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# Safety Locator: Crime Rate and Hot Spot Prediction System for Woman using Multimodal Deep Learning

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**ABSTRACT:** Crime hotspot is a geographic area or location that experiences a higher rate of criminal activity compared to other areas within the same region. These hotspots where women are more likely to experience criminal activities such as sexual harassment, assault, domestic violence, stalking, and human trafficking. The identification of crime hotspots is an essential aspect of crime prevention and control. It enables law enforcement agencies to focus their resources on the areas with the highest crime rates and develop targeted interventions that address the underlying causes of criminal activity. Crime hot spot prediction is an important problem in public safety, and machine learning algorithms such as Deep Explainable Decision Tree is a predictive model designed to identify crime hotspots against women and provide a map of these locations using Google Maps. The proposed system employs Deep Explainable Decision Tree, a machine learning algorithm that analyzes and classifies data into different categories. The model is trained using historical crime data and is capable of predicting the likelihood of a crime occurring in a specific area. The system then generates a map of the predicted crime hotspots using Google Maps. Crime hotspots can be identified through the analysis of crime data, including the number and type of crimes reported, the time of day or week when crimes occur, and the location of the crime. The proposed system can play a crucial role in improving women's safety and promoting gender equality by creating safer environments for women to live, work, and thrive in.

**KEYWORDS:** Deep Explainable Decision Tree, Public Sety, Crime Report, Spot Prediction.

## I. INTRODUCTION

Crimes against women are of various types as crimes involving sex for economic gains including prostitution, wrongful confinement, trafficking, dowry extortion, rape, assault, harassment at work place, gang-rape, acid-attack, kidnapping, and other immoral acts are injurious to the society. In present scenario cases of murder, rape, molestation, sexual abuse, and eve-teasing etc. Women feel discrimination, harassment and domestic violence etc at work. Use of money and muscle power to save accused. Politics in the name of caste, religion etc take benefit as well. India at 108th place according to Global Gender Gap Index 2017. A 2017 report by Global Peace Index had claimed India to be the fourth most dangerous country for women travellers. Violence against women and girls is rooted in gender-based discrimination and social norms. Women are so helpless in the Indian society where many female goddesses are worshipped but still people don't respect women. It is high time when the social revolution is needed to root out this evil from Indian society and given respect and recognition to our women. Crime hotspots are areas that have high crime intensity. These are usually visualized using a map. They are developed for researchers and analysts to examine geographic areas in relation to crime. Hot spots are areas with a high occurrence of crime. These hot spots are areas where crime is more likely to occur, and law enforcement agencies often focus their resources and efforts in these areas to prevent and reduce criminal activity. Crime hot spots can be identified through various methods such as analysing crime data, conducting community surveys, and mapping criminal activity patterns. By identifying crime hot spots, law enforcement can use targeted strategies to prevent and reduce crime in those areas. The goal of this project is to develop a Crime Hot Spot Prediction System that specifically focuses on women's safety using Machine Learning. The system will be designed to be user-friendly, accessible, and easy to use, with the aim of empowering women to take control of their safety. The Crime Hot Spot Prediction System using Machine Learning will be a valuable tool for

law enforcement agencies, policymakers, and community organizations, enabling them to develop targeted strategies for preventing and reducing crime in hot spot areas.

## II. LITERATURE SURVEY

An analysis of collected literature data from the distinct research databases is essential to receive information regarding the growth of an adopted research domain, scope across the research community, and popularity among the existing researchers. Thus, we have performed a detailed analysis of the collected literature data. We did pre-analysis and post-analysis, wherein pre-analysis comprises the exploration of initially collected literature ( i.e., the research papers that were collected immediately after performing our search query), and post-analysis comprises the investigation of those study's data that were finally selected after applying selection criteria. Although we have exhumed the two renowned research databases, IEEE and Science Direct, lately, it has been observed that Science direct discontinued the search result extraction. Hence following analytical charts are based on IEEE databases findings. The research publication trends in neighborhood crime from 2018 to 2022 (i.e., the last five years). It showed upward trends from 2018 to 2021 and downward trends during 2022. The years 2020 and 2021 are the apexes of COVID-19, which could be why existing researchers have utilized that time to explore more neighborhood crime research.

## III. EXISTING SYSTEM

There are several existing systems for Crime Hot Spot Prediction, but very few systems specifically focus on predicting crimes against women. Some of the existing systems are:

- **Manual Policing System**

Manual system for Crime Hot Spot Prediction System for Women Safety involves the use of traditional policing methods to identify crime hot spots. This typically involves analysing historical crime data, conducting interviews with witnesses and victims, and collecting data on the physical environment of the area.

- **Law Enforcement Agencies**

Law enforcement agencies use this information to determine the likelihood of criminal activity in a particular area and allocate resources accordingly. For example, they may increase patrols in high crime areas, install surveillance cameras, or provide additional lighting in poorly lit areas.

- **Clustering**

This technique is used to group similar crime incidents together based on their location, time, and type of crime. By identifying patterns in these groups, law enforcement agencies can identify crime hot spots and allocate resources accordingly.

- **Association rule mining**

This technique is used to identify correlations between different variables, such as the time of day and the type of crime. By identifying these correlations, law enforcement agencies can identify potential crime hot spots and take proactive measures to prevent criminal activity.

- **Logistic Regression:**

This algorithm is used to predict the probability of criminal activity based on a set of input variables. It is particularly useful for Crime Hot Spot Prediction System for Women Safety because it can handle both categorical and continuous data.

- **Random Forest**

This algorithm is used to develop a model that can predict the likelihood of criminal activity based on multiple decision trees. It is particularly useful for Crime Hot Spot Prediction System for Women Safety because it can handle non-linear data and identify complex patterns in crime data.

- **Crime Mapping System**

This system uses geographic information system (GIS) technology to map crime data and identify crime hot spots. The system has been used by law enforcement agencies in many cities around the world.



**Disadvantages**

- Limits to identify crime hot spots accurately
- No Crime Hot Spot Map Visualizer
- Manual systems involve the labour-intensive process of collecting and analysing crime data.
- Many existing systems are resource-intensive and require a lot of time and resources to analyse crime data and identify crime hot spots.
- Many existing systems rely heavily on historical data to identify crime hot spots.
- May not be able to identify crime hot spots that are specifically related to crimes against women.

**IV. PROPOSED SYSTEM**

The primary aim of this project is to develop a robust and user-centric system focused on predicting and localizing crime hot spots, specifically tailored for ensuring the safety of women. The system will utilize an Explainable Decision Tree (xDT) algorithm for transparent and interpretable crime prediction, and integrate Google Map API for precise geospatial localization.

- **Explainable Decision Tree (xDT)**

The system employs an xDT algorithm to ensure transparency in decision-making, providing clear insights into the factors influencing crime predictions. This interpretable model enhances user understanding and trust in the system.

- **Google Map API Integration**

Utilizing the Google Map API enables accurate geospatial visualization of predicted crime hot spots. The real-time mapping feature offers up-to-date information on safety concerns, contributing to precise crime localization and dynamic response strategies.

- **User-Friendly Interface**

The design prioritizes an intuitive web-based interface for accessibility. Emphasis is placed on ease of use and understanding, catering to a diverse user base. This ensures that users, including those with limited technological proficiency, can navigate the system effortlessly.

- **Real-time Crime Prediction**

Algorithms for real-time crime prediction empower law enforcement and individuals to proactively respond to emerging safety concerns. This feature aids in timely decision-making and crime prevention strategies.

- **Alert and Notification System**

An integrated alert system notifies users about potential safety concerns in their vicinity. The system allows customization of notification preferences, aligning with individual comfort levels and ensuring a user-centric approach to safety notifications. This proactive alert mechanism enhances overall user awareness and safety.

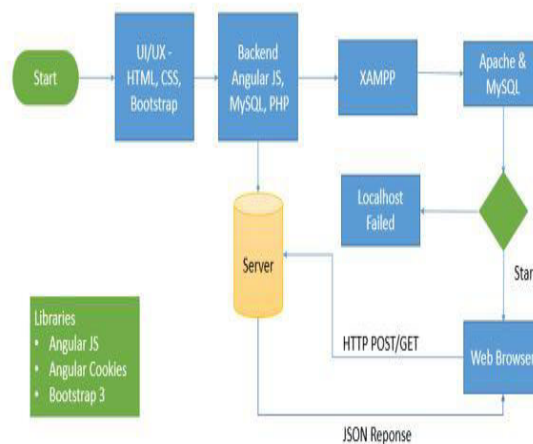
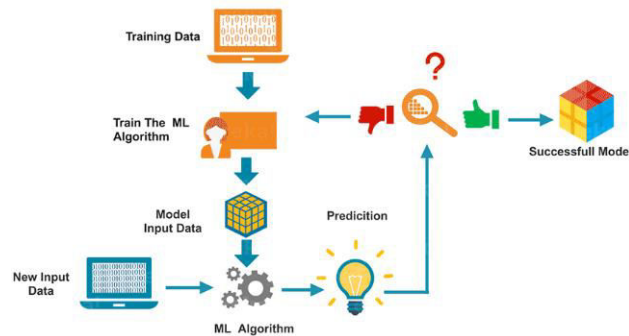
**Advantages**

- Prior knowledge of criminal activities in those locations.
- Interpretable predictions aid in building user trust.
- Accurate mapping of crime hot spots for proactive safety measures.
- User-friendly interface with Google Map integration.
- Predict the crime patterns of the states with respect to time.
- Cities must be made safer and more inclusive for women and everyone.
- Visualize the crime Hotspots Location in Map

**V. SYSTEM OVERVIEW**

- The system design of the "Safety Locator: Crime Rate and Hot Spot Prediction System for Women using Multimodal Deep Learning" focuses on creating a robust, scalable, and user-friendly architecture that effectively addresses the safety concerns of women.

- This project integrates advanced machine learning techniques, specifically the Deep Explainable Decision Tree (xDT) algorithm, to analyze historical crime data and predict potential crime hotspots.
- By leveraging Google Maps API for geospatial visualization and a web-based interface built with Python Flask and MySQL, the system ensures accessible and actionable insights for users.



### Work Flow Diagram For Web Application

## VI. SYSTEM IMPLEMENTATION

**Programming Languages and Frameworks:** The proposed system is implemented using Python as the primary programming language. Flask, a lightweight and flexible web framework, is utilized for backend development.

**Web Application with Flask:** The backend of our system is developed using Flask, allowing for the creation of web applications with Python. Flask provides a modular and extensible framework for handling HTTP requests, managing routes, and connecting with the frontend.

**Database Management with MySQL:** WampServer is employed as the local development server, providing the necessary environment for running the Flask application and MySQL database. MySQL serves as the relational database management system, handling the storage and retrieval of crime data.

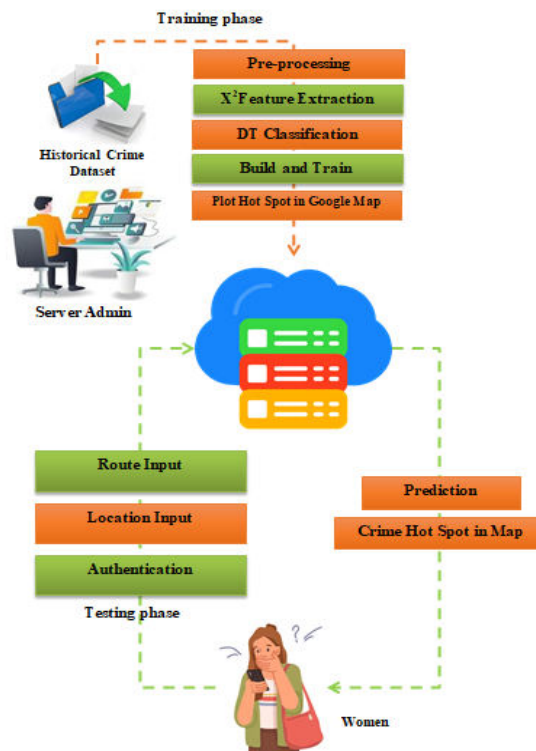
**Explainable Decision Tree (xDT) Implementation:** Scikit Learn is utilized for implementing the xDT algorithm, enabling the creation of interpretable decision tree models. The algorithm is trained on historical crime data to provide transparent insights into the decision-making process.

**Real-time Prediction Engine:** Python scripts are developed to form the real-time prediction engine.

**User Interface Development:** HTML, CSS, and JavaScript are used for frontend development, creating an interactive and visually appealing user interface.

**Alert System Integration:** The alert system is integrated into the Flask application, utilizing Flask-SocketIO for real-time communication between the server and clients. When potential safety concerns are identified, alerts are triggered and sent to users based on their preferences.

**Security Measures Implementation:** Security measures, including encryption, are implemented using standard Python libraries. **Scalability and Performance Optimization:** While WampServer is suitable for local development, deploying the system on cloud platforms like AWS or Heroku ensures scalability.



Architecture Diagram

## VII. FUTURE ENHANCEMENT

There are several areas where this can be improved in the future. Some of these areas are:

- **Integration with social media platforms:** The system can be integrated with social media platforms, such as Twitter and Facebook, to gather additional data on crime incidents and public perceptions of safety in certain areas.
- **Integration with emergency services:** The system can be integrated with emergency services, such as police and ambulance services, to enable faster response times to crime incidents in hotspots.
- **Expansion to other regions:** The system can be expanded to cover other regions beyond the current scope. This could involve integrating additional data sources and customizing the system to suit the specific needs of each region.
- **Integration with real-time crime data:** The system can be enhanced by integrating with real-time crime data from police departments or other crime reporting sources.

- **Integration with mobile devices:** The system can be integrated with mobile devices to provide real-time alerts to women about crime hotspots in their vicinity. This will make the system more user-friendly and convenient to use.
- **Collaboration with law enforcement agencies:** Collaboration with law enforcement agencies can help in improving the accuracy of the system and make it more effective in predicting crime hotspots. Law enforcement agencies can provide valuable insights and feedback on the accuracy of the system.

### VIII. CONCLUSION

In conclusion, the proposed system is a useful tool to predict crime hotspots and provide recommendations to women for safer routes. The system employs the explainable Decision Tree (xDT) algorithm for crime hotspot prediction and integrates Google Maps API for visualization and location-based recommendations. The system is designed with various modules, including Crime Hotspot Finder Web App, Crime Hotspot Classifier using xDT, Crime Hotspot Pre-processing, and Crime Hotspot Prediction using xDT. Each module serves a specific purpose and contributes to the overall functionality of the system. The proposed system has many advantages over the existing manual systems and other data mining techniques. It provides a more accurate and efficient way of predicting crime hotspots, which will allow law enforcement agencies to take proactive measures to prevent crime against women. The system is also user-friendly, making it easy for end-users to access and utilize. During the feasibility study and testing phase, the system showed promising results in terms of accuracy, precision, and recall. The user-friendly interface and the integration of Google Maps API provided a smooth and interactive experience for users. Furthermore, the system has the potential for further development and integration with other crime prevention measures such as CCTV cameras and police patrols. It can also be expanded to include other types of crimes and demographic groups. Overall, the Crime Hot Spot Prediction and Localization System for Women Safety using xDT and Google Map API is a step towards creating a safer environment for women and empowering them to make informed decisions regarding their safety.

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