iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** VI **Month of publication:** June 2022

DOI: https://doi.org/10.22214/ijraset.2022.44468

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue VI June 2022- Available at www.ijraset.com

Credit Card Fraud Detection Using Hybrid Approach of Machine Learning

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Abstract: ***The usage of internet banking and credit cards is growing at an exponential rate. As more people use credit cards, online banking, and debit cards, the probability of becoming a victim of fraud of various kinds also increases. In recent times, there have been a number of instances in which users of credit card companies have, as a result of a lack of understanding, given their card information, personal information, and one-time password to an unidentified fraudulent caller. As a direct consequence of this, fraudulent activity will occur on the account. Fraud is a problem for the same reason that it is tough to track down a con artist who used a phone identity sim or made the call that utilized an internet provider: it is difficult to find them. Therefore, in order to detect fraudulent activity, this research makes use of supervised methodologies and algorithms, and the results are quite accurate. Customers lose trust in an organization when it engages in activities that are fraudulent or illegal, which in turn has a huge negative impact on the organization. Additionally, it has an effect on the total income and turnover of the company. The isolation forest technique is used in this study to classify data sets acquired from professional survey firms in order to detect fraud activities.***

Keywords: Machine Learning, Artificial Intelligence, Hybrid Approach, Decision Tree, Deep Learning, Random Forest.

I. INTRODUCTION

Since the beginning of the digital process, there were always individuals who are looking for new methods to get unauthorised access to the financial information of another person. Due to the fact that all purchases can now be readily performed online by just inputting the credit card details, this has developed into a significant concern in the current day. And in the 2010s, a significant number of customers of American retail websites fell victim to fraudulent online transactions just before to the implementation of two-step verification for online purchasing. Whenever a data breach results in the theft of monetary assets and, eventually, the loss of customers' trust including the company's image, several parties, such as consumers, organizations, banks, and merchants, are placed in risk. Keeping an eye out for fraudulent behavior in the credit card system may be a difficult and time-consuming task for financial institutions. Technology that is capable of learning is a very crucial component in the process of determining whether or not credit card transactions include fraudulent behavior. Different techniques to machine learning have been used, historical data has also been accumulated, and new features have been introduced to increase the accuracy of predictions in order for banks to be able to anticipate these types of transactions. When it comes to detecting fraudulent activity in credit card transactions, the effectiveness of the anti-fraud measures can be significantly influenced by a number of factors, including the sampling strategy that was applied to the data set, the variables that were selected, and the detection methods that were put into action. Theft and fraudulent activity done using or utilizing a credit card at the moment of payment are both examples of credit card fraud. Credit card fraud is a phrase that covers a wide range of activities. It is possible that the goal is to make illegal purchases of items or to move money out of an account without permission. Identity theft often includes the additional crime of credit card fraud. According to the data provided by the Federal Trade Commission of the United States, the incidence of identity theft remained relatively unchanged during the middle of the 2000s, but it rose by 21 percent in the year 2008. Despite the fact that reports of credit card fraud, the kind of identity theft most people think of when they hear the term, dropped as a proportion of overall ID theft complaints. Around 10 million, or nearly one in every 1300 transactions, were found to be fraudulent in the year 2000, out of a total of 13 billion transactions that were conducted yearly. In addition, fraudulent activity was found in 0.05 percent (5 out of every 10,000) of all active monthly accounts. Even if fraud detection methods are developed today to control one-twelfth of one percent of all transactions performed, the amount of money lost still amounts to billions of dollars. Fraud committed via credit cards is now one of the most significant challenges faced by companies. However, in order to successfully battle the fraud, it is necessary to first have a solid understanding of the processes that go into carrying out a scam. Criminals that perpetrate fraud with credit cards resort to a wide variety of deceptive tactics. Simply, Credit Card Fraud is described as “when an individual uses another individuals’ credit card for personal reasons while the owner of the card and the card issuer are not aware of the fact that the card is being used”. Card fraud may begin with the theft of the actual card itself or with the critical data linked with the account.

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This might include the card account number or other information that must necessarily be accessible to a merchant during an authorised transaction. Card numbers, most often the Primary Account Number (PAN), are frequently reproduced on the card itself, and a magnetic stripe on the back of the card carries the data in a format that is readable by machines.

In 2017, a staggering total of 16.7 million people were victims of unauthorised card activities. In addition, the number of claims of credit card fraud in 2017 was forty percent greater than the number of claims in the previous year, as reported by the Federal Trade Commission (FTC). Around 13,000 incidents were recorded in California, which is the state with the highest rate of violent crime overall, followed by Florida, which has the highest rate of violent crime per capita. By the year 2020, the total amount of money at risk is expected to be in excess of about $30 billion. Here are some facts on the fraudulent use of credit cards:



Credit Card Fraud Detection with Machine Learning is an approach that takes the data investigation by a team of Data Scientists as well as model development, which will give the best outcomes in preventing revealing and fraudulent transactions. This process can be thought of as a hybrid between traditional data analysis and artificial intelligence. This is accomplished by combining all of the important aspects of the transactions made by card users, such as Client Behavioral Patterns, Provider, Amount, Product Category, User Zone, Date, and so on. After that, the information is sent into a model which has been gently programmed to look for rules and patterns because it can determine whether or not a transaction is fake.

Clone transactions have been used to make transactions that are close to the original one or to replicate a transaction. This may occur when an organisation sends the identical invoice to various departments within a partner company in an attempt for getting payment from that partner on many occasions.

The traditional rule-based fraud detection algorithm is not very effective at differentiating fraudulent transactions from irregular or accidental ones. For instance, a consumer can purchase the same thing twice by accident or press the submit button twice by mistake.

When a system is able to differentiate between a transaction that was done in mistake and one that was fraudulent, then that is the best choice. In this context, the adoption of Machine Learning techniques would be more effective in distinguishing clone transactions produced by human mistake from actual fraudulent activity.

A breach in a website's security or carelessness on the part of the card owner are the two most common causes of fraudulent usage of credit cards online. Here are several examples:

- A customer gives his credit card number to people he doesn't know.
- Someone else uses a card that was stolen or lost.
- Criminals steal mail that is meant for someone else and use it for their own purposes.
- Employees of a business copy the owner's cards or card numbers.
- Creating a fake credit card.

One of the most significant threats now confronting businesses and the institutions that support them is fraudulent use of credit cards. Just, Master card Misrepresentation is characterized as, "when an individual uses another individuals‟ Visa for individual utilize while the proprietor of the card and also the card backer don't know about the thing that the card is being utilized." various frameworks/models, process and preventive measures will stop Master card extortion and lessen monetary dangers. Banks and Visa organizations have accumulated a lot of Master card account exchanges. The Charge card is a plastic card issued to number of clients as one of the method of instalment. It enables cardholders to buying merchandise and enterprises in light of the cardholder's guarantee.

In China, the number of people who hold Visa cards is rapidly increasing, but the number of people who hold Master cards is still relatively low. Only a small percentage of Master card holders use charge cards to pay for day-to-day purchases with confidence and the assumption that everything is in order. Reason is, Visa holder has no enough certainty to trust upon the instalment framework. Secure credit administrations of banks and improvement of E-business a solid extortion identification framework is basic to help safe Visa use, Misrepresentation location in light of breaking down existing buy information of cardholder (current spending conduct) is a promising path for decreasing the rate of Visa cheats. As there is constrained measure of information with the exchanges being trusted, for instance, exchange sum, shipper classification code (MCC), acquirer number and date and time, address of the trader. Different procedures in Learning Disclosure, for example, choice tree, neural system and case based thinking have extensively been utilized for framing a few misrepresentation location frameworks/models. These methods more often than not require sufficient number of typical exchanges and misrepresentation exchanges for learning extortion designs. Be that as it may, the proportion of false exchanges to its typical exchanges is low greatly, for an individual bank.

1.2 Several Varieties of Unauthorized Use of Credit Cards When con artists get beyond the extortion avoidance frameworks and start engaging in fraudulent trades, that's when the need for frameworks to uncover misrepresentations arises. Misrepresentation is expanding all over the globe, and as a result, huge amounts of money are being lost due to it. This is happening concurrently with advances in data technology and improvements in communication methods. Anderson (2007) has identified and shown the many types of extortion. Cheating with credit cards may be carried out in a broad variety of ways, such as via simple phone cards, burglary, Never Got Issue (NRI) schemes, electronic or online extortion application fraud. Recognizing fraudulent activity on a Mastercard is a very challenging task, but it is also a common problem that requires resolution.

1.3.1 Card not present transaction (CNP)

Cardholders, or someone claiming to be them, must provide the shipper with their card information by mail, phone or the Internet in the case that the card isn't physically available at time of purchase.

1.3.2 Identify Theft

Identity theft may be classified into two types:

Application fraud: It is possible to commit application fraud by opening a record in someone else's name by using stolen or counterfeit records. Criminals may use documents such as utility bills and bank statements to compile personal information.

Account takeover: Theft occurs when a criminal assumes the persona of a knowledgeable consumer, seizes control of the account, and proceeds to conduct unauthorised activities.

1.3.3 Skimming

Personality criminals use an electronic approach to track down the close-to-home data of a victim. The skimmer is a small device that reads the magnetic stripe on a Visa card and saves the information on it. Skimming may happen during a normal trade at a company.

Growing concerns about fraudulent activities in the financial sector have far-reaching implications for the government, business organisations, and finance industry. The significant reliance that the modern world has on internet technology has led to a rise in the number of successful credit card transactions; yet, credit card fraud has also surged alongside both online and offline transactions. The use of credit cards as a form of payment is becoming more common, and as a result, contemporary computational methods have received a lot of attention as a potential solution to the issue of credit card fraud. There is a wide variety of software and solutions for detecting fraud that may prevent fraud in sectors and enterprises such as credit card processing, retail, online commerce, insurance, and manufacturing. The process of data mining is one of the most noteworthy and well-known strategies utilised in the identification of credit fraud problems. It is not possible to know with absolute certainty the person's genuine motive or whether or not a transaction was conducted lawfully. The most efficient course of action would be to use mathematical algorithms to go through the available data for any conceivable indication of fraud. Credit card fraud detection is a technique of identifying these transactions which are fraud into two classes: legit and fraud class transactions. Numerous methods are developed and constructed to solve to credit card fraud detection, such as machine learning algorithms, frequent item set mining, artificial neural network, genetic algorithm, migrating birds optimization algorithm, can also done comparative analysis of random forest, XGBoost, AdaBoost, and so on. The identification of fraudulent activity on credit cards is a subject that is not only quite common but also very challenging. In the first place, the fact that credit cards only save a certain amount of information makes it difficult to find a pattern that matches a dataset. Second, there may be numerous items in the dataset that include fraudulent transactions, but these transactions follow the pattern of lawful conduct. Furthermore, there are a lot of limitations to the situation. In the first place, sensitive data sets are not widely available for the public, and the findings of investigations are often concealed and filtered, which makes the results inaccessible. As a consequence of this, it might be difficult to benchmark specific models. Second, the security

issue puts a constraint on the sharing of ideas and techniques in the field of fraud detection, and more specifically in the field of credit card fraud detection. This makes it more difficult to enhance existing approaches because of the limitation. In conclusion, the data sets are always developing and shifting, which results in the profiles of fraudulent and normal actions being distinct from one another. For example, a legitimate transaction in the present may have been fraudulent in the past, or vice versa. In this study, four sophisticated data mining techniques—namely, random forests, logistic regression, support vector machines, and decision trees, are analysed, and then their performance is compared to one another in order to determine which model is the most accurate. The databases that include information on credit card transactions are scarce, extremely unbalanced, and distorted. The most critical component of data mining is selecting the right features (variables) for the models and the right metrics to assess the effectiveness of approaches on skewed credit card fraud datasets. Credit card fraud detection effectiveness is strongly impacted by the kind of sampling technique employed, and the dynamic nature of the fraudulent behaviour profile makes it difficult to distinguish between genuine and fraudulent transactions. In the conclusion of this study, the findings of classifier evaluative testing are summarised and compiled. Random Forest Classifier has an accuracy of 85%, AdaBoost has an accuracy of 83%, and LightGBM has an accuracy of 93%, but the greatest results were produced by XGBoost, which had an accuracy of 97%. For credit card fraud detection, this means XGBoost Classifier is the best at solving the issue with 97% accuracy, according to the findings of this study.

II. LITERATURE REVIEW

A variety of strategies and algorithms have previously been devised to aid in the detection of such scams. Using machine learning is also a part of this investigation. To conduct research on the data, trained ANN algorithms are used to obtain datasets from various overseas survey organizations. Algorithms like SVM and decision trees are used to detect and prevent fraudulent activity.

Misuse identification and information discovery are the two principle access utilized for credit card misrepresentation location. The accentuation on abuse location access is more often than not after applying order strategies the exchange level. In the work of [16], common validation among client and trader is the most imperative element of the present system. All extra security frameworks are commonly found on cardholder confirmation yet overlook the trader check which makes the exchange framework defenseless against vendor related and Internet-related cheats, for example, website cloning, dealer conspiracy, triangulation and so on. In the work of [17], the casual issue of credit card extortion identification utilizing abnormality recognition strategies has been presented, by misusing the grouping of exchanges in building cardholders bio-data's. Their work explored how this influences recognition execution. The attention is on extortion cases which can be identified at the exchange matched.

In the work of [18], a viable meta-classifier display that works on two preparing levels is presented. Flash-based usage has been utilized to deal with the idea of the space. Investigations were led with credit card information and examinations had been achieved with Fraud Prospector and more advantageous Fraud Prospector. In any case, the created model displays moderate dimensions of data, which are adjusting parts, particularly for inequality information. In the work of [19], own introduced investigation on the execution of customized models in foreseeing misrepresentation of credit card exchange when contrasted with amassed models. The examinations were performed utilizing genuine MasterCard exchange from three people and furthermore, the exchanges were gathered via an online poll. Their test results demonstrate that the precision of the customized replica is commonly more terrible than the amassed replicas. In the work of [20], the random forest algorithm is used for classification. In the work of [21] centers around different grouping systems (AI based) utilized in information extracting and an examination on every one of them. Since characterization takes the most pervasive area among information mining errands, an examination of three methods is utilized in Visa extortion discovery system and is exhibited. Every one of these techniques has its very own benefits and negative marks relying upon the application.

III. PRESENT WORK

A. *Objective*

1) To study the various credit card fraud detection techniques for recognizing their advantages as well as shortcomings.
2) To design an improved credit card fraud detection scheme utilizing the machine learning classification.
3) To compare the results of the proposed research problem with the existing techniques of credit card fraud detection.

B. *Proposed Work*

In this paper, we are going to use various algorithms like Decision Tree, Random Forest and Hybrid Approach to detect fraudulent uses in credit cards.

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1) *Historical Data:* The most important step in solving machine learning problem is gathering historical data. In the research problem, historical data in the form of images has been input that explain the quantity and quality of data. Our model's accuracy is determined on the amount and quality of data we have.
2) *Data Formatting:* This phase is needed to eliminate noise from the input data. Before sending the data to train the algorithm, we eliminate noise. Organizing data that may be required (data type conversions, normalization, deal with missing values, correct errors; remove duplicates, and so on.).
3) *Define Parameters:* After removing the noise from the images, we must divide the data into independent and dependent variables in order to train the model by passing the input data as independent variables and specifying the parameters.
4) *Training Process and Trained Model:* We used 20% data set for testing and observed the result with some stander assumptions that we have considered and predict the model working where we had trained 80 percent dataset after training give to 80 percent data from sample dataset we are using 20 percent data set for testing and observed the result with some stander assumptions that we have considered and predict the model working.
5) *Forecasting Process:* We performed the prediction using CNN, NB, and the proposed model on a brain image dataset of approximately 400 samples. We will find the accurate efficiency of the model by combining dataset value with time span. In comparison to the Proposed Approach, CNN& NB model gives varying productivity. The proposed AI work is straightforward and effective.
6) *Image Transformation:* Generally speaking, the image transfer is carried out where the redundant data is first disposed and then the converted images recover characteristics. This move helps to collect essential features that can be taken together to achieve feature extraction.
7) *Extract Functions Functionality:* Discrete wavelet transformation (DWT) is used, typically, to change the signal to the binding band at both the low and high frequency. The curve let transform, a lower dimensional DWT, describes the numbers at different angles and parameters. In addition, the higher order spectra (HOS) characteristics are used for output representation and extraction purposes. In the output data, the carded data must represent the hints from the input.
8) *A Strategy:* In the methods of processing frame, extreme normalisation, adaptive equalization, and subtraction to the context are done prior to the stage level setup for the area of interest. For the images, the gray co-occurrence matrix functions are most widely used. The characteristics of energy and entropy are also included in several papers. At the same time we are still utilizing the wavelet-based functionality and entropy characteristics. Diverse predictive measurements were used as features both in signal and mechanisms for creating neurological condition CAD systems; such as the moments of Hus, the moments of Zernike, key moments, and statistical moments.
9) *Reduction of Dimensionality:* Techniques in function extraction also provide huge quantities of properties that may be redundant, leading to unrealistic computational specifications, which would in effect make their implementation in real-time inefficient or not to be necessary complex. Therefore, there are widely used different methods to minimize dimensionality of features. Linear discriminant analysis, PCA, and SCA (separate component analysis) are the most often utilised methods. Few added variants of PCA such as kernel PCA may be also included in this documentation.
10) *Grouping of Function:* Techniques usually have two stages of classification techniques: I preparation, and (ii) checking. We need to be told using knowledge gathered already. When categorized and experienced it can be used for classification of new instances. Probabilistic neural network classifying devices (protest NTD) the Support Vector Machines (SVM), including variations in kernel functions such as order polynomial (Poly) functionality, order1, 2 and3, naive Bayes function, neon distinct linear discrimination combination, decision tree forest model, and Gaussian mixers, is the most widely used diagnostic categorized neural disorder system classifiers. One of these, SVM Classifier is the most common ones.

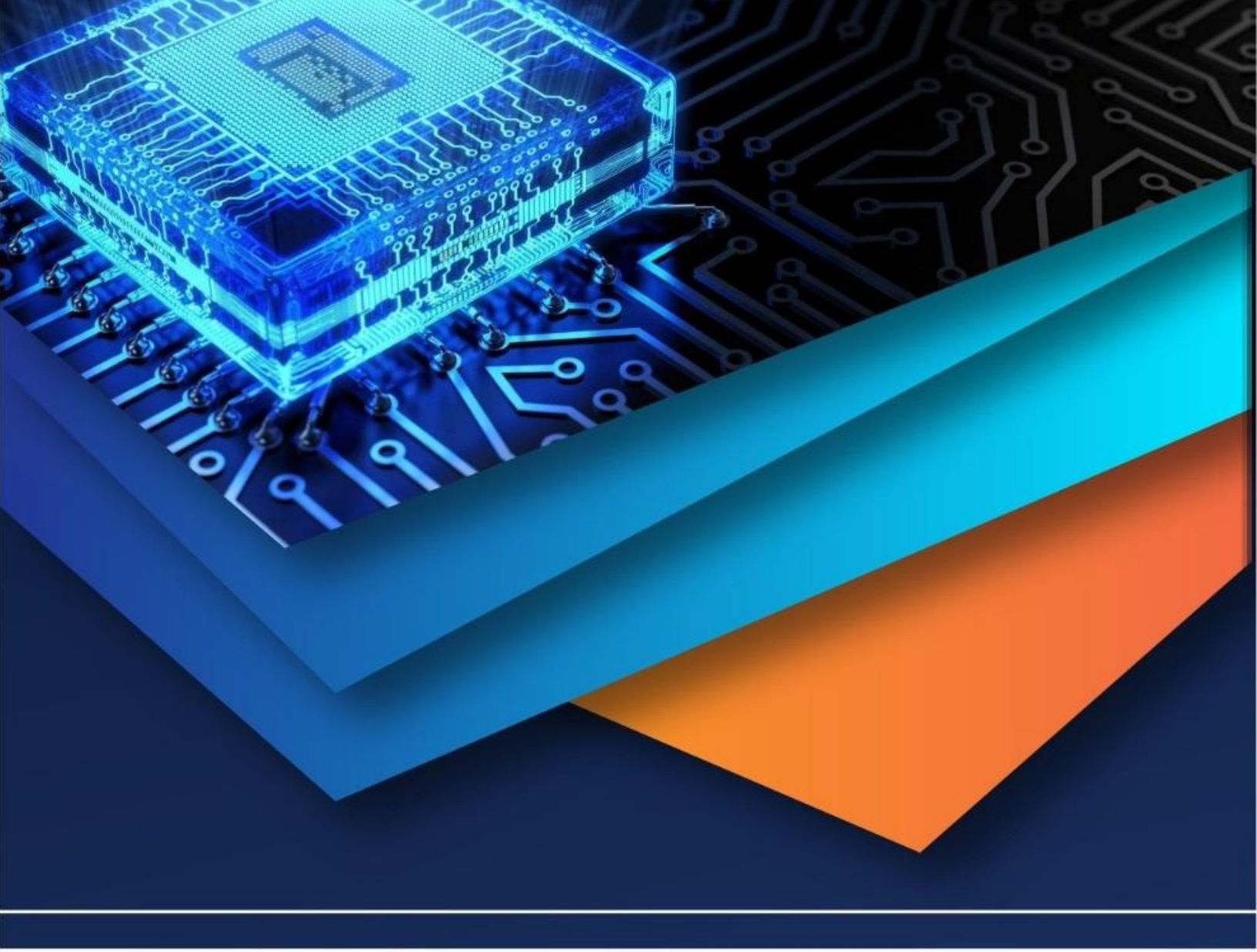
IV. CONCLUSION

The statistical models for credit card fraud detection have grown in popularity during the last decade. Such models are utilized in order to improve the pattern recognition process, that, in comparison to other methods, requires much less time and is capable of managing a significant number of transactions on a daily basis. Hybrid approaches, RF (Random Forests), DF (Decision trees), and other statistical models based on binary classification may increase the accuracy of credit card fraudulent pattern identification. Fraudulent transactions may be categorized as outliers or anomalies, which must be identified appropriately in order to reduce the bank's losses from these transactions. The precision, F1-measure, recall, along with accuracy-based characteristics will be used to assess the suggested model's performance. For the credit card fraud detection system, we are employing supervised learning methods to increase the accuracy. There has been an increase in the number of fraudulent transactions because as world has become more digital. Using a credit card fraudulently is clearly a crime. Recent results in this sector were examined as well as some of the most typical types of fraud that may be perpetrated.

Machine learning may be used to fraud detection in a detailed manner in this work, complete with the algorithm and pseudocode, description of implementation, and results of experiments. Even so, the system is able to achieve a 99.9% accuracy rate. Only 33 % accuracy can be achieved when all of this data is sent in. With such a large disparity between the number of authorized transactions and the number of real ones, it's not surprising that this high accuracy rate is present. As the classes in V28 and V13 are much identical, it could be difficult to find any important information that differentiates fraudulent and legitimate transactions from each other. Instead, variables such as V14 and V17 presents immense differences, which most likely are the reason why they are leading in all analysis. For evaluation purpose, it would be convenient to gather as much information as possible from these feature variables (or similar variables), since they seem to show an important role in credit card fraud detection utilizing machine learning algorithms on this chosen dataset.

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