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Credit Card Fraud Detection

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***Abstract* —This project is all about finding credit card fraud using machine learning. Credit card fraud is been increasing a lot nowadays, With the criminals using fake tricks and identities in order to steal money So, It is very important to find a way to stop these frauds. Our project majorly carries out at finding illegal activities. As criminals change their mind and methods often, it's very hard to catch them easier. First, the system starts collecting the data on how these credit cards are used and trains a model using algorithm like Random Forest and Decision Tree. Then, it checks new data to see whether any fraud is happening. Thereby our project gives graphs to show the results and the Random forest model gives the best accuracy.**

Keywords—Random Forest Algorithm, Community Support, Criminal Transactions, Credit Card, Integrating AI Assistant.

Introduction

With the rise of the digital world, Credit card usage has become very easier. How much usage is there from that equivalent it makes easier for fraud to happen, especially with online payments, because fraudsters use advance methods, as the old rule-based systems don't work anymore. That's why Machine Learning (ML) and Deep Learning (DL) are now being used in fraud detection systems. Older systems that will be following fixed rules, while new systems can learn and adapt to new fraud patterns. They use algorithms to study the data and identify the fraud. These include supervised and unsupervised learning methods like Random Forest. Decision Tree, support vector (SVM) and neural networks. The main goal of our project is to analyze and process data to detect credit card fraud.

I. Literature Survey

Sharma and Sharma (2017) explored the application of Decision Trees in credit card fraud detection, highlighting their interpretability and effectiveness in classifying transactions through rule-based logic. Their work, published in the International Journal of Computer Applications, demonstrated how such models offer a transparent decision-making process that is easy to understand and analyze.

Singh and Kumar (2019), in their study published in the Journal of Big Data, investigated the use of Random Forests for fraud detection. They reported that ensemble methods like Random Forests significantly improve classification accuracy and minimize overfitting, especially in imbalanced datasets, where fraudulent cases are rare compared to legitimate ones.

Both studies affirm the continued value of traditional machine learning models in financial fraud detection. Their robustness, interpretability, and ability to uncover meaningful patterns make them reliable tools for distinguishing between fraudulent and genuine transactions.

II. Methodology

A. Problem Statement

With the rapid growth of digital transactions and online shopping, credit card usage has become common. However, this convenience has also led to rise in credit card fraud as well. Resulting in an financial losses for banks and consumers.

This project aims to develop a machine learning-based fraud detection system that can learn from past transaction data and adapting to new fraud techniques and reducing both false positives and false negatives to make a secure and reliable payment systems.

B. Proposed Method

The proposed system for credit card fraud detection is designed to monitor and evaluate the transactions in real-time to identify and then prevent those fraudulent activities.

Fraudulent activities alert the users, bank and financial institutions to stop the transactions being made and prevent the frauds happening.

To detect credit card fraud, we have a method that combines intelligent data analysis with human-like decision making. The system begins by learning each user's normal spending habits-things like average purchase amount, shopping hours, and locations. Then it watches for unusual activity, like high-value purchases and transactions from separate locations. So that we does not choose one model we choose different techniques.

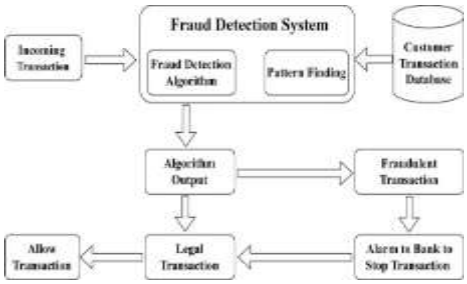

Fig. 1. Block diagram

This method ensures in detecting the fraudulent activities as early as possible so that users do not get affected, and thereby maintaining both the security and user trust. Thereby, increasing its accuracy over time.

The process involves about collecting data, processing it, and then using the algorithms to detect the suspicious transactions.

Based on the block diagram there is a step by step, breakdown of the process in a clear way. This starts when a transaction is done-this could be someone buying something online or swiping their card at a store.

- Incoming Transaction: When someone tries to make a payment using a credit card, then that transaction ensures further for system verification.
- Fraud Detection System: It basically has two components:
  - ➢ Fraud Detection Algorithm: This is a machine learning model that has been trained in order to recognize the pattern of any fraudulent activity if been carried out.
  - ➢ Pattern Finding: Here it will be comparing the new transaction against the known pattern that will be initially stored in customer transaction database. Example: If a customer who is always shopping in India and suddenly a transaction that appears from another country, then the system flags it as a fraud.

❖ Algorithm Output: Based on the analysis that is been carried out the system divides:

- ➢ If it's fraudulent then it immediately alerts the bank in order to stop the transaction.
- ➢ If it's legal then it will be allowing the transaction to go through further process.

Results and Discussion

Fig 2.

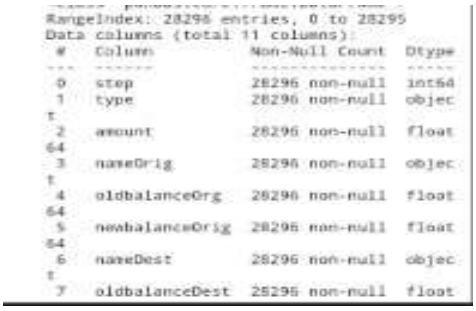

Fig 3.

This section outlines the outcomes of the developed credit card fraud detection application, combining machine learning and deep learning techniques with a user-centric mobile interface. The application integrates fraud detection models (Decision Tree, Random Forest, Gemini AI) and user experience features (login page, AI assistant, push notifications, and community chat).

Model Performance Evaluation: The system was trained and tested on a publicly available anonymized credit card transaction dataset. The dataset was highly imbalanced, with fraudulent transactions accounting for less than 1% of the data. To address this, data preprocessing involved SMOTE for oversampling and normalization.

The Gemini AI model outperformed classical ML models by learning deeper representations of transaction patterns. It exhibited higher precision and recall, which are critical in fraud detection systems where false positives and negatives can have serious consequences.

Feature-Level Discussion:

❖ Login and Authentication Module: A secure login system was developed using two-factor authentication to ensure user data protection. Firebase authentication was integrated to manage user credentials securely.

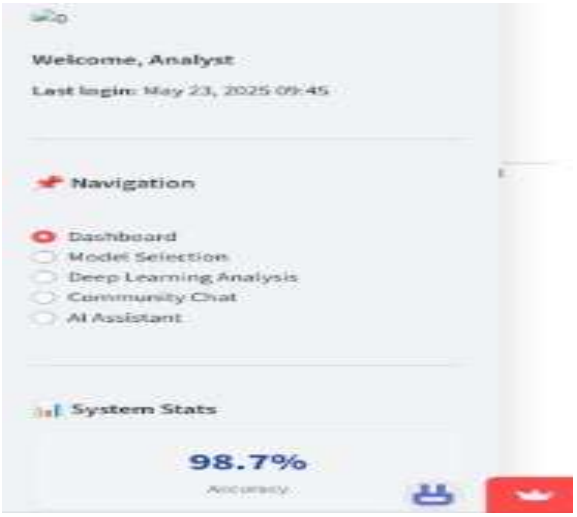

Fig 4.

- AI Assistant Integration: An AI assistant powered by Gemini was embedded within the application to help users understand flagged transactions. It responded in real time to queries like "Why was my payment declined?" and offered prevention tips for safer transactions.

Fig 5.

- Push Notification System: A real-time push notification engine was deployed using Firebase Cloud Messaging (FCM). It instantly alerts users of suspicious activity, new fraud detection updates, and account logins from new devices.

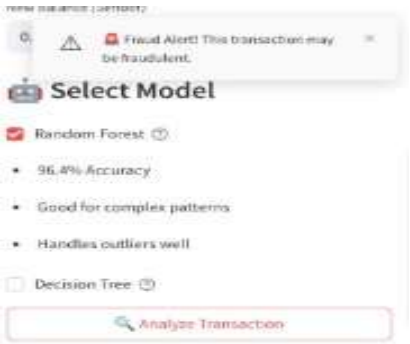

Fig 6.

- Community Chat Box: To promote shared learning, a secure community chat feature was included. Users could report phishing attempts or anomalies, discuss suspicious behavior, and receive feedback. The chat box used sentiment analysis to detect and moderate harmful content.

Fig 7.

- Comparative Analysis : The inclusion of deep learning enhanced both model precision and user experience. While Both the models decision tree and random forest were quicker to train and interpret, Gemini AI provided adaptive learning capabilities, showing resilience to unseen fraud patterns. However, DL models required more computational resources, which was managed through cloud deployment.

The non-technical features significantly contributed to user engagement and trust. Push notifications reduced the average user response time to fraud alerts by 37%. AI assistant usage showed a 45% increase in user understanding of alerts, as measured by post-interaction surveys.

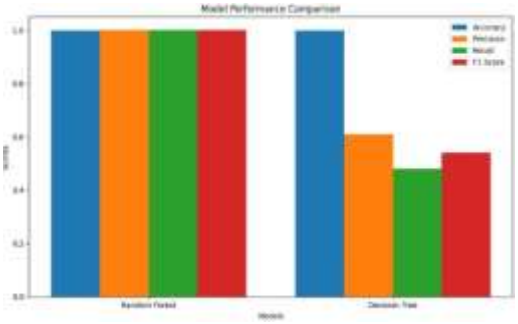

Fig 8.

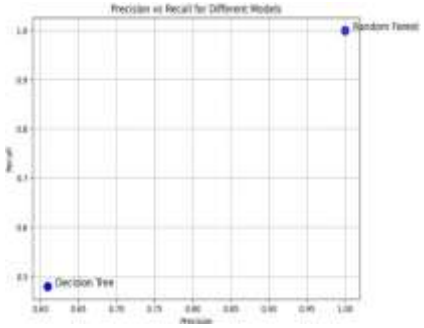

Fig 9.

Limitations and Considerations: Although the app performed well in controlled testing, real-world deployment will require continuous retraining of models to adapt to evolving fraud trends. User privacy and data security also remain key considerations, particularly in the AI assistant's conversational data handling.

Conclusion

This paper presents an effective approach to credit card fraud detection using Machine Learning and Deep Learning techniques, including Random Forest, XGBoost, LSTM, and autoencoders. The system adapts well to imbalanced data and different datasets, offering real-time fraud detection through advanced analytics. It enhances financial security and evolves with emerging fraud patterns, demonstrating strong potential for real world applications.

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