# Fraud Detection in Credit Cards Using Machine Learning

**Tummala Eekshitha, Garapati Naga Venkata Prudhvi, Vanamadi Anusha, Abdul Kaleem,**
**Student, CSE Department & GUDLAVALLERU ENGINEERING COLLEGE (GEC),**
**GUDLAVALLERU, Krishna, Andhra Pradesh, India.**

**Dr. M. Babu Rao M.tech, PhD, Professor, CSE Department & GUDLAVALLERU ENGINEERING COLLEGE (GEC), GUDLAVALLERU, Krishna, Andhra Pradesh, India.**
**baburaompd@gmail.com**

Abstract - **Credit Card Fraud is growing substantially with the evolution of modern technology. Credit card fraud happens frequently and leads to massive financial losses. Online transactions have increased drastically significantly online transactions are done by online credit cards.**

**Identification of fraud credit card transactions is important to credit card companies for the prevention of being charged for items transaction which the customer did not purchase. So this paper aims to illustrate the modeling of a knowledge set using machine learning with Credit Card Fraud Detection.**

**The proposed model will determine whether a new transaction tends to be fraud or legitimate. So, the objective of the paper is to detect 100% of the fraud transactions while reducing invalid fraud classifications.**

**Here an extensive review is done on the existing and proposed models for credit card fraud detection and has done a comparative study on these methods. So different classification models are applied to the training data and the model performance is assessed based on evaluation metrics such as accuracy, precision, recall, f1 score, confusion matrix. The study aims is to determine the best classifier by training and testing using machine learning method, i.e. both supervised and unsupervised techniques that deliver better results.**

**Keywords—Credit card, classification, proposed methods, Supervised techniques**

## I. INTRODUCTION

In technical terms, criminal deception which brings personal or financial gain is expressed as fraud. To eliminate these frauds, we can follow two methods i.e. fraud prevention & fraud detection. People or credit cardholders have to be cautious and follow preventive steps that involve fraud prevention which prevents the fraud to happen in the first place. Another option to recur the loss of fraudulent transactions is fraud detection.

The illegitimate usage of credit cards or their information is considered credit card fraud. The transactions using a credit card can be categorized in two ways i.e. using credit cards in person and digital transactions. The impostors use this confidential information that includes credit number, expiry date & OTP i.e. verification number to accomplish transactions through the internet or telephone. The statistics state that there is an exponential rise in usage of credit cards all over the world and credit card frauds also increase at the same rate. To diminish this loss that occurred by the credit card frauds, an operative system of detecting fraud is necessary to lessen or eradicate these cases. One of the simple ways is to detect fraud is to analyze the spending patterns on every card and to find out any distinction to the "usual" spending patterns. For this, analyzing the existing data purchase of cardholders is the fine way to lessen the rate of successful credit card frauds.

Even the main concern for banks and customers is to find the best process for detecting fraudulent operations through machine learning techniques. Since nowadays, a massive amount of data available for each customer and activity, artificial intelligence can be used to effectively identify suspicious patterns in transactions. To increase the accuracy and performance of the analyses, many institutions are investing in the improvement of ML algorithms. Various studies have been made on detecting fraudulent transactions of a credit card. Finally, some approaches of machine learning like "artificial neural networks, rule-induction techniques, decision trees, logistic regression, and support

 DOI : 10.35291/2454-9150.2021.0333 

vector machines, etc" are useful. These approaches can be used in a combined manner or standalone.

## II. OBJECTIVES

The project aims to implement machine learning techniques for credit card fraud detection with respect to time and amount of transactions and to build a classification model with accuracy.

## III. LITERATURE SURVEY

In previous work and studies shows that many methods have been implemented to detect fraud using supervised, unsupervised algorithms and hybrid ones. Fraud types and patterns are changing every day. It is important to build an intelligent model to detect frauds in credit cards using machine learning. Many kinds of literature relate to anomaly or fraud detection in this domain are published already and are accessible for public practice. Here are some discussed machine learning models and algorithms and fraud detection models used in earlier studies.

In [1] data mining techniques are discussed are time-consuming and with huge data. Overlapping is another trouble with credit card transaction data. Imbalanced data distribution is also a major issue to overcome using sampling techniques.

In [2] discuss data that is Fraud transaction is very less compared to normal transaction data. It may lead to serious bias situations. Also, discuss difficulties in dealing with categorical data. Many machine learning algorithms are not compatible with categorical data. Discuss the detection cost and adaptability as a challenge. We considered Prevention costs and the cost of fraudulent behavior.

In [3] Artificial Genetic Algorithm, one of the approaches that shed new light in this domain, countered fraud from a different direction. It provided accuracy in finding out the fraudulent transactions and minimizing the number of false alerts. Even though, it was accompanied by a classification problem with variable misclassification costs.

An extensive survey[4]presented techniques like Supervised and Unsupervised Learning for credit card fraud detection. Even though these methods and algorithms drew an unexpected accomplishment in some areas, they failed to provide a prominent and consistent result for fraud detection.

**Algorithm for processing:**

**Step 1:** Read the dataset.

**Step 2:** Sampling is done on the data set to make it balanced.

**Step 3:** Apply dimensionality reduction methods such as PCA to the dataset for more reliability.

**Step 4:** Feature selection and Split the dataset into two parts i.e., Train dataset and Test dataset.

**Step 5:**Implement different machine learning algorithms by fitting the training dataset.

**Step 6:**Accuracy and performance metrics have been evaluated to know the efficiency for different algorithms.

**Step 7:** Then retrieve the best algorithm based on efficiency for the given dataset.

**The algorithm is as follows:**

## IV. DATASET COLLECTION

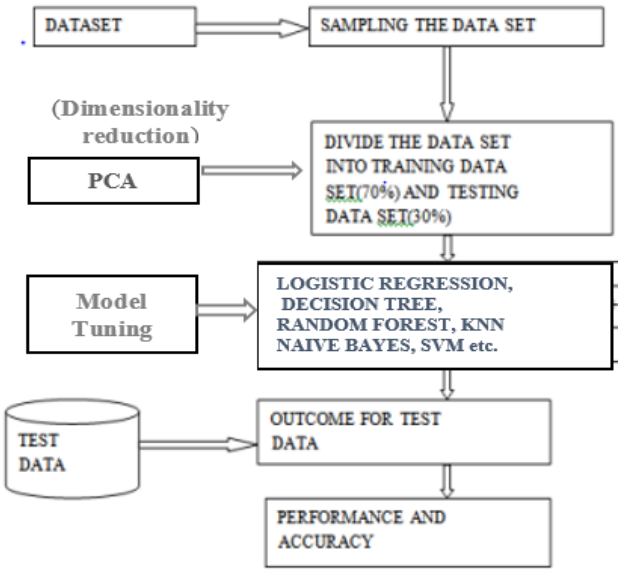
In this project, we considered a dataset which was provided by Kaggle it contains European cardholder's details who made transactions using credit cards in September 2013. This dataset shows the transactions that occurred within two days. The dataset has 492 (0.17%) fraud transactions out of 284,807 normal transactions. All the features or parameters in the dataset are numerical. Due to customer`s confidentiality, the columns were renamed to V1, V2, V3 …, and, V28 its parameters are applied to a PCA transformation which results in one or more of the smallest principal components, resultant in a lower-dimensional dataset that conserves the most data variance. The only two exceptions were the features Time and Amount, expressed in the seconds passed between each transaction and the transaction amount, respectively. The feature Class is the dependent variable and takes two values: that is 0 for normal transactions 1 for fraudulent transactions.

## V. PROPOSED TECHNIQUE

The proposed system efficiently overcomes the issue. It aims at analyzing the number of fraud transactions that are present in the dataset. We use different machine learning algorithms such as Naïve Bayes, Decision Tree Random forest algorithm, SVM, to classify the credit card transactions in the dataset.

The system architecture or pipeline is as follows

 DOI : 10.35291/2454-9150.2021.0333 




At first, all necessary dependencies are imported, then data preparation is performed. Later, data preprocessing is performed. It's a very important task in this project. Data processing involves data cleaning, handling missing values, feature selection, sampling, normalization, dimensionality reduction (PCA), splitting the dataset, etc...

**DATA PREPROCESSING:**

*A. Normalization*

For this, a StandardScaler is used to transform the data so that its distribution will have a mean value of 0 and a standard deviation of 1. This is a crucial step in that the data is transformed to be easily taken by the ML algorithm.

*B. Feature selection and splitting*

After transforming the Amount and Time features, let's split our dataset into train and test data. The size of the test data is 0.25

*C. Balancing the dataset*

The dataset is extremely unbalanced. Since there is a severe skew in the class distribution (284,315 entries in Class = 0 and 492 in Class = 1), the training dataset could be biased and impact the machine learning algorithm to show unsatisfactory outcomes.

*D. Dimensionality reduction with PCA*

Imbalanced dataset classifications pose a challenge for predictive modeling as most of the machine learning techniques used for classification are based on the assumption of an equal number of examples for each class in the dataset. This leads to models that have poor predictive performance, especially for the minor class. This issue is solved by Principal Component Analysis (PCA) algorithm

**IMPLEMENTEDCLASSIFICATION ALGORITHM**

***A. LOGISTIC REGRESSION:***

Logistic regression becomes a classification technique with a decision threshold on the linear regression output. Here the threshold value is a very important thing in logistic regression and is reliant on the classification problem itself. Generally, it uses a sigmoid function for classification.

***B. NAIVE BAYES:***

Naive Bayes models compute the probability of an example to be of a certain class, based on prior knowledge. It is based on the Naïve Bayes Theorem, which assumes that our features are independent of each other.

. P (A/B) = (P (B/A) * P (A)) / P (B)

Where, P (A) – Priority of A P (B) – Priority of B

P (A/B) – Posteriori priority of B

***C. DECISION TREE:***

A Decision tree can be used for both classification and regression problems. Working is the same for both same but some formulas are different. It uses the entropy and information gain for the formula.

***D. RANDOM FOREST:***

The random forest is a supervised learning algorithm in which it randomly creates and combines multiple decision trees into one unit called “forest.” The aim is not to depend on a single decision tree. It improves accuracy and solves overfitting problems.

***E. KMeans:***

K-Means is an unsupervised learning method that is used to solve clustering problems. It groups the dataset into different clusters. Here K defines the number of clusters.

***F. SUPPORT VECTOR MACHINE (SVM):***

Support Vector Machine or SVM is a popular Supervised Learning algorithm in which it creates the best line or decision boundary that can separate n-dimensional space into classes so that a new data point can easily put in the correct category in the future.

***G. K-NEAREST NEIGHBOR (KNN):***

K-NN is a non-parametric algorithm which assumes that the similarity between the new data and existing data and puts the new example into the category that is most similar to the available classes.

**VI. EXPERIMENTAL RESULTS AND DISCUSSIONS**

In this project, different machine learning algorithms are defined and implemented with the Kaggle dataset for credit card fraud detection. Since the dataset is highly imbalanced, we sample the dataset. Here we split 80% dataset for training and the remaining for testing.

The **performance evaluation** of the algorithms is done based on F1 score, precision, recall (sensitivity) and accuracy, confusion matrix. Generally, the f1 score, ROC score, and confusion matrix are best for these kinds of projects.

The given below is the results of all algorithms.

 DOI : 10.35291/2454-9150.2021.0333 

**Logistic Regression evaluation:**

```
Accuracy score: 94.670537
Recall score : 91.601050
ROC score : 93.138536

[[201872  11352]
 [    32    349]]

              precision    recall  f1-score   suppo

           1       0.03      0.92      0.06        38
           0       1.00      0.95      0.97     21322

    accuracy                           0.95     21360
   macro avg       0.51      0.93      0.52     21360
weighted avg       1.00      0.95      0.97     21360
```

**Naïve Bayes Evaluation:**

```
Accuracy score: 99.139065
Recall score : 66.666667
ROC score : 82.931878

[[211512   1712]
 [   127    254]]

              precision    recall  f1-score   support

           1       0.13      0.67      0.22       381
           0       1.00      0.99      1.00    213224

    accuracy                           0.99    213605
   macro avg       0.56      0.83      0.61    213605
weighted avg       1.00      0.99      0.99    213605
```

**Decision tree Evaluation:**

```
Accuracy score: 99.906369
Recall score : 72.965879
ROC score : 86.460194

[[213127     97]
 [   103    278]]

              precision    recall  f1-score   support

           1       0.74      0.73      0.74       381
           0       1.00      1.00      1.00    213224

    accuracy                           1.00    213605
   macro avg       0.87      0.86      0.87    213605
weighted avg       1.00      1.00      1.00    213605
```

**Random Forest Evaluation:**

```
Accuracy score: 99.945694
Recall score : 72.703412
ROC score : 86.348892

[[213212     12]
 [   104    277]]

              precision    recall  f1-score   support

           1       0.96      0.73      0.83       381
           0       1.00      1.00      1.00    213224

    accuracy                           1.00    213605
   macro avg       0.98      0.86      0.91    213605
weighted avg       1.00      1.00      1.00    213605
```

**Kmeans evaluation:**

```
Accuracy score: 53.649025
ROC score : 42.461337

[[114478  98746]
 [   262    119]]

              precision    recall  f1-score   support

           1       0.00      0.31      0.00       381
           0       1.00      0.54      0.70    213224

    accuracy                           0.54    213605
   macro avg       0.50      0.42      0.35    213605
weighted avg       1.00      0.54      0.70    213605
```

**Support Vector Machine (SVM) evaluation:**

```
Accuracy score: 99.821633
Recall score : 0.000000
ROC score : 50.000000

[[213224      0]
 [   381      0]]

              precision    recall  f1-score   support

           1       0.00      0.00      0.00       381
           0       1.00      1.00      1.00    213224

    accuracy                           1.00    213605
   macro avg       0.50      0.50      0.50    213605
weighted avg       1.00      1.00      1.00    213605
```

**K Nearest Neighbor (KNN) evaluation:**

```
Accuracy score: 99.821633
Recall score : 0.000000
ROC score : 50.000000

[[213224      0]
 [   381      0]]

              precision    recall  f1-score   support

           1       0.00      0.00      0.00       381
           0       1.00      1.00      1.00    213224

    accuracy                           1.00    213605
   macro avg       0.50      0.50      0.50    213605
weighted avg       1.00      1.00      1.00    213605
```

The above metrics are helpful in performance evaluation. We can find the best algorithm from the given results.

## VII. CONCLUSION

In this paper, we discussed applications of machine learning like Naïve Bayes, Logistic regression, Random Forest, SVM, KNN, etc. ...and it proves that accurate in deducting fraud transactions and minimizing the number of false signals. The objective of the study was to find the best method for this problem statement. Precision score, recall score, f1-score, confusion matrix, and accuracy score are used to evaluate the performance of the models.

By comparing all of them, we found that random forest performs better than all the algorithms like logistic regression, naïve Bayes, SVM, KNN methods, etc. Kmeans method performs less than all the algorithms which show that supervised algorithms outperform unsupervised algorithms. The second best method with better accuracy is SVM. KNN is also performed better with high accuracy but it is very costly in terms of computation while prediction.

 DOI : 10.35291/2454-9150.2021.0333 

In conclusion, this project suggests that If these ML algorithms are applied to banking credit card fraud detection systems, then the probability of fraudulent transactions can be predicted soon after credit card transactions. And a series of anti-fraudulent transaction strategies can be adopted and used to prevent banks from great financial losses.

## VIII. REFERENCE AND ACKNOWLEDGE

[1] S. Xuan, G. Liu, Z. Li, L. Zheng, S. Wang, "Random forest for credit card fraud detection", IEEE 15th (ICNSC),2018.

[2] Satvik Vats, Surya Kant Dubey, Naveen Kumar Pandey, "A Tool for Effective Detection of Fraud in Credit Card System", published in International Journal of Communication Network Security ISSN:

[3] International Journal of Scientific & Engineering Research, ISSN 2229-5518 IJSER © 2012 http://www.ijser.org Fraud Detection of Credit Card Payment System by Genetic Algorithm

[4] INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH VOLUME 9, ISSUE 10, OCTOBER 2020 ISSN 2277-8616 216 IJSTR©2020 www.ijstr.org Credit Card Fraud Detection Using Supervised Learning Approach

[5] K. Chaudhary, B. Mallick, "Credit Card Fraud: The study of its impact and detection techniques", International Journal of Computer Science and Network (IJCSN)

[6] M. J. Islam, Q. M. J. Wu, M. Ahmadi" Investigating the Performance of Naive-Bayes Classifiers and KNearestNeighbor Classifiers", IEEE International Conference on Convergence Information Technology.

[7]. Dinesh L. Talekar, "Credit Card Fraud Detection System-A " Survey, IJMER 2014.

[8]. SamanehSorournejad, Zahra Zojaji," A Survey of credit card fraud detection techniques: Data and techniques oriented perspective"

[9] Lakshmi S V S S, "Machine learning for credit card fraud detection," International Journal Of Applied Engineering Research 2018

 DOI : 10.35291/2454-9150.2021.0333 