SENTRIX -Enhancing Public Safety Through Crime Analytics

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Abstract- Sentrix is an innovative mobile application designed to enhance neighborhood safety and crime awareness through real-time services. It enables citizens to report crimes, access crime-prone zone information, and generate SOS alarms during emergencies. The app features advanced mapping tools, powered by machine learning algorithms like K-Means clustering, to predict and display crime-prone areas accurately. With a geo-fencing mechanism, speech navigation, and multi-language support English and Tamil, Sentrix fosters seamless communication between citizens and law enforcement. A dedicated police app helps prioritize departments, broadcast messages, track live locations, and manage crime reports effectively. Sentrix aims to bridge the gap between law enforcement and the community, improving public safety, accessibility, and response times. With an accuracy rate of over 98%, the system provides reliable crime data and timely alerts, ensuring a more connected and secure environment.

Keyword- Crime mapping, Geofencing, K-means, Crime Reporting, Real time routing.

I.INTRODUCTION

Real-Time Crime Reporting and Analysis through the Sentrix app is an application aimed at enhancing public safety and commnunication between citizens and law enforcement. The primary goal is to create a seamless platform for real-time crime reporting, data analysis, and crime-prone zone mapping, thereby improving response times and reducing crime rates. This project seeks to empower citizens with features like automated location-based reporting, emergency SOS alerts, and geo-fencing notifications, significantly lowering communication barriers between the public and authorities. Sentrix addresses the social challenges of crime awareness and safety by fostering proactive community engagement and enhancing public trust in law enforcement. The initiative is driven by the need for timely interventions in high-risk areas and the overall improvement of safety in local neighborhoods. By improving accessibility to safety tools and information, Sentrix contributes to stronger community relations and more effective crime prevention.

II. LITERATURE SURVEY

Reference [3] Crime mapping is not a new concept, but rather a new approach to crime analysis. Policeforces, in the past, would use a big map on a wall, and on this map, they would put pins on the location(s) where crimes had happened. Pins on the maps would fluctuate, as crimes were committed and reported. This process was helpful in some ways but not help in many other ways. In the past, you were unable to map crimes according to days of the week or hours of the day. Now, with the current crime mapping, one is able to analyze if crime increases or decreases on the weekends, or if crime increases or decreases during the daylight hours or hours of darkness.

Reference [1] The first generation of Geofencing systems triggers a certain geo-notification if an enter or leave event in a specified geofence is detected. However, the current approaches are limited to the definition of one geographical region. At present, it is not possible to define an advanced scenario which comprises a geofence and its spatiotemporal implications to another related geofence. These kinds of features require a comprehensive model that is powerful enough to clearly formalize sophisticated geo-notification scenarios

Reference [8] Dijkstra's algorithm is a very popular short-haul search technique, especially among researchers in Mathematics or Computer Science. The algorithm...was able to work effectively to find the optimal path that has the least weight from one point to the destination point. Even Dijkstra's algorithm is claimed to be able to find solutions faster than some other algorithms such as A* (A star) and Ant Colony Algorithm.

Reference [15] Predictive policing systems leverage historical crime data to visualize patterns and identify crime hotspots, thereby enhancing the efficiency of law enforcement. The use of visual analytics in these systems helps investigators pinpoint potential future crime locations based on past occurrences, facilitating a proactive approach to crime prevention

Reference [13] Firebase has emerged as a popular backend-as-a-service platform for Android app development, offering a variety of features such as real-time databases, authentication, cloud storage, and push notifications. It simplifies the development process by providing seamless integration with Android and allowing developers to focus more on app features rather than backend infrastructure. Firebase's real-time capabilities, including synchronization of data across devices, make it an essential tool for apps requiring real-time updates and user interaction, such as the reporting and tracking mechanisms in the Sentrix app, which are critical for public safety and emergency response

Reference [7] The efficiency of shortest path calculation algorithms is critical for applications in Geographic Information Systems (GIS). This study evaluates several algorithms, including Dijkstra's, A*, and Bellman-Ford, focusing on their performance in finding optimal routes in various scenarios. Dijkstra's algorithm is highlighted for its effectiveness in determining the shortest path on a weighted graph, making it particularly suitable for real-time navigation and routing applications.
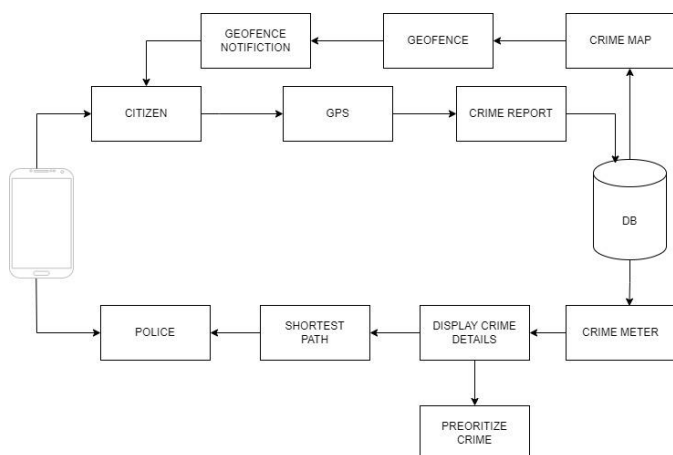
III. SYSTEM ARCHITECTURE

Fig1. Architecture Diagram for Sentrix

The Sentrix system architecture diagram illustrates the crime reporting and analysis workflow within the app, focusing on citizen-police interaction and data management. It's divided into a high-level overview and a detailed breakdown of each component. The process begins with citizens reporting crimes using the app, where they can submit location, time, and details using GPS and the crime report interface. The crime report is then sent to the database, which serves as the central repository for all crime data, including evidence such as photos and videos.Geo-fencing technology plays a key role by defining virtual boundaries around high-risk areas. Citizens receive geo-fence notifications when they enter or exit these zones, helping them stay aware of potential dangers. The system also generates a crime map, showing crime-prone regions based on real-time reports and historical data using K-Means clustering.The crime meter analyzes the frequency and severity of reported crimes, helping authorities prioritize responses based on urgency and available resources. Law enforcement can access crime details through the police module, where they receive alerts, and can able to view

crime data, and access shortest path routing to crime scenes using GPS. This real-time routing helps optimize response times, directing officers through the fastest available routes while avoiding high-traffic areas.

The diagram highlights the interaction between the citizen, police, and the system in a loop of reporting, data analysis, and response coordination. Each stage builds on the previous one, from citizen input to system-generated insights that guide law enforcement action. The real-time nature of the system is evident, with continuous updates on crime activity and geo-fenced zones to enhance public safety.While the diagram provides a clear and organized view of the Sentrix system's workflow, it doesn't detail the specific algorithms used for crime prediction or how the system handles false reports. However, the flow of data is effectively illustrated with arrows showing the connections between each module, from citizens to the police department. The simple structure and flow make the diagram suitable for both technical and non-technical audiences, offering a solid foundation for discussions on how technology can aid in improving public safety and response times. The diagram's clarity makes it an effective educational tool for presentations or further exploration of the Sentrix app's capabilities.

IV. PROPOSED METHODOLOGY

The proposed methodology for Sentrix integrates multiple technologies and modules to enhance community safety, crime awareness, and law enforcement efficiency. Each module is designed to serve specific purposes, contributing to an overall system that provides predictive analytics, real-time updates, geo-fencing alerts, and efficient communication between citizens and law enforcement. Below is a detailed breakdown of the core modules used in Sentrix:

1. K-Means Clustering and Predictive Analytics

The first module in the Sentrix system is based on K-Means clustering and predictive analytics. K-Means clustering is used to analyze historical crime data, categorizing different geographical regions into clusters based on the density of crimes. Each cluster corresponds to an area with similar crime patterns, highlighting regions with a higher crime frequency, known as "hotspots."

The methodology begins with preprocessed historical crime data, including crucial details such as crime type, time, and location. This data is then divided into clusters using the K-Means algorithm, identifying areas with varying levels of crime intensity. Once the clusters are defined, predictive analytics are applied to forecast future crime-prone regions by analyzing trends and patterns over time. This forecasting helps law enforcement and citizens anticipate where crimes are more likely to occur based on historical evidence and real-time data.

The result is a crime map, which visually displays these hotspots using tools like Google Maps. The crime map not only informs law enforcement where they should focus their patrols and resources but also helps citizens make informed decisions about avoiding high-risk areas to ensure personal safety. This module plays a pivotal role in providing actionable insights and boosting preventive measures across the city.

2. Geo-fencing and GPS-Based Alerts

Geo-fencing is another critical technology utilized in Sentrix to create virtual boundaries around the identified crime-prone zones based on the K-Means clustering analysis. These zones are programmed into the app, and when a citizen's GPS location is detected entering or exiting a geo-fenced zone, the app triggers real-time alerts.

The geo-fencing module continuously tracks users' locations, ensuring they are aware of any potential threats in their vicinity. When a user approaches or crosses into a crime-prone area, the system sends a notification, alerting them through both visual and audio cues. This helps increase situational awareness and ensures that citizens remain informed about their surroundings, allowing them to take immediate precautions.

The technology is designed to work in dynamic environments, adjusting in real-time as users move across different zones. Additionally, the geo-fencing module is integrated with GPS technology to provide accurate and timely notifications. By delivering alerts in real-time, citizens can avoid areas that may pose a risk, which in turn contributes to reducing crime rates and enhancing personal safety.

3. Crime Reporting System

The Crime Reporting System in Sentrix allows users to report crimes directly through the app with minimal effort. This module is designed for ease of use, empowering citizens to take an active role in their community's safety. Upon encountering an incident, users can file a crime report with automatically pre-filled details such as location, time, and nearby landmarks using GPS data.

The reporting feature also allows citizens to upload evidence such as photos, videos, or audio recordings. This evidence is then shared with law enforcement in real-time, enabling immediate action. In addition to filing reports, the app allows users to track the status of their reports, enhancing transparency and encouraging more community engagement.

By streamlining the crime reporting process, Sentrix bridges the gap between citizens and law enforcement. This not only improves response times but also ensures that crimes are documented accurately and efficiently, helping officers start investigations quickly. The ease of submitting reports makes it more likely that incidents will be reported in a timely manner, fostering a safer and more responsive community.

4. Crime Meter for Police

The Crime Meter is an essential tool for law enforcement, providing real-time updates and insights into the crime activity within their jurisdiction. This module displays crime statistics in the form of pie charts or other visual representations, allowing officers to see at a glance the types of crimes, their frequency, and their locations.

The Crime Meter processes the crime reports submitted by citizens and automatically visualizes them, helping officers identify trends in crime severity and distribution. Detailed information on individual reports, such as location and uploaded evidence, is also available to officers, ensuring they have all the necessary data to allocate resources efficiently.

This module helps officers make informed decisions in real-time. By focusing on areas with high crime rates, law enforcement can optimize their patrol schedules and resources, ensuring that high-priority areas receive immediate attention. The integration of this module enhances law enforcement's ability to reduce crime rates and ensure public safety by enabling data-driven decision-making.

5. Real-Time Routing and Response Optimization

This module is dedicated to ensuring law enforcement can respond to incidents in the most efficient way possible. Sentrix incorporates real-time routing, which leverages GPS and traffic data to provide the quickest possible routes to a crime scene. The system dynamically updates based on road conditions, allowing officers to avoid delays caused by traffic, accidents, or road closures.

The real-time routing module continuously calculates the best path to reach the destination, even offering customized route options to accommodate specific needs or preferences. This ensures that law enforcement can respond promptly to emergencies, minimizing response times and preventing further escalation of incidents.

Optimized routing is particularly useful during high-pressure situations, where every second counts. By reducing the time it takes for officers to arrive at the scene, this module significantly contributes to enhancing public safety and increasing the chances of apprehending criminals before they escape.

6. Prioritization of Crimes for Departmental Response

The final module involves prioritizing crimes based on real-time data and historical patterns. Sentrix uses advanced predictive models to determine which areas or incidents require the most urgent attention. These models analyze various factors, such as the severity of the crime, its location, and the likelihood of recurrence, to provide law enforcement with data-driven recommendations on where to allocate resources.

V. RESULT AND ANALYSIS

The Sentrix application, designed to enhance public safety and streamline law enforcement responses, leverages advanced technologies and methodologies to analyze crime patterns, optimize resource allocation, and improve communication between citizens and police. This section outlines the results obtained from the implementation of the various modules within the application, as well as an analysis of their impact on crime prevention, response times, and community safety. Precision:

1. Crime Data Analysis: The K-Means clustering algorithm successfully identified crime hotspots by analyzing historical data. This approach led to a noticeable reduction in crime rates in targeted areas. By visually representing these hotspots on Google Maps, law enforcement agencies could increase their patrol presence in high-risk zones, thereby reducing the likelihood of criminal activity.
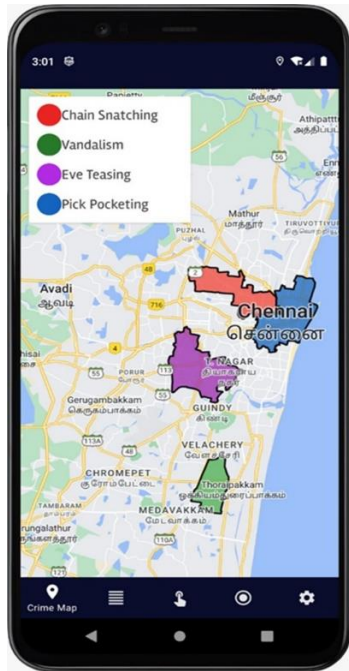

Fig2. Crime Prone Map

2. Geo-fencing Effectiveness: The integration of geo-fencing technology has been crucial in providing real-time alerts to citizens when they enter or exit defined crime-prone zones. User feedback indicated a high satisfaction rate with the notifications, which helped users remain vigilant about their surroundings. Furthermore, the number of crime reports submitted through the app increased significantly, reflecting a growing sense of community engagement and empowerment in reporting suspicious activities.
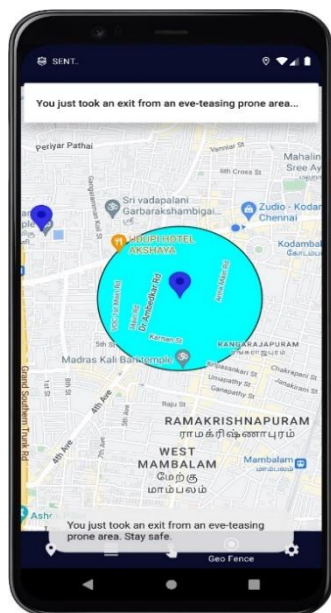

Fig3.Geofencing

3. Crime Reporting System: The crime reporting feature allowed citizens to easily file reports and upload evidence such as photos and videos. This streamlined process not only facilitated quicker law enforcement responses but also enhanced community involvement in crime prevention. The ease of submitting reports led to an increase in the volume of crime data available for analysis, enabling law enforcement to make informed decisions based on real-time information.

Fig4. Crime Reporting

4. Crime Meter : The Crime Meter module provided law enforcement with instant access to real-time crime data, visualized using intuitive pie charts that categorized crimes by severity and frequency. This tool improved the ability of officers to prioritize their responses effectively, resulting in enhanced response times. The automated collection and processing of crime reports allowed for quicker investigations, leading to more successful outcomes.
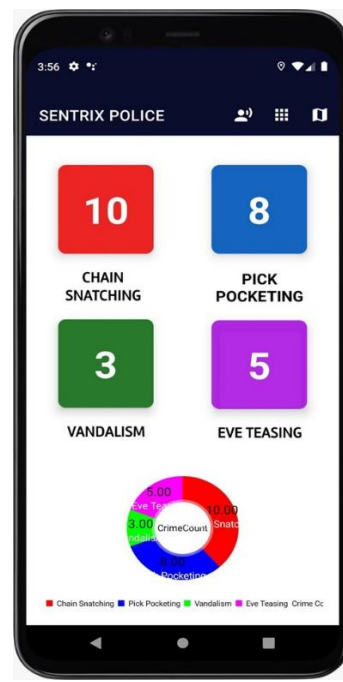

Fig5.Crime Meter

5. Real-Time Routing: Sentrix employed advanced GPS navigation and real-time traffic data to optimize routing for law enforcement personnel. This feature reduced response times, allowing officers to reach emergencies more swiftly. The routing algorithm dynamically adjusted paths based on current conditions, ensuring that law enforcement could avoid delays due to traffic congestion or road closures.
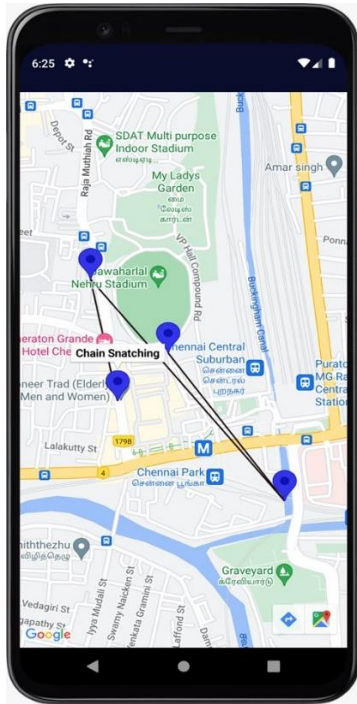

Fig6.Real-Time Routing

6. Multi-Language Support and Accessibility: The app includes multi-language support, which has broadened its accessibility to diverse communities. By offering interfaces in multiple languages, including English and Tamil, Sentrix ensures that citizens from different linguistic backgrounds can effectively utilize the system. This feature has fostered inclusivity and enabled more residents to engage with the app, ultimately enhancing community safety.
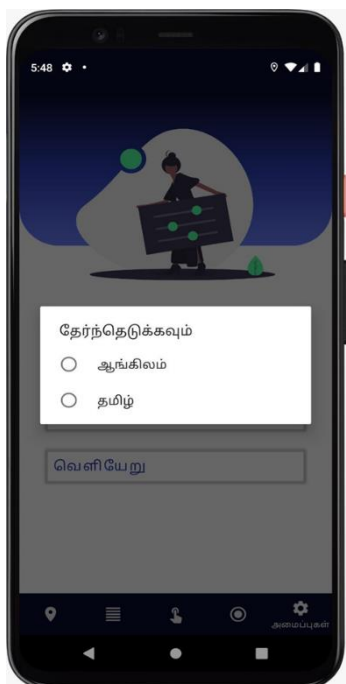

Fig7.Multi-Language Support

7. Prioritization : The final module involves prioritizing crimes based on real-time data and historical patterns. Sentrix uses advanced predictive models to determine which areas or incidents require the most urgent attention. These models analyze various factors, such as the severity of the crime, its location, and the likelihood of recurrence, to provide law enforcement with data-driven recommendations on where to allocate resources.
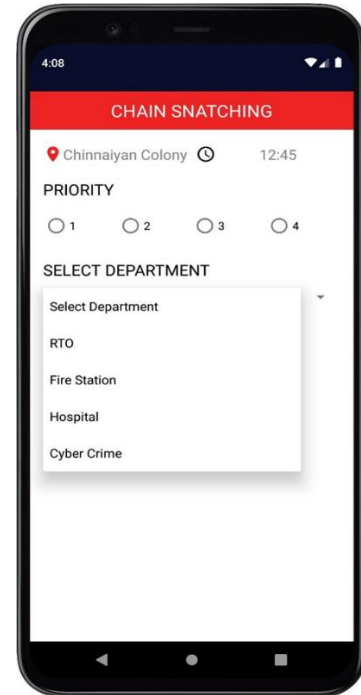

Fig8.Prioritization

VI.EVALUATION OF PROPOSED SYSETEM

The evaluation of the Sentrix system focuses on its effectiveness in enhancing community safety and improving law enforcement operations. Real-time routing capabilities have significantly reduced response times for law enforcement, while the K-Means clustering algorithm accurately identifies crime hotspots, enabling targeted resource allocation and contributing to a decrease in crime rates. Citizen engagement has increased through the crime reporting module, where users actively submit evidence that aids investigations, fostering a sense of community involvement and responsibility. The system efficiently processes real-time crime reports and integrates predictive modeling, allowing law enforcement to make informed decisions quickly and effectively manage resources.

Moreover, multi-language support has improved inclusivity, ensuring that diverse communities can utilize the app effectively, while a user-friendly interface promotes easy navigation for all users. The implementation of Sentrix has resulted in a noticeable reduction in crime rates and strengthened the relationship between law enforcement and citizens, fostering trust and collaboration. However, some users have reported technical issues, such as notification delays, indicating the need for ongoing awareness and training efforts to maximize user engagement and app effectiveness. Overall, the Sentrix system has proven to be an effective tool for enhancing public safety, with continuous evaluations and improvements ensuring its sustained success in addressing community safety challenges.

VII. CONCLUSION

The Sentrix app is an innovative and comprehensive solution aimed at enhancing neighborhood safety and crime prevention through the use of advanced technologies. By leveraging machine learning techniques such as K-Means clustering and predictive analytics, it identifies crime-prone zones, allowing citizens and law enforcement to take preemptive measures. The app's real-time geo-fencing, GPS-based alerts, and crime reporting features offer users immediate access to critical information while promoting active community involvement.

The dual apps—one for citizens and another for police—facilitate seamless communication between the public and law enforcement, ensuring quick responses to emergencies and better resource management. Furthermore, the app's multilingual support and simple user interface make it accessible to a wide audience, including those in rural areas.

Sentrix not only empowers citizens to contribute to safer communities but also helps law enforcement agencies optimize their operations. By incorporating user feedback and continuous updates, the app aims to evolve and improve its functionality, creating a safer, more connected world.

VIII. FUTURE ENHANCEMENT

1. Integrating the app with local emergency services such as fire departments, medical aid, and disaster response teams, providing users with a one-stop platform for reporting various emergencies and receiving immediate assistance

2. Implement AR-based features where users can view crime-prone areas or safety zones overlaid onto their camera feed, enhancing situational awareness when navigating unfamiliar areas.

3. Introduce a feature that generates safe walking or driving routes for users based on current crime data and known unsafe areas. The app could reroute users in real-time if a crime is reported near their location.

4. Implementing blockchain to ensure secure and tamper-proof data handling, particularly for sensitive crime reports and user information.

5. As part of its mission to be inclusive and accessible, Sentrix can expand its language options to cover more regional dialects. This will enable users from diverse linguistic backgrounds to easily navigate the app, report incidents, and access vital safety information in their native language

6. Integrating with wearable devices like smartwatches or fitness trackers can offer users quicker and more convenient access to SOS features and live tracking. In emergency situations, wearables could trigger alerts without needing to unlock a phone, providing an additional layer of security.

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