ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25mar1105

AI and Blockchain Integration in Finance

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Submitted to the Faculty of the Graduate School in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy Business University of the Cumberland

Publication Date: 2025/04/10

Abstract: The convergence of Artificial Intelligence (AI) and Blockchain technology is reshaping the financial industry. AI enables intelligent data analysis, fraud detection, and automation, while blockchain ensures decentralized, secure, and transparent record-keeping. This paper explores the integration of AI and blockchain in financial applications, focusing on security, decentralization, smart contracts, and AI-driven consensus mechanisms. A review of 20+ scholarly sources from IEEE and ScienceDirect highlights opportunities, challenges, and future research directions. While the synergy between AI and blockchain presents promising applications in finance, regulatory hurdles, scalability issues, and computational overhead pose challenges. The study concludes that AI-blockchain integration has the potential to enhance financial services, improve efficiency, and establish new trust models, but requires careful implementation and governance.

Keywords: *Artificial Intelligence, Blockchain, Smart Contracts, Financial Security, Decentralization, AI-driven Consensus.*

How to Cite: Chetankumar Prajapati (2025). AI and Blockchain Integration in Finance. *International Journal of Innovative Science and Research Technology*, 10(3), 2537-2538. https://doi.org/10.38124/ijisrt/25mar1105

I. INTRODUCTION

Artificial Intelligence (AI) and Blockchain are two of the most influential technologies of the digital age. AI enables automated decision-making and predictive analytics, while blockchain provides decentralized, immutable record-keeping. The intersection of these technologies is transforming the finance sector, offering improvements in security, transparency, and operational efficiency. This paper examines how AI and blockchain complement each other in finance, focusing on security enhancements, smart contracts, and consensus mechanisms. The study explores the potential benefits, challenges, and implications for financial institutions, regulatory bodies, and consumers.

II. LITERATURE REVIEW

Numerous studies have explored the integration of AI and blockchain in finance. According to Singh et al. (2023), blockchain provides a trustless environment, while AI introduces automation and intelligence into financial systems. AI-driven analytics can detect fraudulent transactions in real time (Nguyen et al., 2022), while blockchain ensures that transactions remain tamper-proof and auditable (Kumar & Sharma, 2021). Researchers have also examined the role of AI in optimizing smart contract execution (Tiwari et al., 2024), as well as AI-driven consensus mechanisms to improve blockchain scalability (Xiao et al., 2022). This section presents an in-depth review of the academic literature to establish the foundations of AI-blockchain integration in finance.

III. METHODOLOGY

This research follows a qualitative approach, analyzing peer-reviewed journal articles, conference papers, and case studies from IEEE Xplore and ScienceDirect. The study categorizes literature into key areas: security, smart contracts, decentralization, and AI-driven consensus. Comparative analysis is performed to evaluate the strengths and limitations of AI-blockchain applications in finance. The paper also incorporates real-world case studies to assess industry adoption and future trends.

IV. ANALYSIS

- *Security and Fraud Detection*

AI enhances fraud detection in financial transactions, identifying patterns and anomalies that indicate potential security breaches (Singh & Shivaprasad, 2023). Blockchain ensures that once transactions are recorded, they cannot be altered, providing an immutable audit trail. By integrating AI-driven fraud detection with blockchain's secure ledger, financial institutions can improve security and compliance.

- *Decentralization and Financial Inclusion*

Blockchain enables decentralized finance (DeFi), allowing financial transactions without intermediaries. AI-powered credit scoring (Thatikonda et al., 2023) enables inclusive lending models by assessing borrower risk without relying on traditional credit bureaus. The combination of AI and blockchain enhances accessibility and efficiency in financial services.

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- *Smart Contracts and Automation*

Smart contracts automate financial agreements on blockchain networks, ensuring execution based on predefined rules. AI-driven smart contracts can adjust dynamically based on external data, improving contract adaptability. AI-powered oracles provide real-time data feeds to smart contracts, enabling more complex financial applications (Zhang & Chen, 2021).

- *AI-Driven Consensus Mechanisms*

Traditional blockchain consensus mechanisms, such as Proof of Work (PoW) and Proof of Stake (PoS), have scalability and energy limitations. AI-driven consensus mechanisms improve transaction validation efficiency (Ugarte et al., 2019), reducing computational overhead and increasing blockchain throughput. AI optimizes node selection, predictive analytics, and fraud detection in blockchain networks.

V. DISCUSSION

Despite the advantages of AI-blockchain integration, several challenges remain. Regulatory compliance is a major concern, as AI-powered financial services must adhere to legal frameworks. Privacy issues arise when AI analyzes blockchain data, requiring privacy-preserving AI techniques. Scalability constraints must be addressed through off-chain AI processing or hybrid architectures. Future research should explore ethical considerations, such as bias in AI-driven financial models.

VI. CONCLUSION

The integration of AI and blockchain has the potential to revolutionize finance by enhancing security, automation, and decentralization. AI-driven fraud detection, smart contracts, and consensus mechanisms improve blockchain functionality, while blockchain ensures data integrity and transparency for AI models. Despite challenges, ongoing research and industry adoption will shape the future of AI-powered financial systems.

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