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# Literature Survey on Machine Learning Techniques for Fraud Detection

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**ABSTRACT:** Fraud detection is a significant issue in the financial industry due to the increase in the adoption of digital payment systems, online banking, and e-commerce sites. Various fraudulent practices, including credit card fraud and illegal financial transactions, result in substantial financial losses for banks and customers. Conventional fraud detection systems are based on rule-based approaches, which are not effective in identifying new and complex fraud patterns. To address these limitations, machine learning is used for fraud detection purposes. Machine learning techniques are used for analyzing the huge volume of transactions and identifying the underlying patterns that indicate illegal and fraudulent activities. Various machine learning algorithms, including Logistic Regression, Decision Tree, Random Forest, K-Nearest Neighbor, AdaBoost, XGBoost, ANN, and GNN, are used for fraud detection purposes. This literature survey discusses various machine learning techniques used in fraud detection by analyzing various research papers. The paper compares different techniques, advantages, and disadvantages of various algorithms used in different research papers. The study also identifies various research gaps, including imbalanced datasets, changing patterns of fraud, and computational complexities. The findings of this paper will provide knowledge about various techniques of fraud detection, including the need for efficient machine learning techniques in future financial security systems.

**KEYWORDS:** Credit Card Fraud Detection, Machine Learning, Data Mining, Classification Algorithms, Fraud Detection System

## I. INTRODUCTION

The rapid growth of digital payment systems, online banking services, and electronic commerce has greatly increased the volume of financial transactions across the world. While these technologies offer many benefits in terms of convenience and quick service availability, they have also created opportunities for fraudulent activities like credit card fraud, identity theft, etc. Such fraudulent activities result in substantial financial losses to banks, organizations, and customers. Thus, fraud detection is an important challenge in modern financial systems. Conventional fraud detection systems rely heavily on rule-based methods and manual monitoring techniques. While these methods use predefined rules to detect fraudulent activities, they do not perform well in detecting new forms of fraud. For addressing these limitations, researchers have been using Machine Learning (ML) methods for fraud detection. Machine learning methods can learn from large volumes of transactional data, identify hidden patterns, and classify transactions as legitimate or fraudulent.

Various studies have also been conducted to examine different machine learning algorithms in order to improve the efficiency of fraud detection. For instance, Varun Kumar K. S. et al. (2020) used different algorithms like Logistic Regression, Decision Tree, and Random Forest for detecting credit card fraud. S. P. Maniraj et al. (2019) also proposed a machine learning model for analyzing financial transactions in order to detect fraud. Emmanuel Ileberi et al. (2022) suggested a model that uses a Genetic Algorithm as a feature selection tool in addition to algorithms like Random Forest and Artificial Neural Networks. Muskan Banu and Kavitha G (2022) also proposed a study that uses machine learning algorithms for analyzing financial transactions in order to detect fraud.



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Comparative studies have also been performed in order to compare various algorithms. Joseph J. Assabil and Ibidun C. Obagbuwa (2024) have compared various models including Logistic Regression, Random Forest, KNN, AdaBoost, and XGBoost in order to identify the most efficient approach for the detection of fraud. Zahra Faraji (2022) has discussed various machine learning techniques for the detection of credit card fraud. Apart from these techniques, more efficient techniques including data mining models, artificial intelligence models, one-class classification models, and graph-based neural networks have also been proposed by various researchers including Yusuf Yazici (2020), Zaffar Zaffar et al. (2023), and M. T. Singh et al. (2024).

Machine learning approaches have helped in the detection of frauds using the hidden patterns present in the large amount of data. But there are some problems that exist in the field of machine learning, like imbalanced data and changing patterns of frauds. Thus, the various machine learning approaches for the detection of frauds are discussed in the literature survey, along with their pros and cons.

### II. REVIEW OF EXISTING PAPER

#### 1. Credit Card Fraud Detection Using Machine Learning Algorithms

**Authors:** Varun Kumar K. S. et al. (2020)

This study suggested a fraud detection system using machine learning algorithms like Logistic Regression, Decision Trees, and Random Forest. The researchers used machine learning algorithms to classify the transactions as fraudulent or normal using credit card transaction data. The study found that ensemble methods like Random Forest provided better accuracy compared to individual algorithms. However, it was necessary to select appropriate features for better accuracy.

#### 2. Credit Card Fraud Detection Using Machine Learning and Data Science

**Authors:** S. P. Maniraj et al. (2019)

The main focus of the research was the application of machine learning and data science in the detection of fraudulent financial transactions. The authors of the research used large datasets in the detection of suspicious behavior patterns. The research showed the efficiency of using machine learning in the detection of fraud.

#### 3. A Machine Learning Based Credit Card Fraud Detection Using GA Algorithm for Feature Selection

**Authors:** Emmanuel Ileberi et al. (2022)

In the present research, the authors proposed a fraud detection system that makes use of a feature selection method based on the Genetic Algorithm. Once the relevant features were identified, the authors used machine learning techniques like Random Forest and Artificial Neural Networks. From the results, it is clear that feature selection is useful in improving the accuracy of fraud detection models.

#### 4. Credit Card Fraud Detection Using Machine Learning Algorithms

**Authors:** Muskan Banu and Kavitha G (2022)

This study employed different machine learning techniques to detect credit card fraud by analyzing the nature of transactions. The researchers employed different classification techniques to detect fraudulent transactions. The study revealed the efficiency of machine learning techniques in detecting suspicious transactions in financial systems.

#### 5. Credit Card Fraud Detection Using Machine Learning Algorithms: A Comparative Study of Six Models

**Authors:** Joseph J. Assabil and Ibidun C. Obagbuwa (2024)

This research was a comparison of six machine learning algorithms: Logistic Regression, Random Forest, K-Nearest Neighbor (KNN), AdaBoost, and XGBoost. The research tested the performance of these algorithms using fraud detection datasets. The results indicated that the ensemble methods performed better in terms of accuracy compared to the other algorithms.

#### 6. A Review of Machine Learning Applications for Credit Card Fraud Detection

**Author:** Zahra Faraji (2022)

In this paper, an in-depth review of various machine learning models used in fraud detection was carried out. The study focused on various algorithms such as Logistic Regression, Decision Tree, Random Forest, and XGBoost. The research highlighted the significance of machine learning in detecting fraud transactions in financial systems.



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### 7. A Data Mining Based System for Credit-Card Fraud Detection in E-Tail

This study proposed a fraud detection system by integrating data mining techniques with machine learning. The proposed system analyzed transactions in e-commerce environments to detect fraudulent activities. The study found that integrating data mining techniques with machine learning improves the detection of fraudulent transactions.

### 8. Approaches to Fraud Detection on Credit Card Transactions Using Artificial Intelligence Methods

**Author:** Yusuf Yazici (2020)

This research focused on different techniques of artificial intelligence applied in detecting fraud. The study described different AI-based models that use transactional data to detect fraudulent patterns. The research also identified challenges in detecting fraud in financial datasets.

### 9. Credit Card Fraud Detection with Subspace Learning-Based One-Class Classification

**Authors:** Zaffar Zaffar et al. (2023)

The study presented a new method for detecting fraud based on subspace learning and one-class classification. This method was developed specifically for handling imbalanced datasets in which the number of fraudulent transactions is much less compared to normal transactions. It improved the detection of rare fraud cases.

### 10. Heterogeneous Graph Auto-Encoder for Credit Card Fraud Detection

**Authors:** M. T. Singh et al. (2024)

This research proposed a graph-based deep learning model for fraud detection using Graph Neural Networks (GNN) and autoencoders. The model analyzed relationships between different transaction entities such as users, accounts, and devices. The results showed improved detection of complex fraud patterns in financial networks.

## III. COMPARISON WITH EXISTING PAPER

Different researchers have used various machine learning and artificial intelligence-based approaches to detect credit card fraud. The selected studies are mostly focused on improving the accuracy of fraud detection, dealing with large transaction volume, and uncovering underlying fraud patterns. In the past, researchers have used various traditional machine learning-based approaches. Varun Kumar K. S. et al. (2020) used Logistic Regression, Decision Tree, and Random Forest algorithms to detect credit card fraud. The authors have shown that ensemble algorithms such as Random Forest outperform other algorithms. S. P. Maniraj et al. (2019) proposed a fraud detection system using various machine learning and data science approaches to analyze financial transaction data and detect fraud. Some researchers focused their study on optimizing the model's performance. Emmanuel Ileberi, et al. (2022) employed a Genetic Algorithm in optimizing the features of the model, then employed Random Forest and Artificial Neural Network. The study improved the accuracy of fraud detection by optimizing features.

Other researchers focused their study on analyzing the behavior of transactions. Muskan Banu & Kavitha G (2022) employed machine learning algorithms in analyzing the behavior of transactions, as well as detecting fraudulent activities. The study proved that machine learning algorithms can be effective in detecting fraudulent activity in transactions. Comparative research was conducted by Joseph J. Assabil and Ibidun C. Obagbuwa (2024), in which six algorithms, including Logistic Regression, Random Forest, KNN, AdaBoost, and XGBoost, were compared. The research concluded that ensemble learning algorithms, including Random Forest and XGBoost, have better accuracy than traditional algorithms.

Zahra Faraji (2022) conducted a review of different machine learning algorithms used in credit card fraud detection. The author also discussed the effectiveness of different algorithms, including Logistic Regression, Decision Tree, Random Forest, and XGBoost.

Some studies also employed the combination of machine learning with other analytical methods. For instance, the research "A Data Mining Based System for Credit-Card Fraud Detection in E-Tail" employed the combination of data mining and machine learning to identify fraud in electronic commerce transactions. Another research by Yusuf Yazici (2020) examined the application of artificial intelligence methods for fraud detection. In the research, the author also discussed the challenges involved in the analysis of large financial data. Recent studies have concentrated on the application of sophisticated methods to address a particular problem in fraud detection. For instance, Zaffar Zaffar et al.



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(2023) introduced a subspace learning model for the application of one-class classification to address the problem of imbalanced data, where the number of fraud transactions is small. Moreover, M. T. Singh et al. (2024) introduced a heterogeneous graph auto-encoder model using Graph Neural Networks to analyze the relationships between different entities involved in the transactions for the detection of fraud.

Overall, the comparison of these studies indicates that traditional machine learning models are simple and effective for basic fraud detection problems, while ensemble models and advanced deep learning models can be used for better accuracy and performance in complex financial transaction scenarios.

S.No	Authors & Year	Technique / Algorithm Used	Key Contribution	Limitation
1	Varun Kumar K. S. et al. (2020)	Logistic Regression, Decision Tree, Random Forest	Fraud detection using ML algorithms	Limited handling of complex fraud patterns
2	S. P. Maniraj et al. (2019)	Machine Learning & Data Science Techniques	Model for analyzing financial transaction data	Dataset imbalance issues
3	Emmanuel Ileberi et al. (2022)	Genetic Algorithm + Random Forest, ANN	Feature selection improves model accuracy	Higher computational cost
4	Muskan Banu & Kavitha G (2022)	Machine Learning Algorithms	Transaction behaviour analysis for fraud detection	Requires large dataset
5	Joseph J. Assabil & I. C. Obagbuwa (2024)	Logistic Regression, Random Forest, KNN, AdaBoost, XGBoost	Comparative study of six ML models	Performance depends on dataset quality
6	Zahra Faraji (2022)	Logistic Regression, Decision Tree, Random Forest, XGBoost	Review of ML techniques in fraud detection	Does not propose new model
7	Data Mining Based Fraud Detection in E-Tail	Data Mining + Machine Learning	Improved fraud detection in e-commerce transactions	Limited scalability
8	Yusuf Yazici (2020)	Artificial Intelligence Methods	Analysis of AI approaches for fraud detection	Implementation complexity
9	Zaffar Zaffar et al. (2023)	One-Class Classification	Handles imbalanced fraud datasets	Limited performance for complex networks
10	M. T. Singh et al. (2024)	Graph Neural Network + Autoencoder	Detects complex fraud patterns in transaction networks	High computational requirements

#### IV. RESEARCH GAP

Despite the fact that many researchers have successfully implemented machine learning for fraud detection, there are still challenges that need to be addressed in the existing literature. In most of the existing literature, such as the works of Varun Kumar K. S. et al. (2020) and S. P. Maniraj et al. (2019), the researchers mainly focused on implementing traditional machine learning models such as Logistic Regression, Decision Tree, and Random Forest. However, these models might not perform well when dealing with complex financial transactions.

Some researchers, such as Emmanuel Ileberi et al. (2022), also attempted to improve the performance of the machine learning model for fraud detection using feature selection techniques such as Genetic Algorithm. However, these feature selection techniques increase the complexity of the machine learning model. In such scenarios, the processing time might increase. In the existing literature, researchers such as Joseph J. Assabil and Ibidun C. Obagbuwa (2024) mainly focused on comparing the performance of various machine learning models for fraud detection.

Another major problem with the fraud detection system is the problem of the imbalanced dataset, where the number of fraudulent transactions is very low compared to the overall transactions. Though Zaffar Zaffar et al. proposed the



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problem of the imbalanced dataset using the one-class classification approach in their research in 2023, the problem is still not solved for the efficient detection of the fraud in the dataset.

Recent research in the area of fraud detection has proposed the use of advanced deep learning techniques, including the Graph Neural Network for the detection of the fraud in the dataset, as proposed in the research by M. T. Singh et al. in 2024. However, the proposed techniques require high computational complexity for the detection of the fraud in the dataset.

### V. CONCLUSION

Fraud detection is considered an important area of research due to the rise in digital payment systems. The literature survey was conducted to understand different machine learning approaches for detecting fraudulent transactions. The techniques considered in this study include Logistic Regression, Decision Trees, Random Forest, K-Nearest Neighbor, AdaBoost, XGBoost, Artificial Neural Networks, and Graph Neural Networks.

From the literature survey, it is found that machine learning approaches improve the detection of fraudulent transactions compared to traditional approaches. The ensemble methods, Random Forest, and XGBoost improve accuracy in detecting fraudulent transactions. Techniques like deep learning and graph neural networks detect fraudulent transactions.

However, there are still some issues that need to be addressed, such as the unbalanced nature of the data set, the changing nature of fraud schemes, and the computational cost of complex models. Future research directions include the development of more efficient hybrid models that employ various machine learning approaches for the detection of fraud and the real-time monitoring of financial transactions.

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