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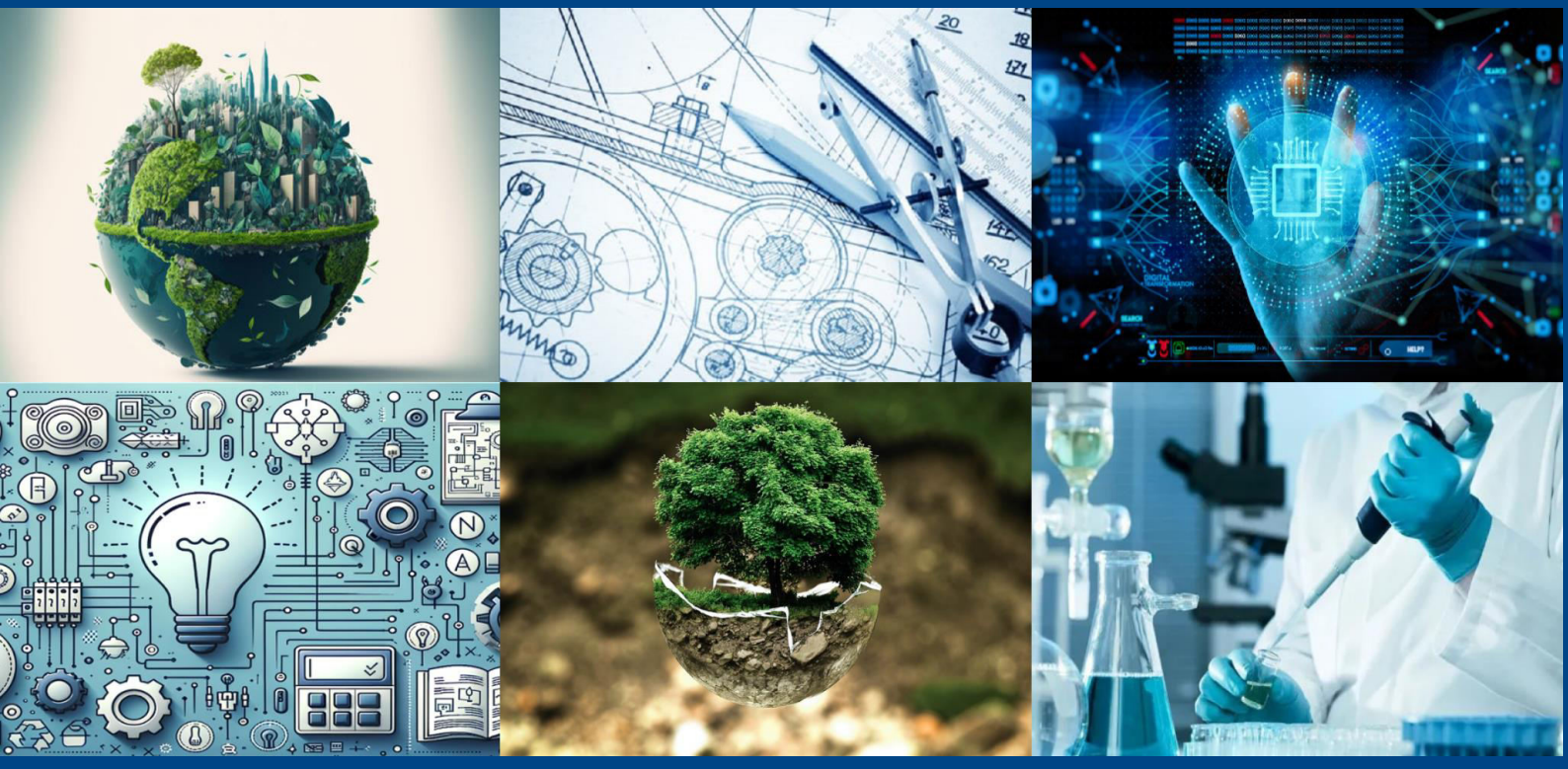

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Enhanced Crime Hotspot Prediction and Visualization for Women's Safety through Deep Learning

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ABSTRACT: Crime hotspots are geographic areas with elevated levels of criminal activity compared to other regions. Women in these hotspots are at increased risk of experiencing various forms of criminal behavior, including sexual harassment, assault, domestic violence, stalking, and human trafficking. Identifying these hotspots is crucial for effective crime prevention and resource allocation by law enforcement agencies. This project presents Safety Locator, a predictive system that uses multimodal deep learning to identify and map crime hotspots where women are particularly vulnerable. The system utilizes the Deep Explainable Decision Tree model, a machine learning algorithm that analyzes historical crime data to predict the likelihood of criminal activity in specific areas. The Deep Explainable Decision Tree model classifies data into crime hotspot categories and visualizes these areas on Google Maps. By analyzing factors such as the number and type of reported crimes, the timing of incidents, and crime locations, the system generates a detailed map highlighting high-risk areas. This map can be shared with the public to increase awareness and promote safety. The development process includes data pre-processing, feature selection, model training, evaluation, hyperparameter tuning, and prediction. The model's performance is assessed using metrics like accuracy, precision, recall, and F1-score, with hyperparameters optimized through cross-validation. Safety Locator aims to assist law enforcement agencies in preventing crime and enhancing public safety by pinpointing areas with high crime probabilities. By creating safer environments for women, the system supports efforts toward gender equality and improved quality of life.

KEYWORDS: Crime hotspots, Crime Hot Spot Predictor System, Map Visualization, Preprocessing.

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.

II. INDIA'S CRIME STATISTICS ON VIOLENCE AGAINST WOMEN

Overall, 60.96 lakh crimes were registered in the country last year, a decline of 7.6% from 2020For the fifth consecutive year, Assam recorded the highest rate of crimes against women in 2021, according to the National Crime Record Bureau's "Crime in India" report for last year. The rate is calculated as the number of crimes recorded for every one lakh people. According to the data, the rate of crimes against women last year stood at 168.3 in Assam, an increase from 154.3 in 2020. Next on the list were Odisha at 137.8, Haryana at 119.7, and Rajasthan at 105.4. In terms of the actual number of cases, Uttar Pradesh with 56,083 cases, topped the list, followed by Rajasthan (40,738), Maharashtra

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(39,526), West Bengal (35,884) and Odisha (31,352). Nagaland reported the lowest crime rate against women in 2021 (5.5). It also had the lowest number of actual cases – 54. A total of 4,28,278 cases of crimes against women were registered in the country under the Indian Penal Code and special and local laws last year. The number is 15.3% more than the 3,71,503 cases registered in 2020.

III. CRIME HOTSPOT

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 areas can be anywhere. They can be bars, malls, neighbourhoods, pretty much anywhere criminals target.

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.

IV. CRIME HOT SPOT PREDICTOR SYSTEM

The algorithm takes as input various features, such as location, time, and type of crime, to make the prediction. Based on the input features, the algorithm classifies the area as a potential crime hotspot or a safe area. Location-based prediction of crime hot spots can be a useful addition to the existing crime hot spot prediction system. It can allow users to enter their current location or intended destination and receive information about potential crime hot spots in that area. This feature can be implemented using a combination of geolocation and data mining techniques.

1. INPUT OR PICK LOCATION IN MAP

The system can use the geolocation feature of the user's device to determine their current location or intended destination.

2. HOT SPOT PREDICTION

This information can then be used to query the crime database and identify any hot spots in the vicinity. The results can be displayed on a map, allowing the user to visually identify the location of potential danger areas. location-based prediction can enhance the usefulness and effectiveness of the crime hot spot prediction and localization system, providing users with valuable information to help them stay safe.

V. CRIME HOTSPOT MAP VISUALIZATION

The Crime Hotspot Visualization module in the Crime Hot Spot Prediction and Localization System for Women Safety using DT and Google Map API is responsible for visualizing the predicted crime hotspots on a map. This module receives the predicted hotspots generated by the Crime Hotspot Prediction using DT module and plots them on a map using Google Map API. The module uses the latitude and longitude coordinates of the predicted hotspots to create markers on the map. These markers are then displayed with the help of the Google Maps JavaScript API. The markers are color-coded based on the predicted crime intensity, with red markers indicating high crime intensity and green markers indicating low crime intensity. The module also provides an option for the user to filter the hotspots based on the crime type. The user can select a specific crime type from a dropdown menu, and only the hotspots related to that crime type will be displayed on the map. Overall, the Crime Hotspot Visualization module enhances the user's understanding of the predicted hotspots and provides an easy-to-use interface for exploring the data.

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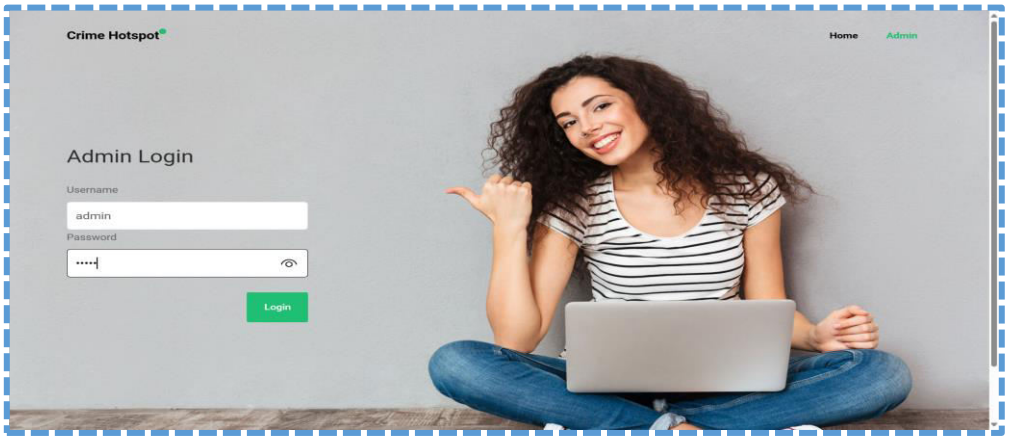
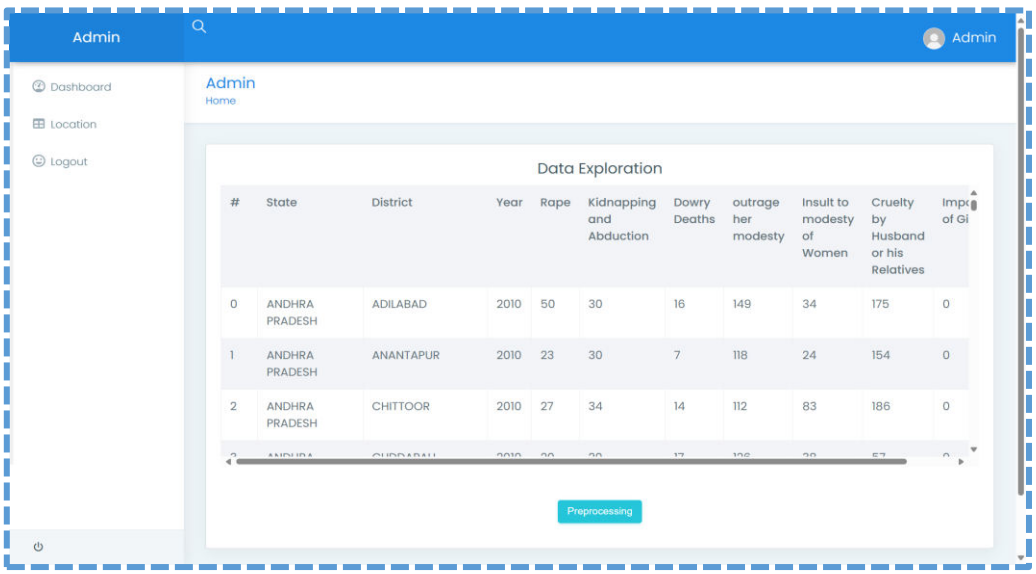
VI. RECOMMENDATION MODULE

The Recommendation module in the Crime Hot Spot Prediction and Localization System for Women Safety using xDT and Google Map API is designed to provide safety recommendations to users based on the predicted crime hotspots in a particular area. This module takes into account the type of crimes that are most likely to occur in the predicted hotspots and suggests safety measures that can be taken to avoid such incidents. The recommendation module uses a rule-based approach to provide safety recommendations. These rules are based on the type of crime predicted in the hotspots and the best practices recommended by law enforcement agencies to prevent such crimes. For example, if the predicted hotspot is for theft, the recommendation module may suggest that users should avoid carrying expensive jewelry or electronics while travelling in that area. Similarly, if the predicted hotspot is for assault, the module may suggest that users should avoid travelling alone during late hours and to stay in well-lit areas. The recommendations provided by the module are displayed to the users in the form of pop-up messages on the Crime Hotspot Finder Web App. The recommendations are also stored in the system's database for future reference. The module also allows users to provide feedback on the recommendations provided, which can be used to improve the effectiveness of the recommendation engine in future versions of the system.

VII. CRIME HOTSPOT OF ADMIN LOGIN





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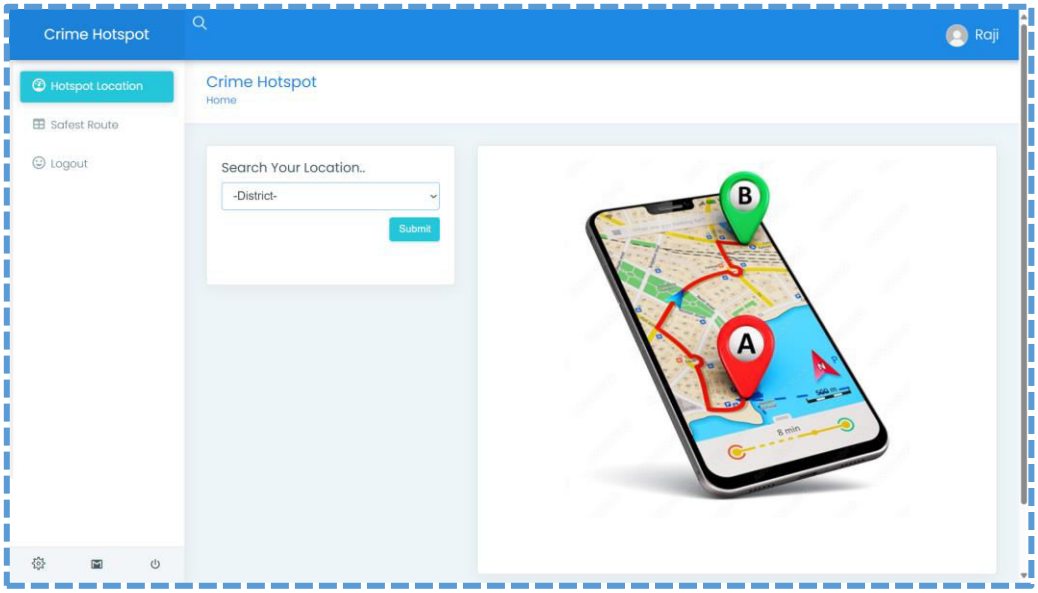
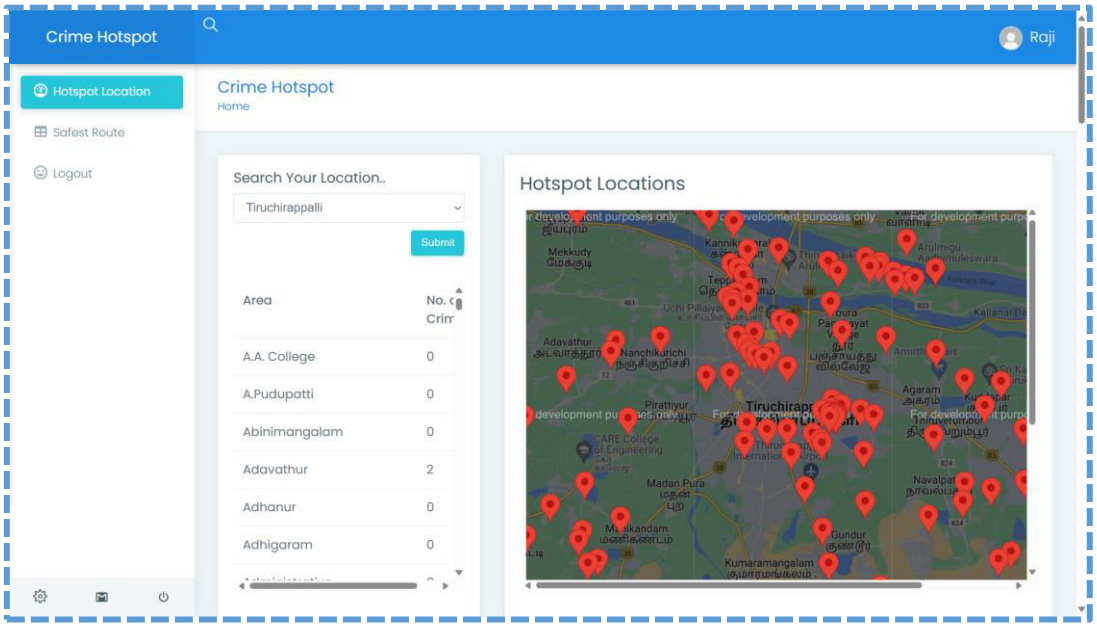
VIII. CRIME HOTSPOT OF LOCATION





IX. RESULT AND DISCUSSION

The Safety Locator project uses multimodal deep learning, specifically the Deep Explainable Decision Tree model, to predict and map crime hotspots where women are most vulnerable. By analyzing historical crime data, the system classifies and visualizes high-risk areas, helping law enforcement allocate resources effectively. This tool aims to enhance public safety, raise awareness, and contribute to gender equality by identifying locations prone to criminal activity.

The Safety Locator system successfully identifies crime hotspots where women are most vulnerable by using the Deep Explainable Decision Tree model, which analyzes historical crime data. The system's predictions, based on factors like crime type, timing, and location, accurately map high-risk areas, which can be visualized on Google Maps. This tool

enhances crime prevention efforts by helping law enforcement allocate resources effectively and raising public awareness to improve safety for women.

X. 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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