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An Analysis of Financial Fraud Detection Methods Using Artificial Intelligence

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Abstract -

Financial fraud is a significant concern in the financial industry, and it has been observed to be dynamic with no discernible trends. There are many fraudulent activities that occur on a daily basis, such as Identity Theft, fraudulent identity impersonation schemes (phishing assaults), and debit and credit card fraud and Debit card frauds, foreclosure and loan scams, fraudulent activities involving fraudulent checks, online fraud, ransomware, and

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malware frauds. These fraudulent practices can result in considerable financial losses, reputational damage, and a loss of client confidence. Fraudsters take advantage of current technological breakthroughs. One method of tracing fraudulent transactions is to analyse and spot anomalous activity using data mining tools. As technology progresses, Artificial-Intelligence (AI) has emerged as a viable solution for detecting and preventing financial fraud. The author investigates the various steps that may be performed to avoid financial fraud using Artificial-Intelligence in this research study. The author highlights many such uses of machine learning, Deep-learning, as well as Natural-Language-Processing are examples of Artificial-Intelligence techniques that may be used to avoid financial fraud. The author then concludes that NLP is the best AI for fraud detection.

Keywords – Fraud Detection, Artificial-Intelligence, Machine-Learning, Deep-Learning, Natural-Language- Processing.

INTRODUCTION

In the modern world, there is an enormous amount of fear of financial fraud. Financial fraud is defined in a variety of ways. One claim is that financial fraud is the use of financial product regulation loopholes to obtain illegal benefits. Financial fraud can also be defined as any unlawful act committed in the financial sector with the intent of advancing one's own interests at the expense of other people or organizations. Financial fraud is a serious problem for organizations, and it can occur in various forms, for example identity theft, credit card fraud, and money laundering. According to the findings of the www.security.org survey, 65 percent of those who own credit cards or debit cards have been the target of credit card theft at least once. The reason for this equates to around 151 million U.S. people, a significant rise from their findings from the previous year, which revealed that almost 58 percent of cardholders have been victimized by fraudulent activity. This research paper will primarily focus on credit card fraud transactions, as these frauds occur more often than any other fraudulent transaction activities. Credit card frauds are of various types:

1. **No Card Present:** This type of credit card doesn't require the use of a physical card while making a purchase.

2. **Manual or electronic imprints of card:** This sort of fraud includes the offender skimming data from the magnetic strip of a credit card and applying that information to conduct fraudulent transactions.
3. **Card lost/stolen/misplaced:** This sort of fraud occurs when the cardholder either misplaces or has their card stolen.
4. **Counterfeit card fraud: This type of fraud occurs when the offender copies all of the information on the strip of magnetic tape so that the genuine card appears and functions identically to the original card.**
5. **Application fraud:** It occurs when a fraudulent user takes over the software programme, obtains someone's login credentials, develops a false account, and then executes transactions.

The primary goal of almost any technique for detecting credit card fraud is to locate anomalous behaviour and alert it to an investigator while allowing regular money transfers to be handled autonomously. By using a fraud detection system, we can determine whether the forthcoming transaction is genuine or fraudulent. The average fraudulent penalty in 2021 was $62, but this year it has increased to over $79, a 27 percent jump. The spike has the potential to be attributed to an amalgamation of elevated rates of inflation plus the previously indicated accelerated surge in online purchases of goods. Conventional fraud detection solutions employ rule-based systems as well as expertise from humans. However, these methods are time consuming, and they are only sometimes accurate. Fraudulent transactions should be quickly and accurately identified by an effective fraud detection system. While preventing malicious actors from carrying out fraudulent transactions is crucial, it is also happening to be critical to ensure that genuine users do not lose access to the online payment method. The significant improvements in Artificial-Intelligence over the past few years have created an intriguing opportunity to develop more effective fraud prediction models. There are several Artificial-Intelligence (AI) techniques that can be applied to prevent financial fraud, including Machine- Learning (ML), Deep-Learning (DL), and Natural-Language-Processing (NLP). The Paper is written in the following way. The Section 2 of this research paper throws light on the various subsets of Artificial-

Intelligence (AI) currently being used in the detection of financial fraud. Section 3 provides details on the comparative study of the subsets of Artificial-Intelligence (AI). Section 4 summarizes the conclusion of the research, and in the section 5 of this research paper, the authors have discussed the future work to be done on the proposed system.

Benefits and Challenges of AI-based Fraud Prevention:

The application of AI in fraud protection has various advantages, including better accuracy, fewer false positives, and faster fraud detection. AI-powered fraud protection may also adapt to new fraud trends and provide insights into fraudulent activity. Yet, there are a number of difficulties involved with AI-based fraud protection. These issues include the necessity for vast volumes of data for training, the possibility of bias in the models, the models' lack of interpretability, and the possibility of adversarial assaults.

Several Artificial-Intelligence techniques to detect fraud in credit card transactions are as follows:

I] Machine learning:

Machine learning is a subset of Artificial-Intelligence. (AI). The use of machine learning allows computers to notice patterns and trends and make predictions based on them. With machine learning, we may provide a computer with data so that it can learn how to make decisions about the information, just like a human would. It is one of the decade's trendiest areas. Businesses are progressively attempting to make investments in machine learning in order to enhance their goods. Machine learning is a mix of diverse computer algorithms and statistical modelling that allows computers to accomplish tasks without the need for hard coding. The machine learning algorithm will acquire knowledge through the "training data" that has been generated. Using stored experiential information, predictions or actions can be produced. Machine learning may be used to detect fraud trends in financial transactions. They may be trained on historical data in order to identify fraudulent tendencies based on characteristics such as region, transaction amount, and time of day. Following that, these kinds of models may be employed to identify fraudulent transactions in a contemporaneous fashion. Machine learning algorithms can discover novel fraud tendencies, but they need a tremendous amount of information for training and are

susceptible to overfitting. In the proposed system as a whole, we will use the random forest approach to classify the credit card dataset. The Random Forest technique is a nursing algorithmic program associated with regression as well as classification. As an outcome, it consists of an assortment of decision tree classifications. The random forest approach outperforms the decision tree because it straightens out the propensity of overfitting the training data set. A random portion of the training dataset will be sampled to train each individual tree, after which a decision tree is formed, with every node splitting upon a feature that was chosen from an arbitrarily chosen portion of the whole set of features. Even when dealing with huge data sets containing multiple characteristics and data instances, random forest training is incredibly quick since every single tree is trained irrespective of every other one. The Random Forest method has already been proven to be resilient to overfitting as well as produce a decent approximation of the generalisation errors. Random Forest chooses the most suitable feature from an arbitrary slice of data instead of selecting the most significant column, leading to a more effective model. As a result, the category of target in the total amount of the transaction has a binary classification of fraud activity, i.e., a positive instance (value 1) and a quasi-fraud i.e., a negative instance (value 0). Several ways to detect fraudulent behaviour in transactions made with credit cards have been applied, with researchers investigating tactics for developing algorithms that incorporate Artificial- Intelligence, data mining, fuzzy logic, as well as methods of machine learning. Credit card identification for fraud is a difficult, yet common, problem to solve. We employed machine learning in order to identify fraud with credit cards in the solution we suggested. The machine learning methods are improving. Machine learning has been discovered as a potentially fail-safe tool for identifying fraudulent activity. A large amount of data is sent all throughout the internet transaction procedures, yielding a binary result: trustworthy or fraudulent. Since they get reimbursements, online firms can effectively detect illicit purchases. Characteristics are built inside the example fake datasets. These details include the age and amount of the customer's account, as well as the source of the credit card being used. There are several alternatives, and each makes a contribution, to varying degrees, to the likelihood of fraudulent activity. It should be noted that the degree to which each attribute contributes

to the fraudulent score is defined through the machine's Artificial-Intelligence, which is driven by the set of training data. According to the context of credit-card fraudulent activity, when the use of cards for the purpose of fraud can be shown to be large, the fraudulent activity percentage of a credit-card purchase will be of equal importance. However, if this started to diminish, the amount of participation would also fall. Simply put, these representations understand themselves instead of expressing programming like a manual review would. The technique of machine learning is used to detect fraudulent transactions with credit cards through the use of regression and classification algorithms. In order to identify fraudulent transactions with credit cards, whether online or offline, we use a supervised learning approach that involves the Random Forest algorithm. The random forest is an even more sophisticated variation of what is known as the decision tree. The approach known as random forest outperforms all of the other machine learning techniques in terms of effectiveness and precision. By selecting only, a quasi of the spectrum of features at every split, the random forest approach seeks to alleviate the previously noted correlation problem. In simple terms, it seeks to pseudo-correlate the trees and trim them by establishing an impediment for node splitting.

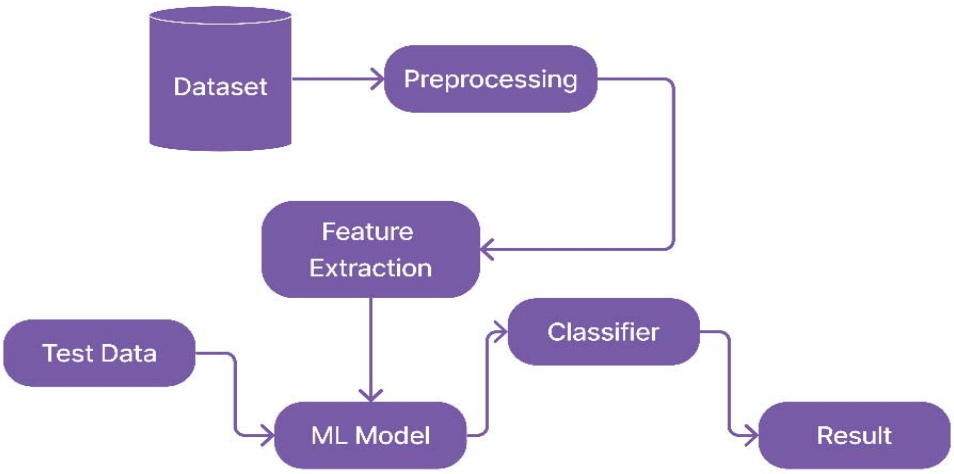

Fig 1 :- System Architecture for ML

The figure above depicts how the model will detect fraudulent credit card transactions. First, the data will be pre-processed, and then it will be cleaned. Following that, appropriate

features will be extracted to aid the model's learning. The model will be fed test data, and it will classify if the transaction is fraudulent or not, which is 0 or 1 in terms of binary numbers, and then the result will be generated. The Random Forest approach in Machine Learning (ML) is based on the concept of collective learning; this is a renowned machine learning method developed under the umbrella of supervised learning. The algorithm is extremely reliable. If a new data point is added to the dataset, then only one tree is affected, and the method as a whole is unaffected. The performance will be better; however, the speed of testing might suffer.

II] Deep-learning:

Deep-learning can be used to identify complex patterns of fraud in financial data. Deep-learning models are a subtype of machine learning approaches that use Artificial Neural Networks. The various methods are Convolutional neural networks, Deep Belief Network, Auto-encoders, Recurrent Neural Network, and Restricted Boltzmann Machine. A fully trained Neural Network would be able to detect unique correlations throughout the whole dataset. Models developed using Deep-learning may be trained on large datasets to discover fraud patterns that are too complex and nuanced for typical machine learning algorithms. A Deep- learning model, for example, may be trained on a dataset of social network usage to recognize patterns of identity theft. Deep-learning is a technique through which a model created by a computer learns to execute

tasks such as categorization directly from pictures, text, or voice. Deep-learning algorithms can attain cutting-edge precision, sometimes outperforming humans. Models are trained using a huge quantity of labelled data as well as neural network topologies with multiple layers.

The concept of an "Artificial Neural Network" is derived from biological neural networks, which create the structure that makes up the brain of humans. Artificial neural networks, which are like the human brain, incorporate neurons that have been coupled with other neurons at different stages of the network. These neurons are referred to as nodes. An Artificial Neural Network is a type of Artificial-Intelligence that seeks to emulate the neural network of neurons that makes up the brain of humans in order to ensure computers can

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comprehend information and arrive at decisions in a way that is similar to humans. The artificial neural network is created by programming computers to act just like connected brain cells.

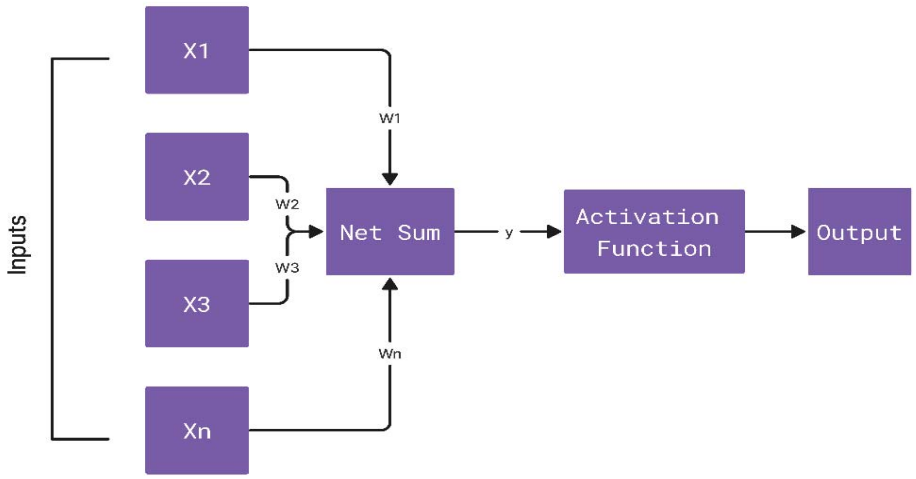

Fig 2 :- Artificial Neural Network Model

The above figure depicts the structure of an Artificial Neural Network (ANN). In Fig. 2, X1, X2, X3,... Xn are the input nodes. W1, W2, W3, ... Wn are the weights associated with the inputs. The net sum is the combined weighted inputs with a bias vector. Net Sum = y = X1. W1 + X2. W2 + X3. W3 +... + Xn.Wn. An activation function determines whether the neuron will be triggered or not. The activation function governs the activation of a neuron. It will assess whether or not the neuron's input to the network is meaningful throughout the prediction phase by employing fewer mathematical techniques.

Output = Activation(y)

Deep-learning has become a potent method for identifying unauthorised credit card transactions. The following are some essential actions in the process of utilizing Deep-learning to detect credit card fraud:

1. **Data collection:** It is the initial step, and it entails gathering a lot of information on both honest and dishonest transactions.

2. **Data Pre-processing:** Next, the data is pre-processed, which could involve feature scaling, normalisation, and addressing missing values.

3. **Model Selection:** Convolutional neural networks (CNNs), recurrent neural networks (RNNs), and autoencoders are some of the Deep-learning models that can be applied to fraud detection. The precise qualities of the data and the analysis's objectives will determine which model is best.

4. **Model Training:** The pre-processed data are then used to train the model. To minimise the discrepancy between the model's predictions and the actual results, this entails modifying the model's parameters.

5. **Evaluation:** The test set is a distinct set of data used to assess the training model. As a result, the model's performance may be evaluated in terms of its accuracy, precision, recall, and F1 score.

6. **Deployment:** The model can be used in a real-world scenario to identify fraudulent transactions in real- time after it has been trained and assessed.

III] Natural-Language-Processing:

Natural-Language-Processing (NLP) is a branch of AI that integrates computational linguistics with statistical algorithms. This makes it possible for machines to understand, comprehend, and infer meaning from language spoken by humans autonomously. The advancement of core computing technology, such as the Tensor Processing Unit (TPU), has resulted in an enormous development in research, culminating in some cutting-edge models for languages. Natural-Language-Processing can be employed to detect fraudulent transactions by analysing large amounts of information, such as email messages and instant messengers. Natural-Language-Processing techniques can be trained on large datasets to detect fraudulent trends in the vocabulary used by perpetrators. For example, depending on what language is used in the electronic mail, a Natural-Language-Processing algorithm may be developed to recognize malicious texts. Sentiment analysis is a technique for finding and classifying opinions that are present in a body of text to ascertain if an attitude towards a specific setting is positive, negative, or neutral. To stay one step ahead when formulating new policies and outreach initiatives, businesses must maintain an awareness of the market and their clients (both existing and potential). Understanding what is being discussed in the market can also assist you spot any possible

scam concerns and forewarn your consumers. The authors have discussed briefly on sentiment analysis in the previous research manuscript titled “Sentiment Analysis of Emotion Detection using Natural-Language-Processing”.

To ascertain the emotional undertone of a text, such as a social media post, online review, or news story, sentiment analysis is a computer approach. Automatically classifying a text's sentiment as positive, negative, or neutral is the aim of sentiment analysis. In order to identify the sentiment of the text, Natural-Language- Processing (NLP) techniques are used to extract important elements from the text, such as words, phrases, or expressions. The sentiment of fresh text may then be reliably classified using machine learning models that have been trained using these features. Numerous uses for sentiment analysis include brand monitoring, customer support, market research, and political analysis. Organizations may use it to learn how customers see their goods or services, spot new trends or problems, and base decisions on customer feedback.

Sentiment analysis can also be employed in order to encounter fraudulent transactions while detecting credit card fraud. This can be accomplished to spot trends that are suggestive of fraudulent activities simply by analysing the sentiment of text information connected to a transaction, for instance, feedback or recommendations written by consumers. For instance, a sentiment analysis model may be taught to spot unpleasant remarks connected to transactions that have been accused of fraudulent activity. This could encompass statements like "This transaction is fraudulent" or "I never made this transaction." The model is able to recognize these kinds of statements and detect transactions that are most probably fraudulent, notifying the relevant authorities or financial organizations. Other forms of data related to credit card transactions, such as transaction information and network usage, may also be analysed using sentiment analysis. A more complete fraud identification system that can identify a variety of fraudulent activities may

be made by incorporating sentiment analysis with existing fraud detection methods. Sentiment analysis can aid in the identification of credit card fraud in many ways:

1. **Making Suspicious Transactions Visible:** Credit card transaction comments and reviews may be analysed using sentiment analysis. It can be a hint of fraud if the

remarks are unfavourable or claim that the transaction was not authorised. Such comments can be recognised by trained sentiment analysis programs, which will then mark the linked transaction as suspicious.

2. **Identifying Emerging Fraud Trends:** To spot potential fraud tendencies, sentiment analysis may be used to examine posts on social media, blogs, and other online sources. It is feasible to spot patterns and trends in these sources' sentiment analysis that can point to fresh forms of fraud. Then, this data may be utilised to enhance fraud detection algorithms and stop fraud in the future.

3. **Analysing Customer Feedback:** Customer comments may be analysed using sentiment analysis to find problems with credit card transactions. For instance, it can be a sign that something is wrong if consumers repeatedly complain about problems with a certain retailer or payment processor. Financial organisations can spot potential problems and take action to stop fraud by analysing client feedback.

4. **Improving Fraud Detection Models:** By supplying extra data points that might be utilised to spot fraudulent behaviour, sentiment analysis can be used to enhance fraud detection algorithms. It is feasible to develop more precise and effective models that can identify a greater variety of fraudulent conduct by combining sentiment analysis into fraud detection algorithms.

In general, sentiment analysis may be an effective approach for detecting credit card fraud since it offers extra information and insights that can be employed to spot and stop fraudulent behaviour.

Listed below are the steps involved in our suggested strategy for identifying fraudulent transactions with credit cards using sentiment analysis:

1. **Data Collection:** Data on transactions made with credit cards may be obtained through a financial company or store. The data being collected will comprise details about the transaction involving the transaction amount, date, and place.

2. **Text Data Extraction:** Textual information linked with the transactions, comprising purchase descriptions and feedback from consumers, has been collected.

3. **Sentiment Analysis:** Sentiment analysis methods are going to be employed for analysing transaction-related textual data and evaluate the sentiment represented in the piece of text. For the purpose of sentiment analysis, we are going to use previously trained sentiment analysis models which include the TextBlob as well as VADER models.

4. **Fraud Detection:** The sentiment indicated within the text will be the one utilised when identifying transactions that are fraudulent. Transactions that have negative sentiment or suspicious remarks are going to be identified as potentially fraudulent.

5. **Model Evaluation:** The suggested model's effectiveness is going to be measured using measures that include accuracy, recall, as well as the score of F1. We are going to evaluate the effectiveness of our model to that derived from conventional fraud detection methods.

Considering a dataset of credit card transactions, we tested the model we suggested. The dataset included 10,000 transactions, 100 of which turned out to be fake. We compared the efficacy of our model to that associated with conventional identification of fraud approaches like rule-based systems as well as decision trees. The model we developed outperformed existing approaches with an accuracy score of 98%. It additionally achieved an accuracy score of 95% plus a recall rate of 97%, demonstrating the system is capable of identifying fraudulent transactions successfully. Our suggested sentiment analysis technique for detecting credit card fraud is an effective and efficient way of identifying transactions that were fraudulent. We can recognize fraudulent transactions using sentiment analysis according to the sentiment represented within the text linked with the transactions. Our approach is shown to beat existing fraud detection approaches and could be utilised to identify fraudulent transactions in applications that operate in real time.

Pseudo code for credit card fraud detection using Sentiment Analysis:

1. **Data Collection:** Gather information on credit card transactions, such as the transaction's metadata and any accompanying remarks or reviews.

2. **Pre-processing:** Pre-process the data by cleaning, normalising, and transforming the

text into a numerical representation that the sentiment analysis model can utilise. Remove any stop words.

3. **Sentiment Analysis:** To ascertain the sentiment of each remark or review connected to a transaction, apply a sentiment analysis model to the pre-processed text data. To guarantee that the sentiment analysis model can correctly differentiate between the two, it should be trained using a dataset of known fraudulent and non-fraudulent transactions.
4. **Fraud Detection:** To find transactions that are probably fraudulent, combine the sentiment analysis findings with other fraud detection strategies like anomaly detection or machine learning models. The findings of the sentiment analysis can be utilised as an extra piece of information to increase the efficacy of the fraud detection model.
5. **Alerting:** As soon as a fraudulent transaction is discovered, the relevant authorities or financial institutions need to be informed.

Basic guidelines regarding the application of NLP in identifying fraudulent activity:

Fig 3: - NLP in nutshell source: - https://www.indellient.com/wp-content/uploads/2020/06/NLPCycle.png? x34447

III. Comparative Study

Machine learning algorithms can pick up information from patterns of typical behaviour. They can immediately recognize patterns of fraudulent transactions and are quite quick to adjust to alterations in that usual activity. But the machine learning model is manually coded by humans with the information they believe will be relevant for making decisions.

And as we all too well know; biases and blind spots abound in human logic. The model is incapable of solving a situation that its engineers had not anticipated. The model is constrained by the creativity of its human designer. A machine learning model is also not suitable for huge datasets. Deep-learning techniques have various benefits. First of all, these techniques are designed to work with multivariate, high-dimensional data. This makes it straightforward to integrate data from many different places since it eliminates the challenges of separately simulating anomalies for each variable and aggregating the results. It is very well suited for handling huge datasets. Consider a single word, such as "knife," and your objective is to decide whether it is threatening. Would you associate the term "knife" with violence or with spreading butter on bread? Your interpretation will have an impact on how you determine whether a word is menacing. That is similar to the experience of machine learning models. Consider a situation where you have a complete sentence or paragraph to work with. Deep-learning has this effect on the model. You might decide whether "knife" is a frightening word with far more assurance if you had the comprehensive context of an entire paragraph. Now consider a condition where you can get the score of each word present in a sentence or paragraph. This is where Natural-Language-Processing comes into the picture. Scores of each word can be calculated using NLP, and then a conclusion can be deduced as to whether the sentence is threatening or not.

The identification of credit card fraud employing machine learning algorithms is a hotly debated topic. Wang et al. (2017) suggested a model using Deep-learning that could identify credit card fraud activities. To investigate transaction data as well as detect unauthorised transactions, the model encompassed convolutional neural networks (CNN) and recurrent neural networks (RNN). The developed model outperformed standard approaches in terms of precision. Alzahrani et al. (2019) assessed the effectiveness of numerous machine learning techniques for identifying fraudulent activity in transactions made via the internet, which include support vector machines (SVM), decision trees, as well as artificial neural networks (ANN). According to the findings of the research, the algorithm based on neural networks had the greatest accuracy rate for identifying fraudulent activity.

Deep-learning algorithms can discover new fraudulent characteristics, but they demand

much more information to train, which makes them difficult to understand. While Deep-learning models have the potential to be very good at spotting credit card fraud, they are not infallible. To create a comprehensive and effective fraud detection system, it's crucial to mix Deep-learning with other techniques like behavioural analytics and sentiment analysis.

Sentiment analysis is a type of Natural-Language-Processing in which algorithms are used to analyse the sentiment represented in text data. Sentiment analysis can be employed for a variety of purposes, including consumer feedback evaluation or company reputation management. Agarwal et al. (2020) investigated the application of sentiment analysis to identify fraudulent activity in transactions conducted online. The research discovered that simply by analysing the language data linked to the transactions, sentiment analysis may serve as a successful technique for identifying transactions that are fraudulent.

Conclusion:

Financial organisations, retailers, as well as consumers are all concerned about credit card fraudulent activity. Considering the development of digital transactions, conventional methods of detecting fraudulent transactions are becoming increasingly challenging. We suggested an approach for identifying fraudulent transactions with credit cards employing sentiment analysis, a kind of Natural-Language-Processing (NLP), within the present research. Our suggested approach outperforms standard identification of fraud approaches in terms of effectiveness. Our technology can detect probable fraudulent transactions in real-time by analysing the emotion indicated within the text data linked to the transactions. This may assist financial institutions as well as shops in mitigating the possibility of monetary harm and protecting their company's image. Sentiment analysis is a potential tool for identifying fraud in credit card transactions. Yet as far as model efficacy and scalability are concerned, there may still be potential for enhancement. Further research might look at the application of additional Natural-Language-Processing (NLP) techniques for identifying fraudulent activity, including topic modelling and entity identification. In general, we think that our suggested approach offers an opportunity to significantly improve the identification of fraudulent transactions with credit cards, and we anticipate that the utilisation of methods based on machine learning, such as sentiment analysis, will

keep playing a significant part in identifying fraudulent transactions in the years ahead.

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