PROJECT ABSTRACTION

PreventPay: An AI-Powered Proactive Credit Card Fraud Prevention System with Dynamic Risk Assessment and Multi-Gateway Integration

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Project Title

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Problem Statement

Credit card fraud is a growing global threat, with estimated losses surpassing $30 billion in 2023 due to the increasing volume of digital transactions. Traditional fraud detection methods struggle to keep pace with sophisticated fraudulent techniques, often leading to false positives or undetected fraud. The challenge lies in developing a highly accurate, real-time fraud prevention system that can effectively distinguish between legitimate and fraudulent transactions while maintaining transparency and interpretability.

Abstract

This paper introduces PreventPay, an AI-powered fraud prevention system that utilizes the XGBoost classifier to detect fraudulent transactions with exceptional accuracy. Trained on a dataset of 514,167 transactions, the model achieved an accuracy of 98.84%, with precision, recall, and F1-scores of 0.99 for both legitimate and fraudulent transactions. A confusion matrix analysis demonstrated minimal false positives and false negatives, ensuring robust fraud detection while reducing financial losses.

To enhance interpretability, SHapley Additive exPlanations (SHAP) was integrated, revealing key influencing factors such as transaction amount, frequency, and merchant category. This insight-driven approach helps financial institutions understand fraud patterns and refine prevention strategies. Additionally, the system is designed for real-time fraud detection, integrating multi-gateway risk assessment for enhanced security across payment platforms.

Future advancements include incorporating graph-based neural networks for transaction network analysis and adaptive learning models to counter evolving fraud tactics. By combining high-performance machine learning with explainable

AI, PreventPay offers a scalable, transparent, and resilient fraud prevention solution for modern digital financial ecosystems.

Introduction

With the rapid expansion of online transactions, credit card fraud has become a critical issue, causing significant financial and reputational damage to businesses and consumers. Existing fraud detection systems often rely on static rule-based approaches, which fail to detect evolving fraud techniques. Machine learning has emerged as a powerful tool for fraud prevention, offering high accuracy and adaptability. However, many AI models lack interpretability, making it difficult for stakeholders to trust and understand predictions. This paper presents PreventPay, a proactive fraud prevention system that integrates XGBoost-based fraud detection with SHAP explainability, ensuring both accuracy and transparency.

Proposed Solution

PreventPay employs a high-performance XGBoost classifier trained on real-world transaction data to detect fraudulent activities with remarkable precision. The system integrates a multi-gateway risk assessment framework, analyzing transactions across different payment platforms for enhanced fraud detection. To ensure interpretability, SHAP-based feature analysis provides insights into transaction risk factors, enabling organizations to refine fraud prevention strategies dynamically. Additionally, the model supports real-time detection, ensuring immediate fraud mitigation.

Key Features

- High-Accuracy Fraud Detection: Achieves 98.84% accuracy with 0.99 precision, recall, and F1-score for both fraud and legitimate transactions.
- SHAP-Based Explainability: Provides transparency by identifying key fraud indicators such as transaction amount, frequency, and merchant category.
- Real-Time Detection: Instantly flags suspicious transactions, enabling swift fraud prevention actions.

- Multi-Gateway Risk Assessment: Analyzes transactions across various payment gateways to detect fraudulent patterns.
- Adaptive Learning Capability: Future enhancements include graph-based neural networks and self-learning models to counter emerging fraud techniques.

Conclusion

PreventPay represents a breakthrough in credit card fraud prevention, combining high-accuracy machine learning models with explainable AI to enhance security, transparency, and real-time fraud detection. The integration of SHAP-based interpretability ensures that financial institutions can trust and refine fraud detection strategies. Future improvements will focus on advanced neural networks and adaptive fraud detection techniques, further strengthening the resilience of digital financial systems. By leveraging cutting-edge AI technologies, PreventPay sets a new standard for proactive fraud prevention in the evolving financial landscape.