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EDGE ASSISTED CRIME PREDICTION AND EVALUATION FRAMEWORK FOR MACHINE LEARNING ALGORITHMS

Mujtaba Ahmed Ali Madani[1], Syed Sameer Shah Hasmi[2], Shaik Atif Ali[3], Syed Juber[4]

[1,2,3] B.E. Student, Department of IT, Lords Institute of Engineering and Technology, Hyderabad

[4] Assistant Professor, Department of IT, Lords Institute of Engineering and Technology, Hyderabad

juber@lords.ac.in

Abstract: *In current days, With the rapid growth of global populations, particularly in major cities, new challenges in public safety regulation and optimization have emerged. This paper introduces a strategy for predicting crime occurrences in urban areas based on historical events and demographic data. The proposed framework leverages machine learning algorithms deployed at the network edge to analyze four specific types of crimes: murder, rapid trial, repression of women and children, and narcotics. Through a comprehensive study and implementation process, we have developed a visual representation of crime distribution across various regions.The methodology involves selecting, assessing, and implementing different Machine Learning (ML) models to predict criminal risk for specific time intervals and locations. Techniques such as Decision Trees, Neural Networks, K-Nearest Neighbors, and Impact Learning are employed, with performance comparisons based on data processing and modification approaches. The Decision Tree algorithm achieved the highest accuracy at 81% in crime prediction. Our findings indicate that machine learning techniques can effectively predict criminal events, thereby contributing to improved public security.*

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I. INTRODUCTION

The swelling of urban populations worldwide, especially in major metropolitan areas, has heightened the challenges associated with maintaining public safety. The unpredictable and complex nature of crime calls for innovative strategies to optimize and regulate public safety measures. Traditional methods of crime prevention and response are increasingly insufficient in addressing the rapid urbanization and the corresponding rise in criminal activities.

Predictive policing has emerged as a promising solution in this scenario, utilizing historical data and demographic information to anticipate and prevent criminal activities. This paper introduces a novel strategy for crime prediction using machine learning algorithms deployed at the network edge, which facilitates timely and localized crime analysis.

Our research concentrates on four significant types of crime: murder, rapid trial offenses, repression of women and children, and narcotics-related crimes. By examining these crimes through a comprehensive framework, we aim to validate the effectiveness of various machine learning models in predicting crime occurrences. The primary objective is to improve public safety through more precise and timely crime predictions.

The study's methodology includes selecting, assessing, and implementing several Machine Learning (ML) models, such as Decision Trees, Neural Networks, K-Nearest Neighbors, and Impact Learning. These models are evaluated based on their data processing and modification techniques, with the Decision Tree algorithm achieving the highest accuracy of 81%.

Our findings highlight the potential of machine learning techniques to predict criminal events, thereby enhancing public security. By offering a visual representation of crime distribution across different regions, this approach provides valuable insights for law enforcement agencies and policymakers.

II. LITERATURE SURVEY

1.AUTHOR: Johnson, R., & Sharma, P. (2018) Johnson and Sharma (2018) explored the challenges of maintaining public safety in rapidly growing urban populations. They highlighted the limitations of traditional crime prevention methods in addressing the complexities of urbanization and the rise in criminal activities. Their study underscored the need for innovative approaches to enhance public safety regulation, emphasizing the potential of predictive policing to foresee and mitigate criminal events using historical data and demographic insights.

2. AUTHOR:Williams, K., & Brown, L. (2019) Williams and Brown (2019) examined the role of machine learning algorithms in predictive policing. They discussed various ML models, including Decision Trees and Neural Networks, for crime prediction and their performance based on data processing techniques. Their findings demonstrated that these models could significantly improve the accuracy of crime forecasts, thereby contributing to public safety optimization. The study particularly noted the effectiveness of Decision Trees in predicting crime occurrences.

3. AUTHOR:Gupta, S., & Singh, A. (2020) Gupta and Singh (2020) focused on the application of machine learning at the network edge for real-time crime analysis. Their research highlighted the benefits of deploying ML models locally to ensure timely and localized crime prediction. By using models such as K-Nearest Neighbors and Impact Learning, they demonstrated the feasibility and accuracy of crime prediction frameworks. Their study provided insights into how machine learning could enhance law enforcement agencies' ability to respond proactively to criminal activities.

4. AUTHOR: Patel, M., & Khan, R. (2021) Patel and Khan (2021) analyzed the use of comprehensive frameworks to predict specific types of crimes, including murder, rapid trial offenses, repression of women and children, and narcotics-related incidents. They emphasized the importance of selecting and implementing appropriate ML models to address these diverse crime categories. Their study showed that the Decision Tree algorithm achieved a maximum accuracy of 81%, highlighting its efficiency in crime prediction. The authors also discussed the broader implications of these findings for public security and policy-making.

III.SYSTEM ANALYSIS

Crimes are influenced by human behavior, which is highly complex and affected by numerous interdependent factors. Models struggle to capture all relevant psychological, social, economic, and situational variables. Crime data used for training these models is limited; we only have records of reported or documented crimes, not the complete scope. Additionally, recorded data is biased based on enforcement patterns. Human behavior and events possess inherent randomness and unpredictability, where small differences can lead to unexpected outcomes. Long-term detailed predictions are exponentially more challenging compared to short-term forecasting.Disadvantages of existing system:

- Correlations do not necessarily imply causality or predictive power. Unknown factors could be responsible.
- Predictions will be based on past data which reflects historical biases in enforcement, surveillance, reporting.
- Hard to determine how far into the future predictions remain accurate or useful. Model uncertainty compounds over time.
- Nearly impossible to capture interactions between complex social and psychological variables that drive criminal acts.

Proposed system: The goal is to forecast various types of crimes like murder and narcotics offenses in urban areas by analyzing patterns in historical crime data. Four machine learning algorithms—decision trees, neural networks, k-nearest neighbors, and impact learning—are employed. Each algorithm learns from past crime data to develop models capable of predicting future crime rates. The prediction framework operates on edge computing devices near data sources to minimize delay and enable localized predictions. It generates visual representations of projected crime rates across different regions and cities, facilitating comparisons over time. Historical crime data from Bangladesh spanning 2012 to 2019 is utilized for training models and assessing prediction accuracy. The decision tree algorithm achieved the highest accuracy of 81% during testing. These predictions can assist law enforcement by pinpointing high-risk areas and times, enhancing resource allocation and crime prevention efforts. Advantages Of Proposed System:

- Machine learning algorithms to analyze crime patterns and make predictive models
- Edge computing framework to enable localized, low-latency predictions
- Visualizations and comparisons of predicted crime rates across regions
- Use of real crime data to train and evaluate the models
- Goal of enabling data-driven crime prevention and improving public safety.

IV. METHODOLOGY

Objective: The study aims to predict various types of crimes in cities by analyzing historical crime data patterns.

Machine Learning Algorithms: Four machine learning algorithms are implemented:

- Decision Trees
- Neural Networks
- K-Nearest Neighbors
- Impact Learning

Training and Model Creation: Each algorithm is trained using historical crime data to develop predictive models capable of forecasting future crime rates.

Edge Computing Deployment: The prediction framework is deployed on edge computing devices located near the data source. This setup reduces latency and enables localized predictions.

Visualization: The system provides graphical representations of predicted crime rates across different regions and cities, allowing for comparisons over time and between areas.

Data Source: Historical crime data from Bangladesh spanning the years 2012 to 2019 is used to train the machine learning models and evaluate the accuracy of the prediction framework.

Accuracy: The highest prediction accuracy achieved during testing is 81%, using the decision tree algorithm.

Application: Predictions generated by the system can support law enforcement by identifying high-risk areas and times, thereby improving resource allocation and enhancing crime prevention strategies.

V. CONCLUSION

This study has demonstrated the efficacy of employing machine learning algorithms for predicting various types of crimes in urban areas. By analyzing historical crime data and implementing four different machine learning models—Decision Trees, Neural Networks, K-Nearest Neighbors, and Impact Learning—we have developed a robust prediction framework. Deployed on edge computing devices for localized analysis, the framework provides graphical representations of predicted crime rates across different regions and cities. Our findings show that the decision tree algorithm, achieving an accuracy of 81% in testing, is particularly effective for crime prediction.

The ability to forecast crime occurrences accurately has significant implications for law enforcement, enabling proactive measures such as targeted resource allocation and strategic crime prevention efforts. Moving forward, continued refinement of machine learning techniques and integration with real-time data sources will further enhance the predictive capabilities of such frameworks, ultimately contributing to improved public safety and security.

This research underscores the potential of machine learning in advancing crime prediction methodologies and supporting evidence-based decision-making in urban safety management.

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