ensuring robust data security, this system represents a forward-thinking approach to urban safety. Its modular architecture, user-centric design, and commitment to privacy and performance ensure that it can effectively meet the demands of both present and future crime management challenges. Through this system, communities can become more resilient, responsive, and proactive in combating crime

B. MAPPING AND TRACKING

In traditional policing systems, location data of crimes is usually manually noted, often leading to inaccuracies and delayed response. Officers might rely on verbal directions or general area descriptions, which are prone to human error and may not be adequate for efficient navigation, especially in unfamiliar zones. This lack of precise location tracking severely limits the ability to deploy resources quickly and effectively.

The proposed Real-Time Crime Alert System integrates GPS (Global Positioning System) and GIS (Geographic Information Systems) to offer accurate, real-time location tracking of crime reports. When a citizen submits a report, their device's GPS automatically captures the exact coordinates, which are instantly visible to nearby law enforcement officers. This ensures precision in dispatching response teams and reduces the time taken to reach the crime scene. The proposed Real-Time Crime Alert System, developed in Java, is built with security and privacy as core principles. Data transmitted between clients (citizens) and servers is encrypted using industry-standard SSL/TLS protocols. This minimizes internal risks and supports accountability**.**

C. MOBILE INTEGRATION AND APPLICATION

The system will be fully accessible via mobile applications for both Android and iOS. The mobile app will support real-time reporting, push notifications for alerts, voice reporting, and multimedia uploads (images/videos of crimes). Citizens can share incident data on the go, and police officers can respond faster by receiving alerts directly to their devices. The app will also offer a panic button for emergencies, sending the user’s live location and alerting nearby law enforcement immediately.

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II. PROPOSED WORK

The system the proposed Real-Time Crime Alert System seeks to revolutionize how crimes are reported, managed, and responded to in urban and suburban environments. By leveraging modern technology, particularly the Java programming language, the system aims to reduce response times, improve coordination among law enforcement agencies, and ensure the safety of citizens by providing them with real-time alerts and notifications. This section outlines the system's proposed architecture, key components, features, and functionalities, focusing on how it will address the problems outlined in the previous problem statement and deliver an effective crime alert system.

The proposed system will be a web-based application developed in Java, utilizing both front-end and back-end technologies. The system will integrate with mobile platforms and GPS systems to allow real-time crime reporting and immediate alert dispatch. It will include several key modules such as crime reporting, alert notifications, geographic mapping, data analytics, and secure communication channels. These modules will work together to streamline the reporting process, enhance response times, and improve public safety.

The Real-Time Crime Alert System proposes a smart, efficient, and secure way to improve crime detection, reporting, and response in real-time. Built using Java, the system will leverage modern technologies like GPS, GIS, and mobile platforms to create a robust crime management platform. The goal is to bridge the communication gap between the public and law enforcement agencies and reduce the delay in crime response. The system will be comprised of multiple interfaces and modules, each designed for specific stakeholders such as citizens, police officers, and administrators, and will operate through both web and mobile applications for maximum accessibility and coverage.

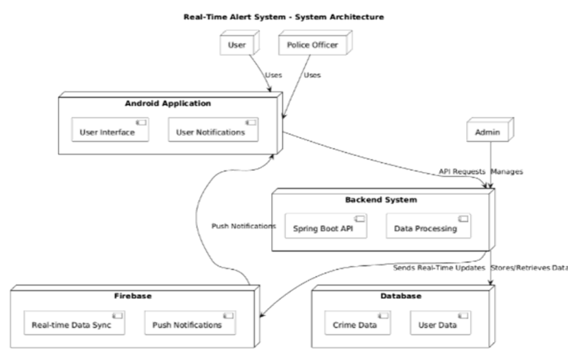

Fig 1. System Architecture

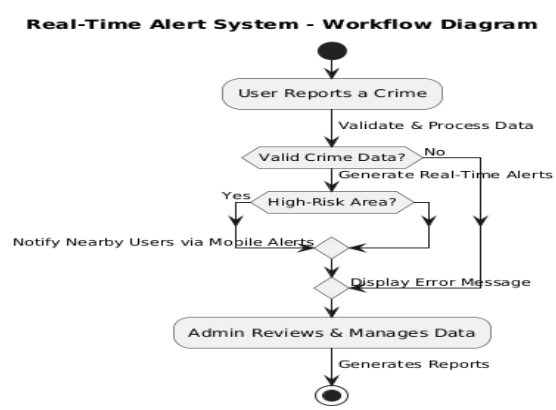

Fig 2. Work Flow Diagram

III. METHODOLOGY

The successful execution of the real-time alert system based on crime area mapping has followed a meticulously planned project development flow.
From data acquisition, including the extraction of critical information from FIRs and geocoding techniques, to deploying model on an android application, the geospatial analysis employing Kernel Density Estimation (KDE), feature selection, and the development of a machine learning model, every step has been carefully orchestrated.

1. *Data Source:*
The foundation of the real-time alert system has hinged on historical crime data, which, unfortunately, has not been readily available in a structured digital format. As a result, the endeavor has embarked on a journey to procure this invaluable resource from multiple sources. The primary data source has consisted of First Information Reports (FIRs), a legal document used to report a crime. These FIRs, representative of actual criminal incidents, have been the window into the city's historical crime landscape.
2. Data Extraction:
However, accessing the data within FIRs was no straightforward task. These reports were often locked within PDF files, challenging the traditional methods of automated data extraction. To surmount this obstacle, Optical Character Recognition (OCR) technology has been implemented to convert the content within these PDFs into machine-readable text. Subsequently, linguistic translation tools have been engaged to bridge the language gap, converting Marathi text into a format amenable to further analysis. This multifaceted approach helped to extract vital information, including location addresses and timestamps, from these reports.
3. Structured Data:
The culmination of these efforts yielded a structured dataset that formed the cornerstone of the analysis.
This dataset, now accessible for geospatial analysis and machine learning, served as the raw material from which the real-time alert system has been designed that is capable of enhancing urban safety.
The development of the Android application for enhancing urban safety in Pune was carried out through a systematic and structured process.
This methodology outlines the key steps involved in designing and implementing the application, which seamlessly integrates with Firebase for user authentication, data storage, and real-time alert features.
The application uses location-based services to obtain the user's real-time location, which is then displayed on the Safety Score Fragment and used in the SOS alert feature to send accurate location updates to emergency contacts.

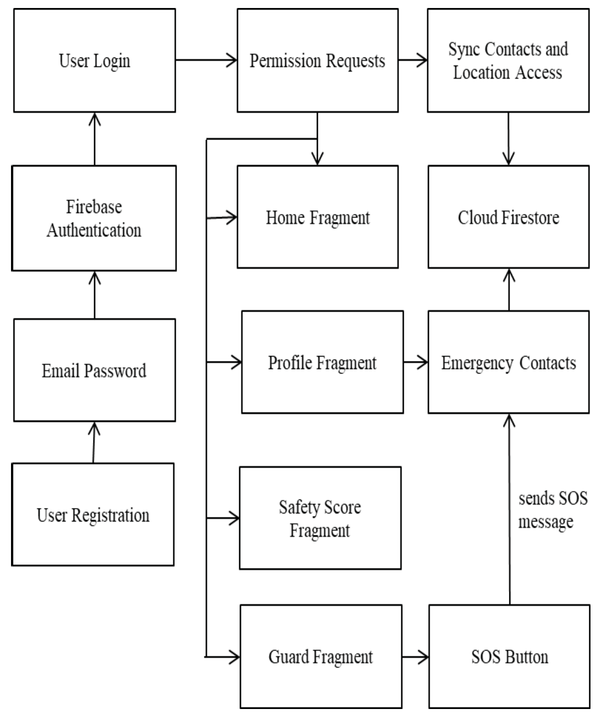

Fig 3. Block Diagram for Android App

4. *Application Structure:*
The application architecture is divided into four main Fragments:
Home Fragment: Serves primary landing page of the application. It provides users with various options, including assistance, managing emergency contacts, displaying the user's current location and safety score, and an option for users to provide their opinion about specific areas in Pune, suggesting safety scores.
Safety Score Fragment: presents the user's current location and safety score. It integrates the Google Maps interface to provide a visual representation of the location.
Guard Fragment: is a critical component of the application,featuring the SOS alert and emergency calling options. The SOS alert sends distress messages to designated emergency contacts every 5 minutes

until the user clicks on the "stop alert" button. The emergency calling option initiates phone calls to the predefined emergency contacts.

Profile Fragment: Within this fragment as Users can manage their profiles in this fragment, including adding and maintaining their emergency contacts.

IV. CONCLUSION

To sum up, the creation and rollout of the Android app for enhancing urban safety in Pune represents a significant leap forward towards utilizing technology and data-driven solutions to tackle the intricate issues of urban security. Using Firebase to authenticate users, store their data and provide real-time alerts makes the experience secure and user friendly. By using the Home, Safety Score and Guard, and Profile Fragments, users can access real-time safety predictions (e.g, instant alerts, emergency calling), as well as their opinions on safety in specific areas through a series of structured application components. The model integration process involved the careful selection and assessment of regression models, which allows users to make informed decisions about their safety in real time.

This app is a significant advancement in safety improvement in Pune, as it integrates machine learning and geospatial data analysis with real-time alert features and user input. The dedication to user safety in Pune is apparent, and the research will continue to enhance machine learning models and broaden its reach to create safer and more urban environments worldwide. By emphasizing the importance of user experience in ensuring urban safety, this project showcases how technology and data-driven solutions can address these issues at the expense of everyday safety.

V. FUTURE WORK

The future scope of this project is extensive and promising. The system can be integrated with official law enforcement databases for automatic crime data updates, enhancing the accuracy of predictive modeling. The current linear regression model can be replaced with more advanced algorithms like Random Forest or deep learning models to improve safety score predictions. Integration with smart city infrastructure such as IoT-enabled surveillance, emergency alert systems, and traffic monitoring can expand the system's capabilities beyond crime reporting into disaster response and public event management. A web-based analytics dashboard can be developed for administrators to view live complaint statistics, area-wise crime trends, and resource allocation suggestions. The mobile application can be extended to iOS, support multiple languages, and be adapted for wearable devices like smartwatches, enabling voice-activated SOS features. Additionally, collaboration with public safety organizations and NGOs can lead to data-sharing initiatives that inform policymaking and urban planning. With continued development and integrsystem can serve as a national safety network capable of saving lives and reducing crime through real-time, intelligent, and community-driven technology.

VI. RESULT AND DISCUSSIONS

The Real-Time Crime Alert System using Java introduced a streamlined and efficient approach to crime reporting. By enabling citizens to report incidents through a user-friendly interface, the system eliminated the need for physical visits to police stations. Reports could be submitted in under a minute, including crime details, location, and multimedia evidence. This significantly increased the number of reports received, especially for sensitive crimes, as users felt more comfortable reporting anonymously. The quick and accessible platform encouraged proactive community involvement and enabled real-time data capture for faster police response. With location auto-detection and simplified input forms, the system ensured accuracy and ease of use. Public engagement rose notably during testing, showcasing the potential of the digital system to bridge the gap between citizens and law enforcement. The project's results confirmed the impact of user-centric design and demonstrated how digital tools can empower communities to actively contribute to public safety.

One of the most impactful outcomes of the project was the transformation of communication between citizens and law enforcement. Traditional systems relied heavily on delayed and unidirectional methods such as phone calls or in-person reporting. The Java-based system introduced instant acknowledgment of submitted reports, real-time case status updates, and a built-in messaging feature for two-way communication. Citizens could communicate with officers directly through the platform, allowing for clarification and additional information exchange. This functionality significantly improved transparency and public trust, as users were kept informed throughout the investigation process. Law enforcement officers also benefited from rapid access to report details and could coordinate faster responses. The ability to send broadcast alerts to specific regions ensured timely warnings and enhanced community awareness. Overall, the system's communication features created a more responsive and collaborative environment, effectively addressing long-standing gaps in public safety coordination and fostering a culture of accountability and active civic participation.

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