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Design and Analysis of Machine Learning Algorithms for the Reduction of Crime Rates in India

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Abstract – Crime has a negative impact on economic development since it keeps rising day by day. Reducing crime has become a top priority in our society since it is such a serious problem. As a result, figuring out what influences crime rates and how to do it in the most effective manner is critical. In order to do this, a database must be kept, which records various crimes with information relating to location, time, and nature, among other things, for future use. Using machine learning algorithms to minimize crime in India is the subject of this study. Finding patterns in large datasets has never been simpler thanks to advances in machine learning. Predicting the sort of crime that will occur in a given area is the primary goal of this study. Through the use of clean and transformed training data sets, machine learning has been utilized to construct a model. Data visualization may be used to do analysis on a data collection and its features. Factors of the situation are being analyzed and documented. In order to keep society secure, risk variables have been discovered and prediction techniques have been devised. This research included clustering algorithms, optimization techniques, and statistical analysis.

Keywords – Machine Learning Algorithms, Reduction, Crime Rates;

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INTRODUCTION

As a social canker worm that has eaten deeply into the social fabric of Nigerian society, crime has had a wide-ranging influence. The term "crime" refers to a breach of a community's or a nation's particular set of values and regulations. Adegoke, (2014) argues that crime is unavoidable in our social existence, but the fact that it is a necessary component of society and that it serves a purpose must be taken into account because of the social and psychological harm it has caused many of its victims in our society. To tell the truth, regardless of the general public's utility in committing crimes, doing so is wrong and cannot be tolerated in a civilized society, regardless of the justification perpetrators may provide.

Challenges posed by crime and instability have grown into daunting proportions that have enraged the whole nation and shattered families, businesses, and investment. The squandering of innocent and guiltless blood every day and the citizens controlled displeasure remain a problem. According to Nwaze, (2011) the pace of carnage in Nigeria's civil conflict pales in comparison to the terrorist assaults that have taken place in the last few months.

Nigeria's most well-known crimes during this period include: armed robbery, outfitted theft, stealing, assault, burglary, rape, etc. As a result of the rise in violent crimes like terrorism and other forms of criminal activity like kidnapping and bombings, the country is seeing an increase in the number of violent crimes, such as armed robbery and banditry, suicide bombings, religious killing and ethnic clashes, as well as politically motivated killings. The GPI's Worldwide Peace Index (GPI, 2012) consistently ranks Nigeria near the bottom of the list, signifying a worsening crime and instability situation in the country. It has been highlighted by Victoria (2010) that the country of Nigeria has been afflicted by a myriad of security challenges, including kidnappings, terrorism and civil unrest, as well as political violence, burglary assaults and fraud, among other things. These infractions, despite rigorous rules and regulations, have continued to grow, with the police seeming weak and unequipped to combat the situation.

Criminal activity in the general population is increasing, and as a result, security agencies must deal with many more hoodlums than in the past. Numerous criminals were punished and incarcerated, some of whom were released after

serving their sentences and under surveillance; others were allowed to return to the general population and continue their criminal activities unchecked. It has been incredibly difficult to study crimes because of this never-ending trend. The Sri Lankan police force has also been grappling with similar issues for some time now. An estimated 50,000 homicides in Nigeria each year are the result of heinous crimes, according to available data. It is the major regional administrative police headquarters that keep track of and investigate all reported crimes.

Providing security and protecting people and property are the primary responsibilities of every country's government. Area 14(2) states that "the administration's primary responsibility shall be to ensure public safety and well-being" in Nigeria's 1999 constitution (b). Efforts to combat crime in Nigeria using the country's conventional ways seem to have little effect. Crime protection and crime fight have become more important to the general public, police agencies, politics, and research because crime damages our feeling of security, affects our quality of life, and has wide-ranging economic effects. Criminal justice authorities have turned to current intelligence and geospatial technologies, which have fast become an emergent scientific study topic, in order to offset the effect of crime on society. Many of these technologies are based on well-known ideas, such as regular activities (Felson, Poulsen, 2003), rational choice, and environmental criminology (Clarke and Cornish, 1993). (Brantingham and Brantingham, 1997). As a result of the development of intelligent crime prediction systems (ICPS), law enforcement authorities will have a plausible response to the aforementioned issues, as well as effective tools to help in crime control and crime prevention initiatives. Artificial Neural Networks (ANNs) and Geographic Information Systems (GIS) make up the hybrid system (GIS).

The Future of AI in Criminal Justice

A new AI application in the criminal justice system may be discovered every day, opening the door for future advancements in public safety.

Crimes might be prevented by movement and pattern analysis, the identification of persons across several sites through closed-circuit television or numerous cameras, and item and activity detection could assist police locate suspects. Because of the vast amounts of data generated by cameras, video, and social media, AI may be able to identify crimes that would otherwise go unnoticed and contribute to public safety by researching possible criminal activities. It's also possible that AI may be used to aid crime labs in areas such as the analysis of complicated DNA mixtures.

Detection and prosecution of crimes and criminal enterprises could be aided by pattern analysis of data. It's also possible that algorithms might help keep criminals and prospective criminals out of the criminal justice system in ways that were previously unimagined.

As a result, AI can help law enforcement officers better respond to potentially risky circumstances, which might lead to a greater sense of well-being for the officers themselves. A safer alternative to putting police and the public in danger could be found in the use of robotics and drones, which could be integrated into public safety systems as a whole. If you're a criminal justice practitioner, drones and robots might help you in ways that haven't yet been thought of.

To better react to crises, avert threats and stage interventions by integrating AI and predictive police analytics with computer-aided response and live public safety video businesses is the goal of law enforcement. Our criminal justice system may benefit from AI, which can aid investigators and help law enforcement officers better protect the public.

RELATED WORKS

Zakaria and Ayman (2014) Crime and criminal data may be analyzed using basic k-means clustering and the Aprior method for data association. The purpose of the article was to assist experts in establishing patterns and trends, generating projections, finding linkages and probable explanations, mapping criminal networks, and identifying prospective suspects, all while keeping the public informed. Clustering is based on the discovery of previously discovered connections between various Crime and Criminal traits. As part of the process of creating and testing the proposed model, a variety of preprocessing approaches were used to provide clean and accurate datasets for both crimes and offenders. A variety of crimes and criminal patterns and behaviors were identified using the preprocessed data, and they were then organized into clusters based on key criteria.

A verifiable dataset was used to examine the outcomes of this technique. Javad (2014) presents an audit of the usefulness of information mining techniques. An important subject in criminology, despite the fact that information mining may be used to many other sectors, is information mining used to identify crime characteristics, the author explains in the article. Identifying and investigating infractions, as well as analyzing their connection to hoodlums, is an important part of the process of reducing crime. Using information mining methods, the creator has discovered that criminology is a good fit because of its large and complicated datasets. Using Data Mining techniques, the article tries to identify crime hotspots and anticipate future crime patterns.

Shyam, (2014) proposes utilizing data mining to tackle criminal detection concerns. There are many ways in which crimes are a nuisance to our society, and they cost us dearly. According to this author, the application of a clustering technique (k-means clustering) to identify criminal trends may help law enforcement officers crack cases faster and with more accuracy. To ensure the accuracy of the findings, the clustering method was tested using actual crime statistics. The semi-supervised learning approach was also applied by the author to boost the predicted accuracy of the knowledge discovery from the criminal data. Community crime patterns were discovered by using fuzzy association rule mining by Anna and Christopher in 2010. In both regional and national forums, new rules are discussed and debated. The support metric was developed to find the most unique and uncommon rules from the plethora of previously identified rules. Crime patterns may be discovered by law enforcement officers instead of spending time on boring and infrequent (rules) patterns.

Madhusmita and Behera (2012) used K-Means Algorithm for information clustering and heredity computation for instatement in a new model with minimal grouping and quantization errors and the ability to link despite high-dimensional datasets, adjusted K-Means calculations are tested on an iris informative index and their execution is compared with that of other bunching calculations. Some of the K-means difficulties, such as the number of groups and the sensitivity to the initial centroid, are addressed here.

Dawei et. al. (2013) suggested a technique for mining geographical data to look at crime hotspots and the factors that affect them. In a geo-spatial dataset, GD Patterns (Geospatial Discriminative Examples) were used to distinguish between two classes of data (hot spots and typical areas). The Hotspot Enhancement Device (HOT) was designed using GD Patterns to improve the differentiating evidence of crime hotspots. Finally, GD Pattern bunches were obtained in order to examine the appropriation and qualities of Crime-related variables in light of a similarity measure.

Yamuna et al. (2012) presented data mining methods to analyze and predict future criminal activity. In order to make a prediction of future crime patterns, it is necessary to track the rate of change in crime rates through time, beginning with one year and then moving on to the next. For the most part, the basic technique involves grouping states with similar crime trends and then arranging records using 'next year data'. Crime trends may be predicted by combining this data with information about the state's neediness. A characterization calculation was used to predict the design of the future Crime. To see where a group will fall in the next year's categorization, a characterization was carried out. Using the current year's data, we can create a prophetic model for predicting one year from now's records. This is why the decision tree computation was used. The summed-up tree was used to predict the next year's obscure crime pattern. In the exploratory results, it was found that the expectation technique used is exact and rapid.

Majeed (2010) A predictive crime model was built using regression analysis and neural network techniques, with the goal of creating novel hierarchical neural Network methodologies to give a more accurate forecast. Clustering algorithms and neural networks are used to create an integrated model for predicting crime in the study area using GIS and the SCS clustering algorithm, as well as visualizing crime data and population data, as well as visualizing 'hot spots,' which were defined by the clustering algorithm SCS. Multiple regression analysis and non-hierarchical neural Network back-propagation network outcomes were compared. Compared to the non-hierarchical BP performance, the new technique obtained a 13 percent gain in average percentage accuracy throughout testing. Cross-border security, Internet security, and domestic crime were all targeted by various criminal detection and prevention approaches.

MODELS IN PROPOSED SYSTEM

Predictive Modeling

Predictive modelling is the process of creating models that may be used to forecast the future. Decision trees and classification, support vector machines, KNN classification, regression, K-Means clustering, density-based clustering, and random forest are all included in this category of analysis. Models of utility and outcomes are used to show the method in a decision-tree. An observable ML method, KNN stores training data instances in multidimensional space. Following clustering, the support vector machine uses a hyperplane to categories and forecast the data above and below the hyperplane. An array of decision trees may be generated during training time using random forest classifications. If you have N observations, you may divide them into k clusters, where each of the observations belongs to a cluster that has the closest mean. Unsupervised machine learning technique for grouping data based on density creates dense areas in the data space. Regression is a method for making predictions in which the values of other variables are utilized to find one of the variables.

Functionality of proposed work

Procedure in crime analysis

To carry out the analysis, the following stages are used:

1. Data collection - The data is sourced from the National Crime Records Bureau's Public Domain Data.

2. Data pre-processing- The raw data is translated into the desired format.

3. Feature selection- In this work, murder is regarded as the most common sort of crime.

4. Prediction and Visualization – Predicted and visualized models are the focus of this study.

5. Interpretation – The crime rate is analyzed.

Models:	K- Means Clustering	Density Based Clustering	Input Mapped Classifier	Expectation Maximization Algorithm
	Clustered Instances 020 (95%) 11 (5%)	Clustered Instances 020 (95%) 11 (5%) Log likelihood: - 74.26837	Correlation coefficient 0.5584 Mean absolute error 26.5054 Root mean squared error 54.4709 Relative absolute error 100 % Root relative squared error 100 % Total Number of Instances 21	STATISTICAL_ANALYSIS (Probability distributions) Time taken to build model (full training data): 0.1 seconds Model and evaluation on training set Clustered Instances 021(100%) Log likelihood: -94.96133
Interpretations	The Clusters depends on the selection of initial centroid which is at random and convergence is achieved	The noise is identified while clustering with respect to the arbitrary size and shape.	Significantly enhanced because of mere co location of related activity.	For fitting mixed distribution which will converge to local optimum with log likelihood of the data.

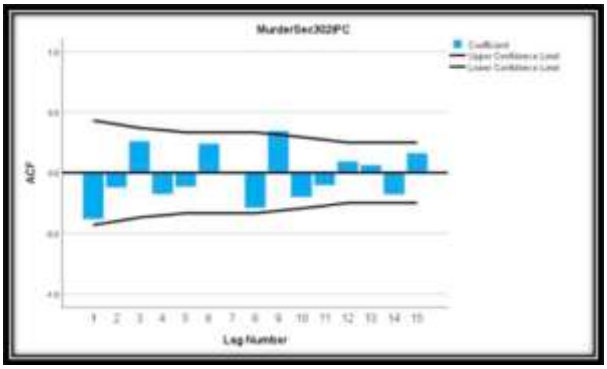


Figure1: Lag No. vs autocorrelation

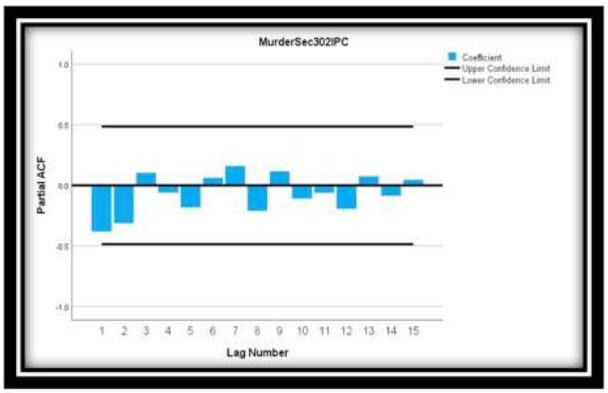


Figure2: Lag No. vs partial autocorrelation

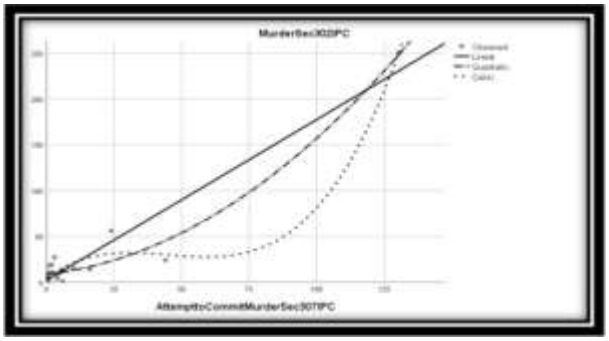
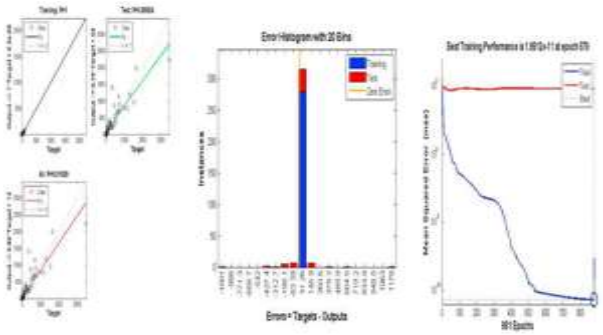


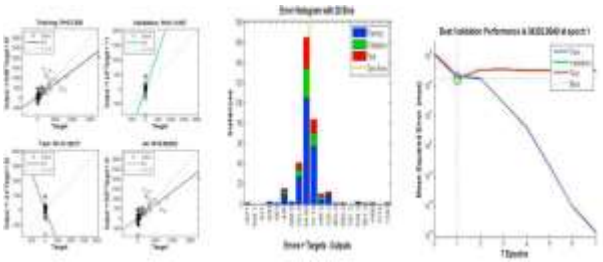
Figure 3: Linear, Quadratic and Cubic regression analysis

Bayesian Neural Networks



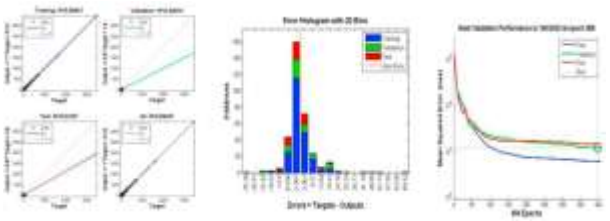
With reference to Bayesian Neural Networks, consistent approaches for inference and prediction of the quality attribute overfitting are established, making it easier to calculate the confidence interval.

Levenberg Algorithm



Stability may be inferred from the preceding graphs, which were generated using the Levenberg algorithm, in which convergence is achieved and many free parameters are handled, resulting in an optimal value.

Scaled Algorithm



From the diagrammatic description of the scaled method it can be deduced that data are normalized within a range and that data pre-processing scaling is given by the independent variable to execute future scaling.

CONCLUSION

Detection of crime utilizing machine learning and data mining attempts to reduce crime rates in the face of increasing scientific advances. This study focuses on the many sorts of crime, their incidence in various locations and eras. An extensive investigation is carried out with murder as the most prevalent crime type in mind. By comparing the results of the three algorithms on real-world data, we were able to identify at which iteration the greatest valid performance could be achieved, and it was found that the scaled method performed the best when compared to the Bayesian and Levenberg algorithms. Analyses were carried out using correlation and ANOVA as well as graphing, and the findings are reported in the preceding paragraphs. The crime rate may be lowered by 78 percent, suggesting an accuracy level of.78, according to the research. The goal of this study is to develop an optimization model and apply it to large datasets, comparing several ML algorithms and other methods like Genetic Algorithm, deep learning algorithms, and so on.

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