

SURVEY ON CRIME ANALYSIS USING DEEP LEARNING AND MACHINE LEARNING MODEL

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Abstract

Deep learning is an artificial intelligence strategy which permits us to train an AI to predict output from a given dataset. AI can be used to train both supervised and unsupervised learning. Prediction is used in various fields. It has an enormous social utility like predicting crime. Various datamining methods can be used to predicting the crime. These strategies are old and not precise with different data which is time consuming as well. Artificial neural networks are a decent substitution to the old datamining methods. This paper focus a survey on different machine learning and datamining methods used in crime analysis process. Criminal information is recorded in various law enforcement agencies. It can be used for the analysis and prediction of the criminal activities in the society.

Keywords: Artificial intelligence, Data mining, Deep learning, Crime analysis, Crime prediction, Machine learning.

I INTRODUCTION

Crime is a social issue. There is a significant increment in crime rates over the last years. To conquer such situation, it is better to keep the track of the pattern of crime occur during the past years. Crime solution is the duty of law enforcement specialist. Now computerised systems are used to track and identify the criminals. Computer experts or researchers in this field help them to make their work easy and fast. Crime and its characteristics are mainly identified in criminology. It is easy to identify criminals' behaviour those who study criminology. Using deep learning techniques can be done on

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pre-existing data source to form new information that is useful for the law enforcement agencies. There are many procedures for the analysis and prediction using machine learning had been performed, but only a few efforts have made in crime field. The police station and other law enforcement agencies hold large amount of information. This data source can be used for the crime analysis and prediction. Solving crime is difficult and time-consuming process but deep learning help in solving crimes analysis much faster way. Deep learning strategy that plays out an interdisciplinary methodology between artificial intelligence and criminology. Deep learning methods can be used for creating crime reports. It helps in the distinguishing proof of criminal a lot faster than human. Thus there is a developing interest for deep learning in criminal science. Crime analysis includes the behaviour of the crimes, criminal identification etc. To develop an algorithm to cover all the crimes is not an easy task, it may vary depends on the pattern of crime. The inspiration for continuing the study is to assist the youthful analysts who are doing their work crime analysis and prediction. This can be taken as a reference to the individual who do their studies in deep learning and machine learning methodology. We can use deep learning technologies to form an artificial neural network. Here we use deep learning to train the dataset and predict the result. Here various crime analysis methods using machine learning are also discussed.

II CRIME ANALYSIS METHODS

Crime analysis is a tremendous task for the police department. There are various deep learning methods can be used for the crime analysis. The model for crime analysis and prediction may vary by utilizing either the datamining technique or machine learning technique. According to the

literature survey, the crime detection process functions as follows.

Creating a map grid is the first process which is the area to be predicted is defined manually. The crime hot area can be graphically represented by using map. The color change may use to indicate the low and high activity. Data visualization can be possible with the help of image, diagram or animation [1].

For the data collection and preprocessing necessary details has to be extracted like the date of crime, type of crime, crime spot, accused relation with the victim, age of the criminal etc. Choose a model for the crime prediction and that model can co-relate the past crime with the present crime from the huge amount of data. This algorithm predict in future where the crime is likely to happen. Necessary precaution can take to prevent the crime. The accuracy of the model will also be analyzed.

The visualization of the result is to be done with chart. The output of the crime prediction model is visualized using heat map or geographic plots.

III NEURAL NETWORK MODEL

Meskela, Afework, Ayele, Mengist and Teferi [2] proposed an approach in which they highlighted the usage of deep learning methodologies. Long Short-Term Memory Recurrent Neural Network (LSTM RNN) model used to predict the crime incidence with respect to time with high accuracy. This high accuracy prediction helps to improve crime prevention. The procedure for crime prediction using LSTM RNN is divided into four steps like data collection, data preprocessing, split (ie to divide the dataset to training set and test split) and model development. Here they used vanilla LSTM model. Their model has a single hidden layer an output layer which is used to predict. Their constructed model is able to predict one year data of crime type and

location and the output is visualized through a graph.

Souglman and Kishore propose a Machine learning and RNN model for crime prediction [3]. In their model they used RNN LSTM techniques. Their main objective is to compare the performance of machine learning and RNN for the prediction of crimes. They compared different machine learning and ANN methods. Here also they followed four steps for the analysis like data collection, preprocessing, building different models using machine learning and deep learning techniques. The model performance is measured. They used two datasets like Denver and Seattle all cities from USA. In their model they choose Python 3.67 programming language and algorithms like Random Forest and LSTM. There are different types of gates in LSTM. It is like forget gate, input gate and output gate. Result from each classifier is compared based on performance metrics, which are calculated using confusion matrices. Different performance metrics compared here are accuracy, precision, recall and f1 score. Dataset is divided 0.75 for training and 0.25 for testing in machine learning model. In deep learning model 0.5625 for training, 0.1875 for validation and 0.20 for testing. Comparing with the different model it is shown that RNN classifier is the best with accuracy of 99.7% Yong, Almeida, Melissa and Wei Ding [4] suggested a recurrent model for crime hot spot prediction. In their studies they propose a spatio temporal neural network model to predict crime hot spot. For these studies they use Portland, Oregon Police Bureau for the past five years. In this paper they used three RNN model for prediction like RNN (Recurrent Neural Network), LSTM (Long Short Term Memory) and GRU (Gated Recurrent Unit). [4] They divided the dataset into 80% for training 10% for validation and 10% for testing. They implemented their model using google tensor flow. They compared the three models using several metrics like accuracy, precision, recall and F1 score. While comparing the performance of all these model GRU and the LSTM model has equal performance. They achieve 81.5% of

accuracy. The other two algorithm perform better than RNN. Compare it with the conventional machine learning algorithm like Decision tree, Naive Bays, Random Forest and KNN and found that LSTM has higher performance than the classification algorithm.

Steven Walczak[5] described an approach based geospatiality in police decision making. It provides an immediate information on crime. For training they used two different methods like back propagation and radial basis function (RBF). In their work they used one or two hidden layers. In each hidden layers varying in the number of NN nodes. In backpropagation they used both one hidden layer and two hidden layers. Data is taken from the RMS crime incidents. Dataset is available from the city of Michigan. The primary NN model is able to predict the type of crime occurring when given only location and time. The location of the crime, type and time of the crime etc is to predict using the secondary NN model. This will help in situation when an emergency call come in or the location is unsure. NN prediction for crime type results backpropagation with two hidden layers trained MLP with 16.4% accuracy for 11 clusters. Single hidden layer back propagation trained MLP 7.9% of accuracy for 24 clusters and for RBF has 12.9. NN prediction of crime location results. Neural Network prediction for the crime location results 8.2% of accuracy for two hidden layers and 7.6 % of accuracy for single hidden layers.

Stalidis, Semertzidis and Daras[6] suggested a deep learning architecture for crime classification and prediction using deep learning architecture. They evaluate the effectiveness of the different parameters in deep learning architecture in their paper. This paper contributes mainly three Deep learning architecture. First one the special and then the temporal pattern, second one is temporal then the spatial pattern and the third one is temporal and spatial in parallel. They used a five dataset contain the details of five

main cities in Us is downloaded from Kaggle. They compared the three main model. The spatial dimension of the data is explored before the detection of the temporal structures (SFTT) in first approach. In the second approach the temporal dimension is explored before special features. We use two parallel branches in third approach one is to extract special features and another is to extract temporal features. Accuracy of this different methods are also evaluated[7]. In their studies they find that DL approaches give better performance than other classification methods. SFTT approach has the highest score in all metrics. And the TFTS approach has the second highest performance and can see that Par B approach does not perform well in this task.

IV MACHINE LEARNING MODEL

Mc Cendon and Natarajan[8] proposed a machine learning algorithm for crime analysis. They done a comparative study between different dataset. In their studies they have used different algorithm such as Linear Regression, Additive Regression and Decision stump algorithm for the analysis. Effectiveness and efficiency of the algorithm is evaluated using five different metrics. These five different matrices are like Mean absolute error, Root Mean Square, Correlation coefficient, Relative absolute error, Root relative square etc. Compared the accuracy of the different model they prove that the additive regression method has the largest accuracy and decision stump method has the least accuracy.

Shivaprasad, Sakshi, Saloni and Hafsa[9] introduced crime prediction model. Gender and age of the convict can be predicted using this model. Different factors are analyzed here such as unsolved crimes, weapons used, month which has the highest crime, crime place of occurrence and the highest crime rate state etc. Dataset is taken from Kaggle website. Multilinear regression and KNN is used here for prediction. From this paper they prove that KNN has the highest accuracy of 85%.

Alkesh and Dr.Saravanaguru[10] proposed a crime prediction and analysis model. They used Chicago crime dataset for prediction. They used different classification like KNN, Gaussian NB multinomial NB, Bernoulli NB, SVM, Decision Tree Classifier etc for the analysis and shown that KNN has the highest accuracy. It has the accuracy of 0.787 and SVM has the low precision. Various analysis like crime location,rate of crime, Date and time, No of crime ,arrested ratio etc are analyzed. After the analysis the result is plotted on a chart.Finally, they produced an interesting statistic.

Mahmud, Nuha and Sattar[11] described a crime prediction using both datamining and machine learning. They have taken Bangladesh crime data for the studies. KNN model is used for the prediction and analysis. Crime rate in different location based on the age, gender can be found out using this model. They credited that their paper has the more accurate prediction. They used different algorithms such as KNN ,Naïve base and linear and KNN has achieve more accuracy compared with the other algorithms. It has the accuracy of 76.9%

V CONCLUSION

Here we presented study about crime analysis and prediction using both machine learning and deep learning model. The current study demonstrates the importance of the effectiveness of crime prediction in timely manner. Different machine learning models are analyzed here and we can see that in most cases KNN has the highest accuracy. Deep learning model will give much precise result compared with the other machine learning models. A superior prediction can give a superior attention to individuals and this way decrease the crime percentage and keep the society safe.

REFERENCE

[1] Yadav S, Timbadian M, Yadav A, Vishwakarma R & Yadav N. (2017, April) Crime pattern detection analysis

& prediction. In Electronic Communication and Aerospace Technology (ICECA), 2017 international conference of (Vol.1 pp.225-230). IEEE.

2. Tsion Eshetu Meskela, Yidnekachew Kibru Afework, Nigus Asres Ayele, Muluken Wendwosen Teferi, Berihund Mengist. (Nov 2020) Designing Time Series Crime Prediction model using Long Short Term Memory Recurrent Neural Network. International journal of Recent Technology and Engineering (IJRTE) ISSN:2277-3878, Vol 9, Nov 2020 Blue Eyes Intelligence Engineering and Science Publication. IJRTE. D5025119420.

[3] Using Machine learning and Recurrent Neural Network for efficient crime detection and prevention (June 2019) Souglman Kabirou Kanlanfeyi, Keshav Kishore. Volume 6, (ISSN-23495162) 2019 JETIR.

[4] Crime Hot Spot Forecasting: A Recurrent Model with Spatial and temporal Information. 2017 IEEE DOI 10.1109/ICBK.2017.3

[5] Predicting Crime and Other Use Of Neural Network in Police Decision Making. (2021) Steven Walczak. Frontier in Psychology October 2021. Vol.12 Article 587943.

[6] Stalidis P, Semertzidis T, Daras P. Examining Deep Learning Architectures for Crime Classification and prediction. Forecasting 2021, 3, 741-762. <https://doi.org/10.3390/forecast3040046>

[7] Bruno Malveira Peixoto, Sandra Avila, Zanoni Dias, and Anderson Rocha. 2018. Breaking down violence: A deep-learning strategy to model and classify violence in videos. In Proceedings of International Conference on Availability, Reliability and Security, Hamburg, GER,

August 27–30 (ARES 2018), 7 pages
<https://doi.org/10.1145/3230833.3232809>

- [8] Machine Learning and Applications: An international journal (MLAIJ) Vol 2..No.1, March 2015. Lawrence McClendon and Natarajan Meghanathan Jackson. Ms, USA.
- [9] Crime Prediction using machine learning Approach. Prof.Shivaprasad More, Sakshi Mench, Saloni Kuge, Hafsa Bagwan.Vol.10, Issue 5, May 2021. Vol. 10, Issue 5, May 2021.
- [10] Crime Prediction and Analysis Using machine Learning-AlkeshBharatil, Dr.Saravanaguru. International Research Journal of Engineering and technology Vol 05, Issue 9 Sep 2018.
- [11] Crime rate prediction using machine learning and Datamining SakibMahnud, MusfifkaNuha and Abdus Sattar.JAN 2021. Soft Computing Technique and Applications. Advances in intelligent system and computing 1248. https://doi.org/10.1007/978-981-15-7394-1_5.