

# Exploration of Crime Detection Using Deep Learning



Shruti Bhalla and Rajesh Kumar Singh

**Abstract** There is the need for a device to identify and forecast crimes at a complex period because of the escalation in the occurrence of crimes. The goal of this survey is to learn different deep learning techniques to help identify and forecast crimes using Deep Learning. Noticeable findings from this survey are that pre-processing becomes an essential activity as dataset instances have a significant amount of missing values, and violence does not arise consistently through metropolitan environments but concentrates in particular locations. Predicting crime hotspots is also a very important activity, and adding post-processing would help lower crime rates. The Deep Learning algorithm was commonly used in many areas, including image recognition and natural language processing. With fine tuning, the Deep Learning algorithm produces improved predictive performance. The overall detection depends on the crime data sets which could be found from the UCI library or any standard repository. Through Deep learning algorithm on the data set, it could be analyzed that how the crime patterns are in the particular demography. So, applying deep learning in crime prevention is highly advantageous and could be further reinforced by offering more resources to intelligent systems. This will certainly help to get better findings about crime through deep learnings. This paper explores mainly genetic algorithms to find the crime detection.

**Keywords** Genetic algorithm · Deep learning · Crime detection · Crime data sets

## 1 Introduction

As deep learning is the most popular technology at present, it is used in multiple applications [1]. Crime Identification and Prevention is one such technology that is being utilized. The premise behind all of these programmes is that criminals are reasonably predictable; it just involves being able to dig through a large array of

---

S. Bhalla  
Punjab Technical University, Kapurthala, India

R. Kumar Singh (✉)  
SUS institute of computer, Tangori, India

knowledge and identify trends that are beneficial and law enforcing. A couple of decades back, this sort of data mining was practically unimaginable, but the assumption is that recent advances in machine learning are up to the challenge. In India, 99% of incidents of sexual harassment on women remain unreported and just 13% of instances of shooting have been registered to the police. Just 20 percent of gunshot incidents have been registered on 911 in a developing world like the United States. An automated device that can track the crime [2] itself and warn the police and include intelligence about the crime scene and the potential perpetrators will be very useful in these situations. Such a device will collect and monitor the photographs of the crime scene and determine and advise the police accordingly.

Pre-trained Deep Learning models are models built to help individuals think about algorithms or test out established systems for improved outcomes without complex architecture. And, the deep learning neural network has five layers, namely, Convolution, Max-Pooling and completely linked layer input and output layers, and more parts address the roles of these layers. Due to certain scarce time, memory, and tools such as CPU, too often people use processors to use pre-trained Deep Learning concepts. And opposed to machine learning that lets one code directly, these pre-trained models would have the strongest and reliable outcomes. In surveillance footage, there is a lot of human interaction required to spot arms that appear to be human-prone mistakes.

## **2 Types of Crime**

### ***2.1 Detection of Fraud***

A fraud is misdirecting or unfairly profiting from another. A fraud involves any act, exclusion, or concealment, including a breach of, or confidence in, a legal or equitable duty, causing damage to others. Cheque fraud, internet sales, insurance fraud, and credit card fraud are different types of fraud.

### ***2.2 Violent Offence***

A violent offence is a crime in which a guilty party threatens to use force on a victim. This includes, for instance, killing or rape, the two crimes of rough act called target. The following are various forms of this crime.

### **2.3 Traffic Ferocity**

High traffic levels are induced by the rising amount of vehicles in towns, meaning that traffic offences are becoming more important, which can cause major road damage and further, injuries that can threaten people's lives. Traffic violation warning systems are required to solve this issue and deter certain effects.

### **2.4 Sexual Abuse**

The chance or threat to violently strike a man is a criminal crime, giving no regard to what touch is ultimately made, insofar as the person understands the danger involved. Sexual harassment levels include:

- Simple Sexual Assault: It entails restricting an individual without unambiguous permission to engage in some form of sexual activity.
- Sexual Harassment with a Firearm: Integrates the usage or threat to an outsider with the use of a firearm or injury.
- Aggravated sexual assault: It occurs whenever, regardless of an attack, the survivor is genuinely hurt, mangled, fiercely battered, or in danger of moving on.

Verbal assault: It is a kind of non-physical, oral ambush that results in the target, instead of physical, significant damage in a passionate, social, and additionally mental pain.

### **2.5 Cyber-Abuse Abuse**

Crimes that are performed by modern media communication networks, such as net and cell, against criminal prosecutions to damage the victims. Online extorting, ATM misrepresentation, wire misrepresentation, paper exchange and theft, intrusion, and so on are various forms. Cyber-crime research is a very serious duty to a country's law enforcement agency. This involves failure in security, or damage to the resources of the PC system, such as records, website pages, or programming.

## **3 Review of Literature**

In recent years, [3] have performed numerous research on the estimation of crime events. This predictive power is built to help deter crime by encouraging the successful operation of police patrols. Data from various fields such as population, finance, and schooling were included in previous studies. Their projection models

handle data similarly from multiple domains. Such approaches have challenges in the estimation of crime events, such as trouble detecting extremely nonlinear associations, redundancies, and similarities between different datasets. This allows environmental background knowledge, such as broken windows theory and crime reduction through urban design, to develop crime prediction models. This paper suggests a feature-level data fusion approach based on a deep neural network (DNN) with environmental background in this article. The dataset is comprised of data gathered in Chicago, Illinois, from numerous online crime information sources, demographic and meteorological data, and photos. Authors pick crime-related data before producing training data by performing statistical analyses. Finally, they train their DNN, consisting of four styles of layers: geographical, temporal, environmental meaning, and layers of representation of joint features. The fusion DNN, combined with critical data derived from multiple contexts, is a result of an effective decision-making method that analyzes data consistency statistically. Experimental output findings suggest that the considered DNN model is more reliable than other prediction models in forecasting the frequency of violence.

In most visual-based monitoring software and protection devices, Target Detection is the main module. Photos and videos play a vital part in offering photographic images of an incident in crime scene investigation. It helps police officers to reconstruct a scene by identifying items relevant to a particular incident for further study. However, for law enforcement officers, the process of identifying items of concern is rather repetitive because of the availability of a vast amount of data. In this study, they present a real-time framework focused on Faster R-CNN (Region-based Convolutionary Neural Network), which automatically identifies artefacts that might be located in an indoor environment. They applied this to a subset of ImageNet comprising 12 entity groups and a Karina dataset to assess the feasibility of the proposed framework. They obtained an average precision of 74.33%, and the mean time taken to detect artefacts per image was 0.12 s [4].

It is easier to deter a crime from taking place than to discover whether or how the crime took place. Much like a vaccine is provided to an infant to avoid illness, with such an elevated crime incidence and brutal crime incidents in today's country, it has been important to provide a prevention scheme that stops crimes from arising. It relates to different strategies such as informing people, building awareness, raising efficacy, and constructive police methods and other preventive tactics through vaccinating population against crime. Driven by two separate current methods to crime prediction, the first offers a visual analytics framework that creates a proactive and analytical context for decision-makers to help them make better choices on resource distribution and implementation. The analysis of crime events relies primarily on the past background of crime and different geospatial and demographic data [1]. They may not take into consideration the rich and quickly expanding social and web networking background that affects events of interest, while it is exciting. Semantic analysis and natural language processing of Twitter posts via latent Dirichlet allocation is the next method, Subject Detection Sentiment Analysis [4, 5]. Yet, all approaches face intrinsic restrictions. Crimes that occur these days have main features

such as periodic replication of crimes, crimes that occur as a consequence of some other operation, and the incidence of crimes pre-indicated by any other results.

The fast and precise detection of criminal behavior is key to securing every home. The incorporation of crime prevention technologies aims to strengthen this protection with the exponential development of smart cities. In order to attain this purpose, a heavy emphasis has been imposed on traditional video monitoring in the past. Which also generates a video data backlog that a supervising official may control. This generates an increasingly heavy burden for supervising officials in broad metropolitan centers, contributing to a rise in the rate of error. To further reduce the workload, solutions have been introduced. At present, auto-regressive models have been used to accurately anticipate violent behavior, but they still have a number of limitations. This paper suggests a solution for processing video stream data by utilizing neural networks in conjunction with a Hybrid Deep Learning algorithm. The proposed technology would be able to detect and analyze illegal behavior efficiently, which would in turn reduce the supervising officials' workloads. It will make for an accurate and adaptable crime prevention framework as introduced via smart city technology [6].

This paper intends to expand the connexion between two images and identify the query picture in the source image by matching the features in the videos by providing a tool for identifying a specific individual or entity. Chowdhary and Rudra [7] the production would be frames matching the function object (not featuring its query) in a specified video. They define a way to use SIFT to locate special feature points in a picture or frame, i.e., the transform method of scale-invariant objects. SIFT is used to obtain distinctive feature points that are invariant to picture scaling or rotation, noise existence, picture lighting shifts, and so on. The picture is recorded for contrast with the feature points contained in the frames after the feature points are identified in a picture. For finding the appropriate query image in the picture, the feature points are compared using homography estimation scan. If the object is not present in the frame, then no output is present.

Crime acts impact our society in many detrimental respects, predicting the sites where potential incidents are most likely to arise will aid security departments across the globe greatly in avoiding such offences. This research introduces an innovative method focused on historical crime data to forecast potential crime hotspots. The sites where any crime has existed was compiled and translated into heat maps in grayscale and used to forecast potential hotspots. A deep learning methodology is used as it offers higher efficiency and quicker outcomes relative to conventional approaches, supplying police departments with real-time data to work more effectively. If adopted, the recommended proposal could be predicted to decrease crime rates in the future [8].

There is a need for the device to identify and forecast crimes at a volatile period owing to the escalation in the incidence of crimes. Noticeable outcomes from this analysis is that pre-processing becomes an essential activity as the dataset instances have a significant amount of missed values, and violence does not appear equally through metropolitan environments but concentrates in particular locations.

Predicting crime hotspots is also a very important activity, and the implementation of post-processing would therefore help reduce the incidence of crime [9].

Crime is one of our society's challenges, violence reduction needs the identification of aggression first, which involves a number of human capital, and can thus not be achieved immediately and omnipresently. It has become possible to diagnose aggression with limited human contact through the advancement of technology. In this article, the concepts and strategies for developing an automatic detection framework for aggression are discussed. The proposed device is capable of rendering the identification of aggression quick, immediate, and omnipresent. It was planned not only to detect aggression at the moment it happens, but also to forecast it for some period before, based on an individual's understanding of verbal and nonverbal signals. In addition, the machine can use numerous external data sources to get information about individuals and the environment and use it in the process of reasoning, thereby improving the accuracy of prediction [10].

Drug-related drug behavior in Taiwan is growing steadily and has a major and harmful social effect. This paper suggests a computer-driven methodology focused on the hypothesis and spatial analysis of "broken windows" to evaluate crime data utilizing software mining algorithms, and thereby forecast new crime hotspots for extra police action. In many areas, including image recognition and natural language processing, the Deep Learning algorithm has been widely implemented. They notice that the Deep Learning algorithm offers stronger predictive outcomes with fine tuning than other approaches for possible crime hotspots, including Random Forest and Naïve Bayes. In addition, by accumulating data with distinct time scales, try to increase model efficiency. This imagines possible crime hotspots on a map to test experimental findings, and examines if the models can classify real hotspots. Finally, they address the applicability of this strategy, and present potential avenues for science [11].

## 4 Study of Genetic Techniques for Crime Detection

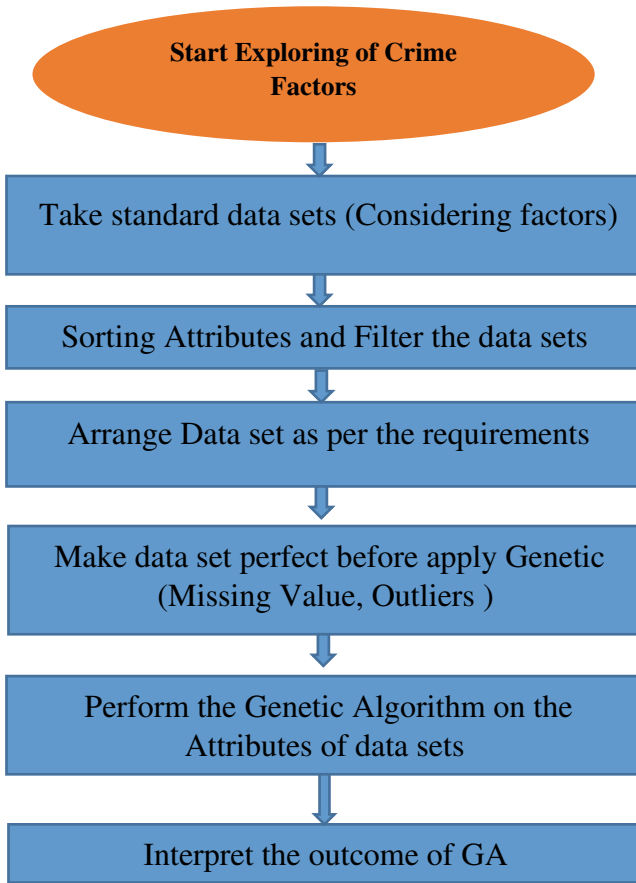
Different methods are used in fraud detection. Here, this paper explores the genetic algorithm in general, and how it works to detect the crime. This paper focuses on genetic algorithm with deep learning algorithm.

The genetic algorithm is a tool for interpreting alteration problems that are both obligatory and unconstrained. It is based on a mechanism of biological preference impersonating natural growth. At any iteration, it creates marks. An effective strategy addresses this. It is connected to the enormous class of revolutionary algorithms that build strategies that strengthen problems such as inheritance.

The following are few steps of this algorithm:

- Initial population implies the beginning of the human phase.
- Fitness feature defines the capacity of the organism to interact with others.
- The screening feature chooses the right user.

As the study of Genetic algorithm apply, the detection of crime draws the following steps.



As in the above flow chart, the procedure shows how the genetic algorithm could be applied over the datasets of crime. This is the way how the crime detection is made possible through genetic algorithms under the study of Deep learning mechanism.

## 5 Conclusion and Future Scope

There is a need for a system that can detect and anticipate crimes at an evolving moment, contributing to a rise in the rate of crime. The purpose of this study is to learn numerous deep learning techniques such as deep neural network and artificial neural network to identify and forecast crimes. The notable findings of this study show that pre-processing becomes an important task when the survey instances have

a large number of crimes that regularly occur in metropolitan areas. It is also a very valuable practice to forecast crime hotspots, and the introduction of post-processing will also help to reduce the crime incidence. This paper explores the studies on the diverse methods and strategies utilized to detect the crime. Therefore, for certain areas, crime hotspots ought to be predicted in order to assess which places are more vulnerable to crime and the type of crime. This study reveals how the techniques like deep learning algorithm play an important role to understand and detect crime.

## References

1. Wang B, Zhang D, Zhang D, Brantingham PJ, Bertozzi AL (2017) Deep learning for real time crime forecasting. [arXiv:1707.03340](https://arxiv.org/abs/1707.03340)
2. Navalgund UV, Priyadarshini K (2018) Crime intention detection system using deep learning. In: 2018 international conference on circuits and systems in digital enterprise technology (ICCSDET). IEEE, pp 1–6
3. Kang H-W, Kang H-B (2017) Prediction of crime occurrence from multi-modal data using deep learning. *PloS One* 12(4):e0176244
4. Saikia S, Fidalgo E, Alegre E, Fernández-Robles L (2017) Object detection for crime scene evidence analysis using deep learning. In: International conference on image analysis and processing. Springer, Cham, pp 14–24
5. Azeez J, Aravindhar DJ (2015) Hybrid approach to crime prediction using deep learning. In: 2015 international conference on advances in computing, communications and informatics (ICACCI). IEEE, pp 1701–1710
6. Chackravarthy S, Schmitt S, Yang L (2018) Intelligent crime anomaly detection in smart cities using deep learning. In: 2018 IEEE 4th international conference on collaboration and internet computing (CIC). IEEE, pp 399–404
7. Chowdhary A, Rudra B (2020) Video surveillance for the crime detection using features. In International conference on advanced machine learning technologies and applications. Springer, Singapore, pp 61–71
8. Nair SN, Gopi ES (2020) Deep learning techniques for crime hotspot detection. In: Optimization in machine learning and applications. Springer, Singapore, pp 13–29
9. Bhardwaj AS, Divakar KM, Ashini KA, Devishree DS, Younis SM (2019) Deep learning architectures for crime occurrence detection and prediction
10. Dorogy Y, Kolisnichenko V, Levchenko K (2018) Violent crime detection system. In: 2018 IEEE 13th international scientific and technical conference on computer sciences and information technologies (CSIT), vol. 1. IEEE, pp 352–355
11. Lin Y-L, Chen T-Y, Yu L-C (2017) Using machine learning to assist crime prevention. In: 2017 6th IIAI international congress on advanced applied informatics (IIAI-AAI). IEEE, pp 1029–1030