

A Survey on Analysis of Crime Detection Techniques Using Machine Learning

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Abstract— Finding the patterns from the huge collection of datasets is considered as one of the primary application of machine learning. Machine learning has already proved itself in transportation field and can be used in various other fields such as manufacturing, healthcare, investigation of crimes etc. Great advancement in technologies and societies has led to advancement in crimes and also the damage caused by them. It becomes even more difficult to prevent when the population in any area is concentrated and changes are rapid. That's why in many cities various crime prevention measures have been adopted as a part of smart city development. However, crimes can happen anywhere the need only is to determine the pattern of their occurrences which in turn can reduce the crime percentage. In order to provide society a better living crime investigation or analysis is considered as important application of machine learning. In this paper a survey has been done on analysis of crime and their prediction using machine learning techniques.

Keywords—Machine Learning, Crime prediction, pattern extraction, Decision tree, KNN, SVM.

I. INTRODUCTION

ML is considered a part of artificial intelligence because it is designed to extract features from any example which is a part of human computing. The idea is that instead of humans, the computer will have to perform this pre-defined task repeatedly and with fewer efforts. With the use of these machine learning algorithms the tasks that are previously impossible and complex for machines, now have been mastered on them. There is also the fact that machines can see the pattern's that humans can't. This is the reason why the interest in the field of machine learning is increasing day by day, especially in investigation of crime. An unlawful activity for which a person can get punishment by law is crime; if this act is performed against any individual then it is called personal such as robbery and murder. If anybody performs theft of someone's property then it is called property crime. The term crime analysis means prediction or analysis of crime pattern [1]. In this paper we have discussed about 4 types of crimes namely detection of frauds, violence of traffic, web related crimes and sexual offense.

Organization of the paper: The paper is arranged in such a way that a basic introduction about machine learning is discussed in section 1. Section 2 has presented about various types of crimes, techniques for crime detection has been discussed in section 3. Section 4 provides the related work and finally section 5 concludes the paper.

II. TYPES OF CRIMES

A. Detection of frauds

Frauds mean misusing the benefits of others that can cause damage to them. These includes credit card related frauds,

insurance frauds, internet, check related frauds, etc. Internet related frauds include selling any duplicate or fraud item through internet. Frauds through checks means giving check to someone when there is insufficient money in account. Fraud of insurance means taking fake claim for any property damage or any fake health claims. Taking the credit card detail of any customer without their permission for any kind of purchase is considered as credit card fraud.

B. Violent Crime

A crime where criminal threatens to utilize compel upon a casualty is known as violent crime. This includes 2 types of crime rape and murder. Murder can be further of two types killing someone directly or with the help of other people.

C. Violence of Traffic

Violence of traffic means when someone breaks the traffic law applied on vehicles while running on roads. Nowadays with the increase in traffics and vehicles the chances of traffic violation as well as accidents have increased which includes property destruction and endangering life of others. This problem can only be resolved used traffic violation detection systems.

D. Sexual assault

Criminal assault is the gamble or attempt to genuinely strike a man, offering little appreciation to whether contact is truly made, to the extent that the loss is familiar with the hazard included.

The level includes:

- Straightforward Sexual Assault: It incorporates obliging an individual to take an interest in a sexual activity without unequivocal consent.
- With use of a Weapon: It fuses the usage or risk of the use of a weapon or harm to an untouchable.
- Aggravated Sexual Assault: It happen when the setback is genuinely harmed, ravaged, furiously beaten, or in danger of passing on as a result of an assault.
- Verbal assault: It is a kind of non-physical, oral trap that results in an energetic, mental, and moreover mental harm to the setback, rather than actual significant harm way.

E. Cyber crime

Computer related crimes are said to be known as cyber crimes. Computers with networks for crime are included in it. Offenses that are executed against criminal interaction to hurt the casualties by present day media transmission frameworks, for instance, net and cell. Different sorts are web blackmail, ATM deception, wire distortion, archive sharing and burglary, hacking, etc. Digital wrongdoing examination is vital obligation of regulation authorization framework in any country. It incorporates breakdown of assurance, or mischief to the PC system properties, for instance, reports, site pages or programs.

III. TECHNIQUES FOR DETECTION OF VARIOUS CRIME

For the detection of crimes various techniques are available, some of them are discussed below. After the pre-processing described in the previous sections, we had to compare three different classification algorithms to figure out which one of them is the most accurate algorithm. With the end goal of legitimate execution and working a few Algorithms and procedures were utilized. Following are the calculations utilized in our work:

A. KNN (K-Nearest Neighbours)

One of the most powerful algorithms used in pattern recognition is KNN in which the cases are stored and based on the similarity measures new cases are classified. Steps involved in KNN are-

- Every new instance is grouped by a larger part that votes in favor of its neighbor classes.
- The object is doled out to the most widely recognized class among its K closest neighbors (estimated with distance work).

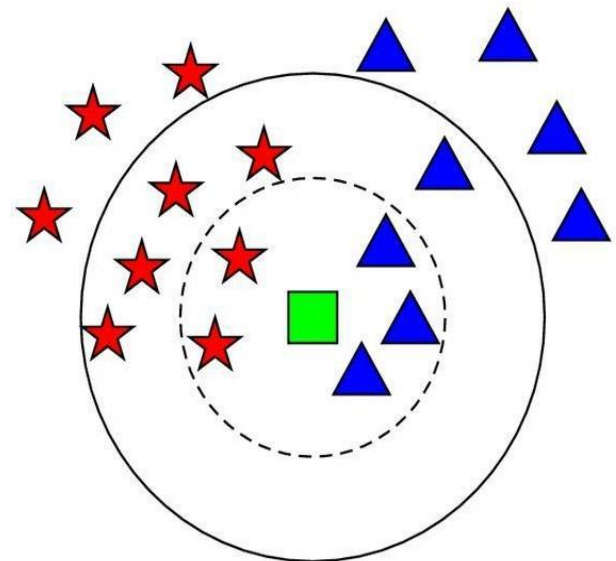


Figure 3.1 KNN 's Principal Diagram

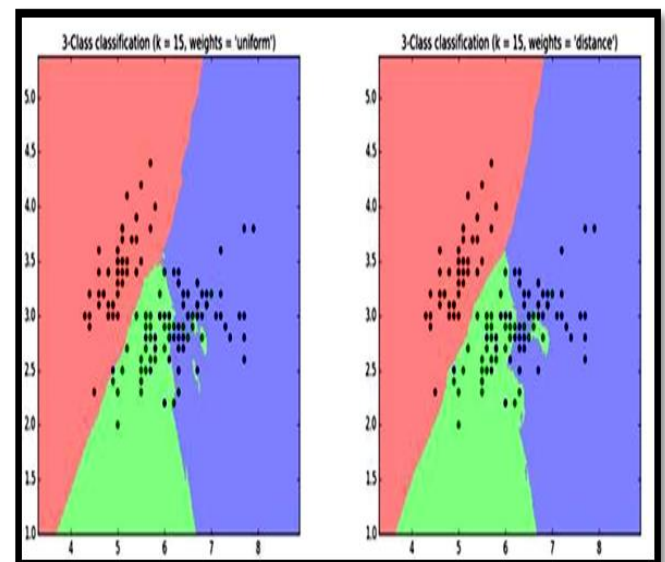


Figure 3.2 KNN graphical representation

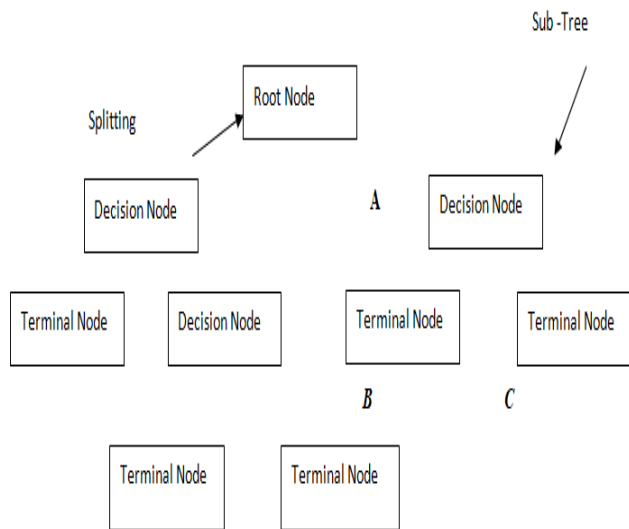
We have utilized the default distance work i.e. Euclidean Distance given in the sklearn library for which the following equivalent formula is used.

$$d(x,y) = \sqrt{\sum(x_i - y_i)^2}$$

B. Decision Tree

With the name decision tree, it is clear that it is a tree that is helping us in dynamic. Utilized in characterization and relapse is also an extremely essential and significant prescient learning calculation.

- Not the same as others since it works naturally i.e., taking choices individually.
- Non-parametric: Fast and effective.
- It comprises hubs that have parent-kid connections.



* A is the parent node of B and C

Figure 3.3 Decision Tree Example

IV. RELATED WORKS

A. Survey on fraud detection

In this paper, Syed Ahsan shabbier et al., portrayed Generic calculation for forestalling charge card fakes. It was utilized for further developing the registering cost with time by making complex frameworks. It could investigate a fake exchange in barely any second. The likelihood of distortion trades could expect not long after Mastercard trades and course of action of antagonistic to coercion frameworks could be gotten to keep banks from inconceivable incidents and limit risks [2].

In this paper, Naeimeh Laleh et al., talked about managed strategies, semi-regulated techniques, solo strategies, and constant ways to deal with identify the kind of misrepresentation and analyze the various methods [3].

In this paper, Abhinav Srivastava et al., portrayed secret Markov model. It showed the execution and sufficiency of the gadget. It additionally showed the needfulness of taking the spending profile. The precision of the framework was 80 % [4].

In this paper, Sammaes et al., proposed Bayesian and Neural organizations that give computational student which comprise of preparing set having element and information for distinguishing extortion so it can accurately group the new information as misrepresentation or not. It is presumed that both the procedure can be utilized for identifying misrepresentation [5].

Financial fraud presents more and more threat that has serious consequences in the financial sector. As a result, financial institutions are forced to continually improve their fraud detection systems. In recent years, several studies have used machine learning and data mining techniques to provide solutions to this problem. In this paper, we propose a state of art on various fraud techniques, as well as detection and prevention techniques

proposed in the literature such as classification, clustering, and regression [6].

B. Survey on crime related to violation

In this paper, Chao Yangt et al., examined with regards to unpleasant fluffy *c*-implies calculation for examination of vicious wrongdoing, harsh set and data entropy. It was consolidated to redesign the limit so it could manage the vulnerability, dubiousness, and inadequacy. This calculation was utilized for settling covering information [7].

In this paper, Chao Yang et al., proposed swarm unpleasant calculation to explore the blend parts of ruthless wrongdoing and separate three kinds of blend factors, for example Hereditary, normal and mental factors and surveyed the execution and the fluffy multitude improvement method by getting various diminishments for the blend factor datasets. It works better in a blended dataset bunch [8].

In this paper, Jorge E et al., examined with regards to open air actual activities and brutal wrongdoing among inward city youth. Various relapse investigations were performed utilizing open air actual activities. This review was performed for exhibiting associations between young people open air actual activity and for estimating brutal wrongdoing densities along other normal key factors.

C. Survey on Traffic Violence

In this paper, Sachin Kumar et al., talked about k-mode grouping and affiliation rule mining calculation which were utilized to analyze different plan or example of mishaps happened in the street. Subsequent to applying the calculation EDS was made premise of month and hour to screen the mishaps happened.

In this paper, Aaron Christian et al., proposed hereditary calculation. The framework gave identification to both infringement however distinguished turning infringement quicker than blocks the walker path infringement and cycle each information in turn yet runtime of the framework is slow yet can be gotten to the next level [9].

In this paper, Jieling jin et al., depicted with regards to total planned operations model, neural organization model and bayesian organization model and utilized for investigating the criminal traffic offense and looked at changed model. Precision of Bayesian organizations was around 70%, the aggregate calculated model was around 47%, and the neural organization model was around 51%. Bayesian organizations model better anticipated the degree of criminal traffic offenses [10].

In this paper, Sachin Kumar et al., proposed k-implies grouping and affiliation rule mining calculation It was utilized for showing the pace of clumsy regions for example high, low and moderate. Affiliation rule digging was utilized for observing the relationship between different characteristics that regularly happened together

when a mishap happens. Both the calculation could be utilized for perceiving factors related with street mishaps.

D. Survey on Sexual Assault

In this paper, Elise Clougherty et al., examined piece thickness assessment, calculated relapse and arbitrary timberland displaying was utilized to lead spatial and fleeting examination of sexual assault [11]. Kernel thickness assessment was utilized to think about the likelihood thickness elements of rapes over day by day, week after week, and month to month time-frames. They developed time series utilizing strategic relapse, and irregular timberland models to evaluate relationship between's point-areas of sex violations, weather patterns. These outcomes show that rape is bound to happen close to the homes of enrolled sex wrongdoers.

E. Survey on Cyber Crime

In this paper, Anshu sharma, et al., proposed k means bunching calculation which was utilized for building examples of information [12]. Information were gathered and disseminated, two third of genuine information and distortion history data were used for getting ready and remaining data were used for estimate and web wrongdoing revelation. The accuracy of the proposed work was 94.75 % and it beneficially perceived the bogus pace of 5.28%.

In this paper, K. K. Sindhu et al., clarified logical examination adventures in the limit media and secret information examination in the record system, network criminological and digital wrongdoing mining. Gadget was proposed by joining computerized scientific examination and mining of wrongdoing information planned for finding thought process and example of assaults and hecks of attacks sorts happened in that time span.

In this paper, K. Chitra lekha, et al., examined with regards to k-implies calculation, affected affiliation classifier and j48 expectation tree for identifying web wrongdoing informational collections and for tackling the issue. It likewise perceives designs in wrongdoing for anticipating taking an interest crime so it very well may be controlled. They fostered a wrongdoing apparatus for perceiving point of wrongdoing immediately and to recognize future cybercrime design.

In this research work the author has determinate cybercrime attacks detection and prediction model of determine the cyber attacks using data mining and machine learning techniques. For implementation of this proposed work WEKA simulation tool has been used for execute data mining algorithms and Jupiter anaconda navigator simulate tool for machine learning algorithms for determinate accuracy of data mining and design production model using machine learning algorithms [13].

F. Other surveys

Crimes are the social disturbance that is happening all over the India thusly, it is essential to concentrate on the

components that sway the crime percentage. The motivation behind this review is to examine the connection between different components and the crime percentage in India. The review centers around the degree of impacts of different components on Crimes enlisted under IPC in every Indian state and significant association region. Crime analysts break down the information with different levels of accomplishment. However, with the expanding crime percentage, human abilities will in general bomb when they are given an immense volume of informational collections. Use of information examination methods can be utilized to work with the undertaking that can remove the concealed information from the gigantic informational collections and give the Crimes examination office another edge for Crimes investigation.

Gathering Crimes data from government entrances utilizes information examination procedures that can help with anticipating or keeping away from future Crimes patterns. Records of past crimes that are taken through government bodies establish the Crimes type, time, area, data about the people in question, their sexes, ages, economic wellbeing, and some more. Accordingly, predicting the happening of Crimes events involves the investigation of all the previous Crimes records and ordering of all the Crimes classes. Various data mining techniques are available that can be used in the investigation of the Crimes things happen in various nations and urban communities.

Examination of Crimes has been performed by planning, and similitudes have been found with the past Crimes pattern when contrasted with the present situation. This assignment was a way to deal with deciding where the greatest quantities of Crimes occurrences happen. The use of information investigation methods is critical for Crime's location and counteraction errands.

A relative report was directed for various Crimes designs which displayed preferred outcomes for straight relapse over other arrangement techniques. The design was carried out that gathers the crude information and classifies the information into Crimes types, areas, and spots. Then, at that point, existing grouping calculations were utilized, and the best method was picked bringing about a Crimes forecast. The current work exhibits Crimes expectations for 28 states (Andhra Pradesh comprehensive of Telangana) and 7 association domains of India. It has considered the assortment of Crimes records from 2001–2014 containing data about various kinds of Crimes like adolescent offense, murder, and so on.

Different scientists have resolved the issues in regards to Crimes control and have proposed distinctive Crimes forecast calculations. The exactness of expectation relies upon the characteristics chosen and the dataset utilized as a source of perspective.

In this paper, behavioral data of humans that are driven using mobiles are combined along with the original crime dataset. This technique is used in London and UK for the

prediction of crime [14]. In this paper, a correlation is performed using a well-known open-source software i.e. WEKA Tool between Decision Tree and Naïve Bayesian [15].

In this paper, various patterns of road accidents that happened in Ethiopia are considered along with several circumstances such as weather, condition of the road, driver, etc [16]. The author has compared the three most popular classifiers such as KNN, Naïve Bayesian, and Decision tree applied it on 18,300 accidental datasets and proved that they have an average accuracy of 80% on a given dataset.

One of the greatest challenges nowadays is to predict crime more accurately when the size of the crime dataset is large. To find the hidden pattern in a large dataset, data mining techniques are used. In this paper, a framework for data mining has been proposed. Crime prediction mainly focuses on finding the hotspot area of crime which means an area where most of the crime happens [17].

In this paper, the author has compared and analyzed KDE and RTM models for generating maps of hotspots and utilizing sparse data for creating area-specific prediction models [18]. In this paper, for predicting crime hotspots a model utilizing histogram-based techniques has been proposed [19]. In this paper, to predict crime hotspot areas in Bangladesh, a crime incidence scan method has been applied for training ANN (artificial neural network) [20]. In this paper, crimes related to drugs and their hotspot areas are predicted in Taiwan using data-driven machine learning techniques [21].

In this paper, a machine learning model has been proposed for the prediction of different categories in crimes in Canada using a reverse geo-coding technique and a clustering method [22]. In this paper, for predicting crimes in Chicago a deep neural network-based model has been used, which is trained by spatial, temporal, environmental, and joint features [23]. A few prediction strategies were evaluated in [24], and a KDD technique that combines the statistical modeling, machine learning, database storage, and AI technologies, were suggested as an effective tool for crime prediction.

In this paper, a framework that can capture both temporal as well as the spatial pattern for utilizing the meteorological, human mobility data, etc [25]. In this paper, a completely probabilistic calculation dependent on Bayesian methodology was applied in the state of New South Wales (NSW), Australia to display the reliance between the offense information and natural factors like the segment qualities and the spatial area [26]. In this paper, the WEKA tool was utilized to perform a study for estimating the exactness and adequacy of linear regression, additive regression, and decision stump algorithms for foreseeing the crimes in the Mississippi [27]. In this paper, a survey on various data mining approaches performed on crime data has been done and also introduced about ANN,

decision tree, rule induction, nearest-neighbor method, and genetic algorithms [28].

In this paper, a model for determining crime patterns in an urban area based on a regressive model has been proposed [29]. In this paper, a random-walk-based approach has been used to model offenders' activities in the Metro Vancouver area, the author also proposes a probabilistic model of spatial behavior for known offenders [30]. In this paper, random forest algorithm has been used for predicting crimes in Brazil and quantifying the role of urban indicators [31].

In this paper, to develop the predictive solutions for large city Dempster-Shafer hypothesis of proof also the strategy of multi-bit has been used [32]. In this paper, for the prediction of crime in the city of San Francisco 3 algorithms namely KNN, Parzen windows, and Neural Networks are generated and bought together for analysis [33].

In this paper, Gradient Boosting Machine (GBM) method was applied to detect the undetected link of the criminal network in an ML model. In this work, VPD criminal data is analyzed using KNN and boosted decision tree classification algorithm [34].

V. CONCLUSION

Nowadays, crimes are considered to be the biggest thread affecting the advancement of an individual in terms of both money as well as fulfillment. To avoid crimes, it is important to analyze which spot people should not travel to; this is considered as one of the important factors. Great advancement in technologies and societies has led to advancement in crimes and also the damage caused by them. It becomes even more difficult to prevent when the population in any area is concentrated and changes are rapid. That's why in many cities various crime prevention measures have been adopted as a part of smart city development. However, crimes can happen anywhere the need only is to determine the pattern of their occurrences which in turn can reduce the crime percentage. In order to provide society a better living crime investigation or analysis is considered as important application of machine learning In this paper a survey has been done on analysis of crime and their prediction using machine learning techniques.

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