Crime Forecasting: An Investigation of Four Different Techniques

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ABSTRACT: One of the most pervasive and worrying aspects of our culture is crime. A great number of crimes are perpetrated every day, making the lives of regular residents uneasy. Therefore, it is essential to stop the crime from happening. Recently, it has been clear that artificial intelligence is important in practically every industry, and crime prediction is one of them. However, it is important to keep a thorough record of the crimes that have been committed since this data may be needed in the future. The capacity to foresee crimes that may happen in the future can aid law enforcement in stopping crimes before they happen. . Strategically, the capacity to foresee any crime based on time, place, and other factors can aid in supplying police enforcement with important information. However, as crimes are rising at an alarming rate, precisely anticipating crime is a difficult undertaking. So, it's crucial to identify potential crimes now in order to prevent them from happening later. Many academics have recently experimented with predicting crimes using various machine learning techniques and specific inputs.

KEYWORDS: Crime, Crime Prediction, Crime cast, Deep Learning, Data mining.

1. INTRODUCTION

Crime is a major threat to humanity. Many crimes occur at predictable periods of time. Perhaps it is rapidly growing and spreading. Crimes occur in tiny villages, towns, and large cities. Murder, kidnapping, battery, robbery, rape, assault, false imprisonment, and homicide are all examples of crimes. Because crime is on the rise, it is imperative that cases be resolved as quickly as possible. Crime has risen at a rapid pace, and it is the role of the police force to control and minimise crime. Because there is a massive quantity of crime data available, the police department's key issues are crime forecasting and identity verification. There is a need for technologies to make case handling faster. Many documents and examples have revealed that machine learning techniques and data science may render the process faster and easier. When crimes are committed regularly in a society, they in certain ways have an impact on institutions and organisations. Therefore, it's important to research the connections and contributing elements to various crimes in order to correctly forecast and prevent them [1]–[3].

It is difficult for a police investigator to individually disentangle the inherent intricacies inside police records, and the challenge is exacerbated when the analysis is conducted by a team. The allocation of data to the group can result in crucial information being missed that may be valuable in solving the crimes since each member does not have all actual information. For a long time, criminologists and statisticians have used their talents and expertise to try to anticipate when and where the next batch of crimes would occur, with varying degrees of success. The frequency of crime and the increased knowledge of modern offenders placed a pressure on conventional procedures. When faced with millions of records, human logic fails.

Both qualitative and quantitative methodologies can be used to forecast crime. Qualitative techniques to crime prediction, such as environmental analysis and scenario scripting, can help predict the future character of criminal behaviour. Perceptible approaches, on the other hand,

are used to forecast the future breadth of crime especially, more precisely, crime rates. Annual crime rate trends created using time series models are a frequent way for developing projections. This method also entails connecting previous crime trends to factors that may impact the extent of crime in the future. This study includes the following crime prediction techniques (Figure 1):

• Data mining method

• Crime casting method

• Deep learning technique

• Sentimental analysis techniques
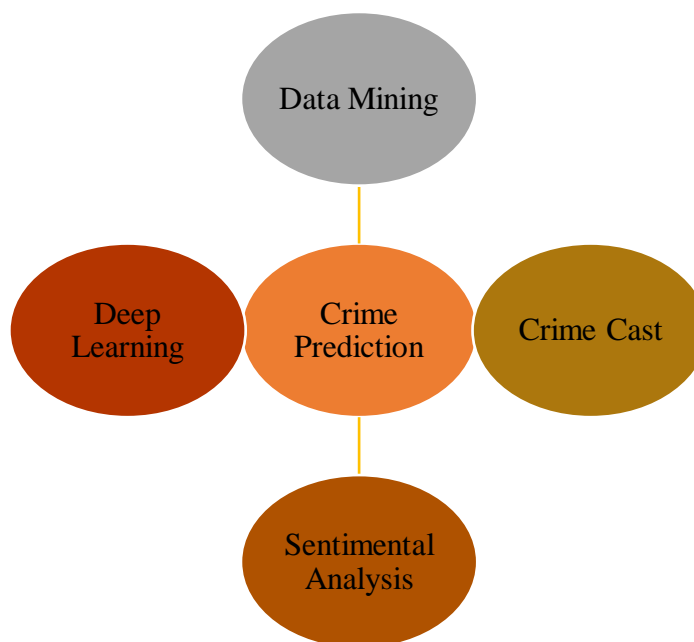
Figure 1: Illustrating the different techniques of Crime Prediction.

1.1. Data Mining Techniques

Data Analyzing and data mining techniques are used to discover trends and patterns in crime statistics that has previously been stored through multiple sources, lowering the rate of crime [2], [4].

1.2. Sentimental Analysis technique

The following processes make up the tweet analysis used to detect crime: 1. Tweet gathering 2. Data cleaning and processing 3. Sentiment analysis of the tweets gathered. Twitter, an unauthorised Java library for the Twitter Application Program Interface, is used to collect the twitter data. The application was automated using this in order to be incorporated into Twitter. Then, tweets are gathered based on crime-related subjects within a certain city zone. To gather data, a keyword search method was used. These keywords are used to identify tweets about crime that contain terms like "crime," "gun," "murder," "kill," and other similar phrases. After parsing each tweet, sentiment analysis is performed. After that, every single tweet is analysed before sentiment analysis is done. This analysis is done specifically for the purpose of

separating the various phrases in a tweet based on the white-space borders, changing the tweet's case to lower case, and removing any non-alphanumeric symbols. The estimation of the offence is then made using sentiment analysis of tweets [5]–[8].

1.3. Crime Cast

A mathematical modelling approach called Crime Cast uses the prior database to anticipate the future and determine the crime rate, types of crimes, and dangers associated with them. This method involves locating an area with a higher crime rate. Hotspots are the name given to these areas. Coldspots are the areas with the lowest crime rates. So, by modelling the installation of probabilistic models and Artificial Neural Networks, Crime Cast—a technique for making predictions from crime databases—can be implemented in hotspots. The hotspot zone is always shifting. Therefore, crime forecasting organisations may focus more on hotspots than coldspots. Methods used for Crime Cast Technique (Figure 2):

- Multivarate Time Series Clustering
- Support Vector Machine
- Fuzzy Time Series
- Bayesian Network
- Artificial Neural Network
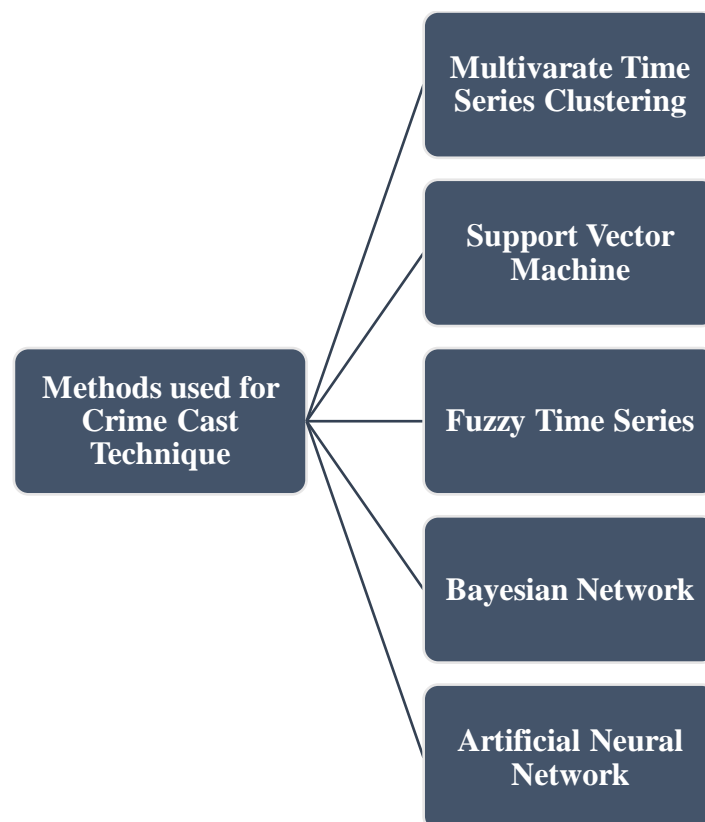
Figure 2: Illustrating the different methods used in Crime Cast Technique.

1.4. Deep Learning

Deep learning is made up of several layers, some of which involve non-linear processes like neural networks and propositional equations. In this case, the artificial intelligence technology known as deep learning is utilised to create a model of the world containing a variety of crimes and the relationships between them. Multiple algorithms are used by deep learning to transform the original data into more complex representations.

2. DISCUSSION

The area has advanced significantly thanks to technology, which has also gotten cheaper to the point that most, if not all, law enforcement agencies can now afford electronic records and some type of mapping software. The computing capacity required to execute data analysis has also been made available by technology, which has further improved analyst education. Departments and outside researchers may now perform additional research thanks to all of this.

Solving a crime problem is a difficult endeavour that calls for human experience, intellect, and techniques that can aid in crime detection issues. In addition, the forecasting of future crime patterns or trends takes into account changes in the crime rate from one year to the next and uses forecasting techniques to identify such changes in the future. Finding techniques that can quickly and properly assess this expanding amount of crime dataset is now a concern, as it was highlighted in. The suggested study demonstrated how quickly and accurately the learnt target function may be evaluated when predicting crime using neural networks. However, we are still looking for the greatest solution to the initial query: How can we lower crime? We now know that crime does seem to concentrate in certain areas. We have discovered that these hot patches exhibit stability over longer time scales, but far less stability over shorter time scales. We also understand that the general public is wary and that little is known about how these tactics influence particular people, their neighbourhoods, and the greater community [9]–[13].

Even though this work was written with great precision and thorough investigation, there are certain issues that might become problematic in the future. The first step is to construct the entire system correctly and completely in the near future so that it may be implemented promptly and correctly. Since these technologies cannot be used in the open world, the implementation itself is also a major problem. Before the system can be used more widely, it must first be evaluated in a small section of a metropolis and improved upon continuously (using modifications of the original model). Therefore, the difficulties serve more as a tool for refining the model and gradually producing a flawless one that can be used in the actual world. Additionally, there are certain technical challenges with the model since processing the massive amount of learning data would take days or perhaps weeks. Even though these issues need to be resolved, a team of specialists may work together to resolve them with due diligence, and if they do, the results will be worth the effort and perseverance.

The analysis of crime data is a sensitive field that can effectively forecast and classify the growing amount of crime data. As a result, the systematic tool for crime analysis will review and examine the crime prediction methodologies. How to effectively and reliably analyse the growing amounts of crime data is the primary difficulty confronting many law enforcement agencies.

3. CONCLUSION

To conclude, the development of new information systems and data mining techniques has made it possible to make predictions of the place, time, victim or perpetrator of a future crime

by analyzing past crime reports. Providing that enough relevant data has been collected before, computational algorithms can be used to find patterns and forecast crimes. Underlying theories make use of criminological findings such as the increased threat to areas already targeted once or to areas close to a victimized neighborhood. The usage of computers allows for a quicker and more effective analysis as well as the discovery of patterns otherwise not humanly detectable. In order to be effective, forecasts need to be followed by concrete measures. They can be used to plan police operations and specifically deploy forces and resources in real-time.

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