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Deep learning architectures for crime occurrence detection and prediction

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ABSTRACT

Due to the escalation in the rate of crimes, there is a requirement of the system that will detect and predict crimes at the dynamic time. The objective of this survey is to learn Data Mining techniques that will go on to help in detecting and predicting crimes using association rule mining, decision trees and naive Bayes, k-means clustering and Machine learning techniques such as deep neural network and artificial neural network. Noticeable findings from this survey were that when the dataset instances have a large number of missing values pre-processing becomes an important task and crime does not occur uniformly across urban landscapes but concentrates in specific areas. Hence, predicting crime hotspots is a very crucial task and also applying post-processing will help in decreasing the rate of crimes.

Keywords— *Predict crimes, Data mining techniques, Decision trees, Post-processing*

1. INTRODUCTION

Crime Detection is using already present data of crime scene and criminals to derive patterns. By analyzing this data on past crime, a person can predict when and where future crimes are most likely to occur. The increasing use of advanced systems to track crimes may speed up the process of detecting and predicting crimes. Crime analysis is a vital aspect in data mining field as there is a huge data presently that needs to be efficiently handled. Data mining techniques can be a proposed solution to this. Automated data collection has fostered the use of data mining for intrusion and crime detection. Indeed, banks, large corporations, insurance companies, casinos, etc. are increasingly mining data related to their customers or employees in view of detecting potential intrusion, fraud or even crime. In this survey, the analysis of techniques that can be used for detecting and predicting crime is done to minimize the rate of crime. Different techniques are learned such as Association rule mining, Naïve Bayes Algorithm, K-Means Clustering, Artificial Neural Network, Decision Tree Algorithm, and Deep Neural Network. Clustering is given a set of objects, clustering is the process of class discovery, where the objects are stacked into clusters and the classes are unknown before. Association rule mining aims to find the rules which enable us to predict the occurrence of a certain item based on the occurrences of the rest of the items in the transaction. Frequent patterns are extracted by the help of the apriori algorithm to find a relation between two crimes, criminals and the crime scene. The Naïve Bayes (NB) algorithm is a commonly used algorithm for review classification. The main pros of NB are that they are simple, easy to implement, and comprise better performing algorithms.

Criminal Profiling is an investigative tool used by law enforcement agencies to identify the likely suspects (descriptive offender profiling) and analyze patterns that may predict forthcoming offences and victims. Analyze criminal records and background. Areas of huge crime rates are often referred to as hot spots. Researchers and police use the term in many different ways. Regions in the map with excessive crime intensity are referred to as crime hotspots. Crime Hotspots can be visualized using Heat Maps or Geo-Plots.

2. LITERATURE SURVEY

Papers used to study Data Mining Techniques for crime detection are described below. The techniques are used for clustering crime-prone regions, finding patterns in locations of crime, visualising patterns through maps. Crime analysis and prediction using data mining, 2014 IEEE Conference by S.Sathyadevan and S. Gangadharan. The dataset that was used was Real-time data from blogs, social media and used MongoDB to store this data. Techniques used were naive Bayes, apriori algorithm and decision tree. The methodology is to Predict regions that have a higher probability of crime occurrence and visualize crime-prone places, criminal profiling. The method

was able to predict crime-prone regions in India for a certain day and naive Bayes gives almost 90% accuracy for their dataset. Strength Crime, visualize crime-prone places. Weakness is predicting the time when a crime is happening.

Crime data analysis with the help of data mining techniques to improve crimes prevention IJCA by D. Z. ZUBI and A. MAHMMUD. This dataset was collected manually from the Libyan police department. Data mining algorithms used are Association rule mining, k-means clustering. The Methodology is to derive crime patterns and joining them to classify crime records. The method was able to get a relation between criminal age and number of crimes is high. Clusters are made using crime type for analysis and location. Strength is Analysing crime patterns become easy due to clustering. Weakness is it cannot predict for multi-modal data or high dimensional data.

Crime pattern detection, analysis and prediction IEEE Conference 2017 by Sunil Yadav, Meet Timbadia, Ajit Yadav, Rohit Vishwakarma and Nikhilesh Yadav. This dataset was taken from online portal of India (2001-2014). Data mining algorithms used are Apriori, k-means clustering, naïve Bayes, correlation and regression. The method is to make clusters and mining frequent data, classification and finding a correlation, regression from the dataset. Detect crime for various states. The technique was able to correlate between states and rate of crime which is 0.98. Regression shows that out of 10 only 3 cases are convicted of the charges. Strength is, Crime prediction is done based on states and age group with respect to dates. Weakness is, it cannot predict crime hotspots with respect to time, and handling incomplete data is difficult.

And Machine Learning Techniques include making the same additional use of images for crime detection and prediction are as shown below. Prediction of Crime Occurrence from multimodal data using deep learning Research Article, 2017. The dataset used was American Fact-Finder 2014, weather data, Google street view images. The methods used are DNN, Pearson correlation -coefficient analysis, SoftMax classifier. The walkthrough is to predict to Crime occurrence by fusing multi-modal data, using criminal activity records in specific regions to predict the occurrence of crimes. Accuracy is 84.25 for multi-modal data fusion using DNN, and it can efficiently fuse multi-modal data with environmental context information. The paper Predicts occurrences of crime using previous criminal activity. The advantage is that it works well on high dimensional and multi-modal data. The drawback is, the DNN –Based crime occurrence and prediction cannot be applied to incomplete data.

2.1 Crime cast

A Crime Prediction and Strategy Direction Service IEEE, 2016 by Mahmud-Zinnah. The dataset is prepared, the probability of crime in location is calculated, hotspot detection is complete and using ANN crime-cast is implemented. Calculating the probability factor of every crime for location. Calculating the probability factor of every crime for each location using ANN. The system put forth a crime prediction model CRIMECAST simulating in statistical and ANN implementation. The advantage is, the ANN implementation gives us a more precise prediction than mathematical implementation. The model for crime prediction and detection could change by using either of the data mining techniques or machine learning techniques. According to the literature survey, the crime detection process works as given

2.2 Creating a Map Grid

The area that needs to be predicted is manually defined. The crime-prone areas can be graphically represented using a heat map that gives out level of activity, usually darker colours to represent lower activity and brighter colours to represent higher activity. The actual responsibility of the data visualization is to create images, diagrams, or animations to give out data summarization.

2.2.1 Data collection and pre-processing: The fields that will be useful need to be derived, those are the date when the crime was committed, type of crime, and the location of the committed crime including the coordinates as well as a criminal information.

2.2.2 Model for crime prediction: Predictive policing starts with accumulating huge amounts of data on previous crimes and co-relating them with current crimes. Analyze Data: Software searches for patterns and correlations in previous crime data. Predictive Maps: Algorithm predicts when and where a crime is likely to occur in future. Increased surveillance: Based on the possibility of the crime, redeploy resources during a specific period to prevent the crime.

2.2.3 Statistical analysis: The results given out by the neural network are to be analysed using the Sum of Squares Error (SSE) of the output values and the target values, also accuracy needs to be kept in check.

2.2.4 Visualizations of results: The output of this model is the probability of crime and non-crime occurrences. Outcomes of this predicted data are observed using heat maps or geographic plots.

2.2.5 Post processing: Escalated surveillance: Based on the possibility of the crime, redeploy or deploy more resources during a specific period.

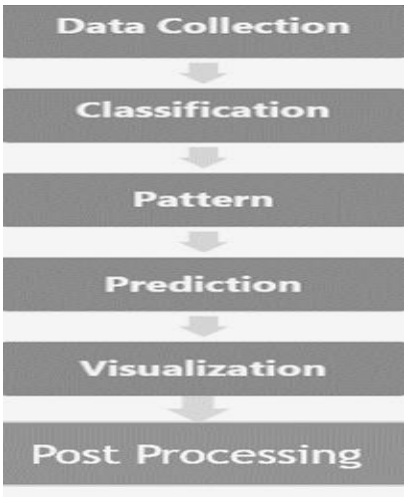

Fig. 1: Crime Prediction workflow

3. CONCLUSION

This survey reviews the literature on many methods and applications that are used to solve the crimes. Hence, for specific areas crime hotspots need to be predicted to identify which places are more prone to crimes and the type of crime. This survey shows that Crime does not necessarily occur uniformly across urban landscapes but concentrates in certain places. The data set to be processed is large so pre-processing and handling missing values becomes a vital task. For predicting forthcoming crimes from the huge amount of data the Artificial Neural Network and Deep Neural Network can be helpful for Detecting

Crime as well as Predicting Crime using previous crime datasets. When data is supervised, data mining algorithms can be preferred, and when data is multi-modal, huge and unsupervised the deep learning techniques can be employed.

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