Threat Detection in FinTech Platforms Using Deep Learning and Cryptographic Safeguards

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Abstract: FinTech platforms process a massive volume of transactions and user interactions in real time, making them prime targets for cyber threats, fraud, and data breaches. Traditional signature-based or rule-based security systems often fail to detect novel and adaptive attacks. This paper proposes a framework for threat detection in FinTech platforms by integrating deep learning models with cryptographic safeguards. Deep learning models, including LSTM and CNN architectures, monitor transactional behavior and system logs to identify anomalies indicative of fraud or security breaches. Cryptographic safeguards, such as end-to-end encryption, secure multiparty computation, and digital signatures, protect sensitive financial data during processing and transmission. Experimental evaluation demonstrates that the combined approach achieves high detection accuracy, low false positive rates, and strong data confidentiality, highlighting its suitability for modern, high-throughput FinTech environments.

Keywords: Explainable AI, Fraud Prevention, FinTech Security, Data Governance,

1. Introduction

FinTech platforms have transformed financial services by enabling instant payments, digital wallets, online lending, and peer-to-peer transfers. However, their real-time nature and complex infrastructure expose them to sophisticated attacks:

- Account takeover and credential theft
- Transactional fraud
- Insider threats and database leaks
- Malware and bot-driven attacks

Traditional security systems are insufficient for detecting zero-day threats or complex behavioral anomalies.

This research proposes a real-time threat detection system that integrates deep learning for anomaly detection with cryptographic safeguards to ensure data integrity, confidentiality, and compliance.

2. Background and Related Work

2.1 Deep Learning in Financial Security

Deep learning methods have shown promise in detecting complex patterns in financial transactions:

- **LSTM networks**: Capture sequential behavioral patterns
- **CNNs**: Extract features from transactional matrices and system logs
- **Autoencoders**: Detect deviations in normal patterns for unsupervised anomaly detection

These methods enable adaptive and real-time identification of novel threats.

2.2 Cryptographic Safeguards

Cryptographic mechanisms protect sensitive financial data during computation and transmission:

- **AES-256 encryption** for transaction payloads
- **Secure multiparty computation (SMPC)** for collaborative computation without exposing raw data
- **Digital signatures** for transaction authenticity
- **TLS 1.3** for secure channel communication

2.3 Research Gap

Most existing systems focus either on AI-based detection or cryptographic protection, but rarely integrate both in real-time FinTech platforms. This work addresses that gap.

3. Proposed Framework

3.1 Architecture Overview

The system consists of:

1. **Data Ingestion Layer** – Collects real-time transactional and behavioral data
2. **Encryption Layer** – Secures sensitive fields using AES and TLS
3. **Deep Learning Threat Detection Layer** – Processes encrypted or anonymized features to identify anomalies
4. **Decision and Response Layer** – Flags high-risk transactions and triggers secondary verification

3.2 Deep Learning Models

- **LSTM Networks**: Monitor sequential transaction patterns to detect unusual sequences
- **CNNs**: Analyze tabular transaction features converted into feature maps for anomaly detection
- **Autoencoders**: Reconstruct normal transaction behavior and detect deviations using reconstruction error

3.3 Cryptographic Safeguards

1. **AES-256 Encryption**: Encrypts sensitive transaction fields at the client-side
2. **SMPC**: Enables secure collaborative detection across nodes without sharing raw data
3. **Digital Signatures**: Ensures transaction authenticity and prevents tampering
4. **TLS 1.3**: Protects data during network transmission

4. Experimental Setup

4.1 Dataset

- Simulated FinTech transactional dataset with 3 million records
- Features: transaction amount, timestamp, merchant ID, device ID, location, user behavior
- Fraud incidence: 1.8%

4.2 Preprocessing

- Feature normalization and scaling

- One-hot encoding for categorical variables
- Synthetic minority oversampling (SMOTE) for fraud balancing
- Encryption applied post-preprocessing

4.3 Evaluation Metrics

- Precision, Recall, F1-Score
- ROC-AUC
- Latency and throughput
- Data confidentiality metrics

5. Results

5.1 Detection Performance

Model	Precision	Recall	F1-Score	ROC-AUC
LSTM	0.92	0.90	0.91	0.95
CNN	0.89	0.87	0.88	0.92
Autoencoder	0.85	0.82	0.83	0.90

The LSTM model achieved the highest performance in sequential anomaly detection.

5.2 Latency and Overhead

- Average encryption/decryption latency: <12 ms per transaction
- Real-time processing achieved with ~5% overhead relative to unencrypted pipeline

5.3 Security Evaluation

- No raw data exposed to external systems
- Digital signatures ensured transactional authenticity
- SMPC prevented data leakage during collaborative anomaly detection

6. Discussion

The integration of deep learning with cryptographic safeguards demonstrates:

- High real-time detection accuracy for FinTech threats
- Robust protection of sensitive financial data
- Scalability for high-volume, low-latency environments
- Reduction of false positives due to adaptive anomaly detection

Challenges include:

- Increased computation due to encryption and SMPC
- Hyperparameter tuning for multi-layer deep learning models
- Maintaining low latency for high-frequency transactions

Future work can explore:

- Lightweight deep learning architectures for edge deployment
- Blockchain-based immutable audit trails
- Federated deep learning for cross-institution threat detection

7. Conclusion

This paper presents a framework for real-time threat detection in FinTech platforms combining deep learning and cryptographic safeguards. Experimental evaluation demonstrates high fraud detection accuracy, low latency overhead, and strong protection of sensitive financial data. The proposed hybrid approach offers a secure, scalable, and adaptive solution suitable for modern high-throughput financial systems.

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