



FINTECH REVOLUTION: A SYSTEMATIC REVIEW OF AI AND BLOCKCHAIN INTEGRATION IN MODERN FINANCIAL SYSTEMS IN BANKING SECTOR

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Abstract—The FinTech revolution is changing the way banks work around the world by combining blockchain and artificial intelligence (AI) to make safe, efficient, and customer-focused financial environments. A systematic review of AI blockchain convergence in modern banking, emphasizing its transformative impact on security, operational efficiency, and financial innovation. AI enables intelligent decision-making through applications such as fraud detection, credit risk assessment, algorithmic trading, and predictive analytics, while blockchain provides decentralized, tamper-resistant, and auditable transaction infrastructure. Digital currencies, asset tokenization, decentralized finance (DeFi), smart contracts, and automated regulatory compliance are some of the new FinTech applications driven by their synergy. This integration also supports Environmental, Social, and Governance (ESG) by facilitating real-time fund allocation, sustainable investment tracking, and transparent auditing. Despite its significant potential persisting, including regulatory ambiguity, scalability limitations, cybersecurity risks, and data privacy concerns, which limit large-scale adoption in banking systems. By synthesizing and analyzing key technological trends, the current capabilities of AI-blockchain integration in FinTech that the synergistic convergence of AI, blockchain, and financial technologies is a critical enabler for next-generation digital banking, promoting financial inclusion, resilience, and sustainable economic growth.

Keywords—FinTech, Blockchain, Artificial Intelligence, Digital Banking, Tokenization, Finance.

I. INTRODUCTION

The global financial services environment is changing because of the financial technology (FinTech) revolution by redefining traditional banking operations and accelerating the transition to a digitally driven ecosystem [1]. While financial institutions have incorporated technology since the 19th century, the scale and speed of innovation in the 21st century are unprecedented. 1,537, over US\$80.4 billion in venture financing was raised by FinTech start-ups in 64 countries, while 291 companies obtained US\$4.5 billion for projects about Bitcoin. Furthermore, the InsurTech segment attracted US\$19.5 billion across 61 countries, highlighting how digital solutions are becoming integral to financial operations [2][3]. This rapid growth mirrors broader entrepreneurial trends in transportation, healthcare, energy, and IoT technologies, illustrating FinTech's pivotal role in global digital transformation.

This expansion of FinTech has disrupted traditional banking models, enabling the rise of start-ups, BigTech firms, banks that compete across multiple financial service domains. Innovations in payments, remittances, peer-to-peer lending, the function of financial intermediaries are being redefined by wealth management, crowdsourcing, capital markets, and digital insurance, enhancing operational efficiency and expanding access to financial services [4][5]. This shift toward digital ecosystems naturally creates the basis for using blockchain technology, which provides the security and trust mechanisms required for such large-scale financial digitization [6][7]. Blockchain technology, originally developed as the distributed ledger behind Bitcoin, has evolved into a cornerstone of decentralized finance (DeFi). Its

cryptographically secured, immutable, and transparent ledger enables trustless transactions, reducing reliance on centralized intermediaries [8]. Beyond cryptocurrencies, blockchain powers cross-border payments, distributed autonomous organizations (DAOs), and digital asset management, supporting real-time, secure, and global financial operations.

Artificial intelligence complements blockchain by providing intelligence and adaptability to digital finance [9][10]. Personalized financial services, algorithmic trading, consumer behaviour prediction, credit scoring, and fraud detection are some of the many current AI applications. When combined with blockchain, AI enhances decision-making, transaction transparency, and automated fund allocation, enabling efficient and resilient banking ecosystems. This convergence of AI and blockchain also aligns with Environmental, Social, and Governance (ESG) initiatives, as it allows financial institutions to direct investments toward green energy projects and social impact initiatives, thereby promoting sustainable economic growth [11][12]. Finally, Blockchain technology and AI are key components of the FinTech revolution because they promise to increase financial market accessibility, which is crucial for crisis management and long-term resilience, efficiency, and transparency. During global disruptions, including pandemics and climate-related emergencies, AI-driven analytics and blockchain-enabled transparency facilitate rapid, secure, and scalable fund distribution, overcoming the delays and inefficiencies of conventional banking.

A. Structure of the paper

This paper is systematized as follows: Section II introduces the fundamentals of FinTech, AI, and Blockchain in banking. Section III presents their applications in banking, Section IV. discusses the synergistic integration of AI, blockchain, and FinTech in Section V, Literature review, Section VI Conclusions and future work.

II. FOUNDATION OF FINTECH, AI AND BLOCKCHAIN

Fintech, or financial technology, refers to the phrase used to characterise the incorporation of technology into financial services to enhance and automate their provision and usage. This combination has transformed the conventional financial processes, resulting in financial solutions that are more efficient, accessible.

A. Overview of Fintech in the Banking Sector

Fintech is a general phrase that may signify different things to different individuals. It might be considered the nexus of money and technology [13], relates to three technological deployments peer-to-peer funding (crowdfunding), Finance's usage of Distributed Ledger Technology (DL) and robots to offer financial services advice. It indicates either technology-driven innovation.

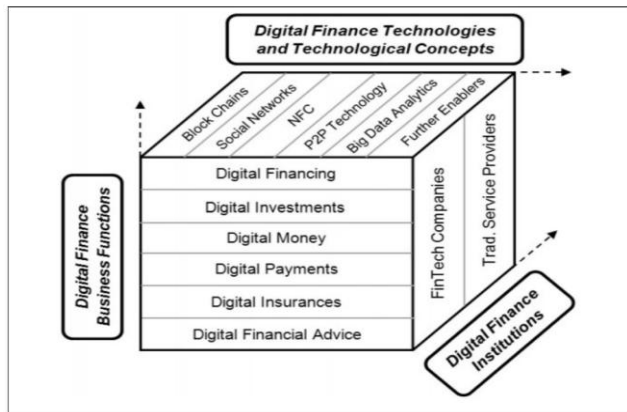


Fig. 1. Fintech Architecture

Fintech encompasses the following activities: financing, investing, money, payments, insurance, and financial advising (Figure 1). Traditional banking, once reliant on manual processes and physical branches, has evolved into a technology-driven ecosystem that prioritizes speed, security, and customer-centric solutions.

Mobile banking, cloud computing, big data analytics, blockchain, and artificial intelligence (AI) are all examples of fintech in banking. These innovative technologies improve transaction efficiency, fraud detection, risk management, and personalized financial services. The adoption of FinTech has enabled real-time digital payments, automated lending platforms, smart auditing, and enhanced regulatory compliance, reducing operational costs while improving accessibility and transparency.

B. Blockchain Technology: Architecture and Types

A distributed digital ledger that records transactions across a network, blockchain technology. It was first created as a platform for Bitcoin. [14][15]. Every transaction is connected to the one before it, arranged into a block, and safeguarded with cryptographic techniques. Blockchain technology is an unsettling force on a wide variety of different companies,

entirely revolutionizing the way information is passed around, stored, and protected. Blocks are connected to each the next through cryptographic hashes, creating a chain to guarantee data integrity and security.

1) Architecture of Blockchain

Blockchain technology enables various transactions to be carried out by several communicating parties without the participation of a third party. Miner nodes are specialised nodes that verify and validate these transactions and communications. Figure 2 illustrates the Blockchain's architecture. The chain and block structure is shown [16]. The previous block's hash determines the chain of blocks. The split between a block's two sides.

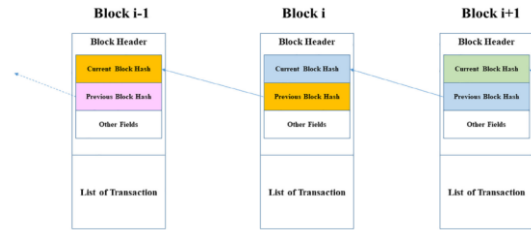


Fig. 2. Blockchain Architecture

- **Block header:** The header of a block consists of three sections. An element that connects one block to another is the hash code of the prior block. The second component, which is realistically challenging to execute, consists of mining statistics that are needed to generate the block that modifies all of the hash codes of the remaining chain.
- **List of transactions:** The block's second part provides a list of legitimate transactions. The block and transaction size determine a block's total number of transactions. The transactions are authenticated and authorized using asymmetric cryptography as soon as the chain includes a transaction.

2) Types Of Blockchain

Figure 3 shows that there are various kinds of blockchain, each with its own set of advantages and applications. These range from public financial systems to private, encrypted business solutions.

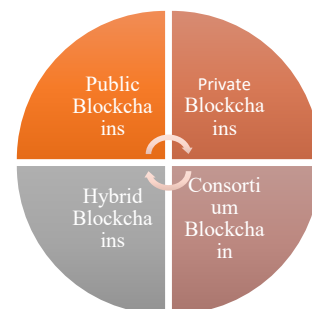


Fig. 3. Types of Blockchain

- **Public Blockchains:** The network allows anyone to participate, as public blockchains are open and permissionless. A dispersed network of nodes manages these completely decentralized blockchains. They use consensus methods such as Proof of Stake (PoS) and Proof of Work (PoW) to construct new

blocks and verify transactions. Blockchains like Ethereum and Bitcoin are instances of this kind.

- **Private Blockchains:** Permissioned blockchains, sometimes referred to as private blockchains, limit access to a certain user group [17]. A single organization governs these networks.
- **Consortium Blockchain:** Consortium blockchains combine public and private blockchain features; instead of a single organization governing the network, several organizations work together to distribute trust among each other.
- **Hybrid Blockchains:** Blockchains that are hybrid combine elements from public and private blockchains to create a customizable solution [18]. These blockchains enable both public and restricted access, allowing certain data to be shared publicly while keeping other data confidential

C. Fundamentals of Artificial intelligence (AI) in banking

AI has become a transformative driver in the modern banking sector, enabling automation, predictive analytics, and intelligent decision-making. By using technology like NLP, DL, and ML, AI enhances operational efficiency, strengthens security, and improves customer experiences in financial institutions.

1) AI in Risk Management and Fraud Detection

The aim of risk management in the financial services sector is to identify, assess, and rank potential threats to mitigate their impact and prevent adverse outcomes. When it comes to detecting fraud, AI has proven to be quite effective [19]. Financial institutions are always at risk from fraud, which can take many different forms, including money laundering and credit card fraud.

2) Credit Scoring and Loan Assessment

In banking, AI is employed in credit scoring and loan evaluation to more accurately assess a borrower's creditworthiness and ability to repay loans than is possible with conventional techniques. AI models offer quicker and more accurate loan approvals by examining transaction histories, spending trends, digital footprints, and other data sources [20]. This increases the efficiency of operations, lowers the risk of non-performing assets (NPAs), and facilitates personalized lending decisions.

3) Customer Service Automation

To enhance and streamline customer service processes. It could highlight how these technologies aim to improve response accuracy, speed, and personalization [21] the possible advantages of such automation, such as enhanced customer satisfaction, cost effectiveness, and efficiency.

4) Anti-Money Laundering and Compliance Automation

Compliance with regulations and anti-money laundering (AML) measures are essential in today's banking industry for the prevention of illegal financial transactions. Artificial intelligence (AI) enhances AML by detecting suspicious transaction patterns, monitoring real-time financial activity, and reducing false positives it ensures regulatory adherence, and enables faster detection of fraudulent or high-risk activities.

III. BLOCKCHAIN APPLICATION IN BANKING

Blockchain technology has become a game-changing instrument in the banking industry by providing safe,

transparent, and decentralized financial operations. Its unchangeable and impenetrable ledger guarantees that every transaction can be independently verified and audited, reducing the reliance on intermediaries and mitigating the risk of fraud in banking. Some of the applications are discussed below:

A. Digital Identity Verification and KYC

Banks and other financial institutions are required to keep detailed records of their clients' identities, financial situations, and risk tolerances according to the Know Your Customer (KYC) standard in the banking industry [22]. Included are biometric verification, ID card verification, and document verification for address confirmation. By using KYC, financial fraud, antisocial behaviour, and money laundering are avoided. The banks' existing manual KYC procedure has redundancies, delays, and higher costs. The four main components of an Ethereum-based KYC verification system are the customer, the Ethereum Blockchain, the bank, and safe storage.

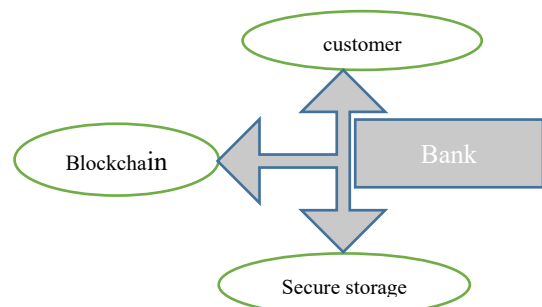


Fig. 4. Digital Identity Verification and KYC

Some of the digital identity verification and KYC-related keywords discussed are below:

- **Customer:** The consumer sends the bank a KYC request, which contains the customer's data and personal information.
- **Blockchain:** Blockchain has a smart contract (a software that manages all logic) that keeps track of all banks, their clients, and KYC requirements.
- **Bank:** After securely storing the KYC documents, the bank generates a hash link so they may be put on the blockchain.

B. Smart Contract and Automated Settlement

A significant development in blockchain technology is smart contracts. To fulfil the conditions of an agreement, smart contracts were initially suggested in the transaction protocol. Smart contracts, in their simplest form, are digital containers for code that mimic and encapsulate the terms of physical contracts [23]. A contract is essentially an agreement between many parties that may be enforced in a court of law, and each party has a responsibility to fulfil its share of the agreement. Most importantly, the contract must have the force of law, usually accomplished through a single organization.

C. Cross-Border Payment and Remittances

The high volatility of many cryptocurrencies has positioned them more as investment assets rather than reliable payment instruments leading individuals and businesses to seek the combination of cryptocurrency flexibility and fiat currency stability for cross-border payments [24].

D. Tokenization of Assets and Digital Currencies

Blockchain technology, tokenization transform ownership rights of tangible assets like commodities, stocks, and real estate into digital tokens that can be safely exchanged on decentralized marketplaces. Fractional ownership is made possible by this method, which also improves market liquidity and lessens the need for middlemen [25]. The emergence of digital currencies such as Bitcoin and Ethereum has made borderless, peer-to-peer transactions, and digital currencies issued by central banks (CBDCs). Digital currencies and tokenized assets improve financial inclusion, security, and transparency; nonetheless, issues including market volatility, cybersecurity threats, and regulatory ambiguity must be resolved before they can be widely used in contemporary banking ecosystems.

E. Decentralized finance (DeFi) and lending platform

One sector that stands to benefit greatly from the advent of blockchain technology is the banking sector, but the technology has the potential to revolutionise many others. Blockchain technology's primary characteristic is its distributed, decentralized ledger, which makes record-keeping secure, transparent, and impermeable. Decentralization guarantees that there isn't a single entity or middleman in charge of the whole network. Instead, a huge number of people, commonly referred to as nodes, are responsible for maintaining the network. Redundancy, a single point of failure elimination, and a full copy of the blockchain are all present on every node [26]. Distributed ledger technology ensures that information is not stored centrally but is dispersed throughout every network node.

IV. SYNERGISTIC INTEGRATION OF AI, BLOCKCHAIN AND FINTECH

The convergence of Artificial Intelligence (AI), Blockchain, and Financial Technology (FinTech) represents a transformative paradigm in modern banking systems, as shown in Figure 5. While each technology independently enhances efficiency, security, and innovation, their synergistic integration enables intelligent, transparent, and fully digitalized financial ecosystems [27]. This section highlights AI-enhanced security, blockchain for data analytic and many the through the following subheadings:

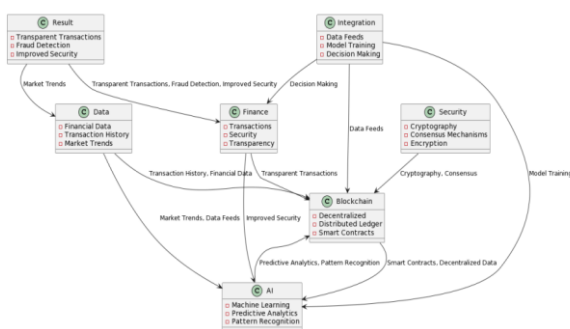


Fig. 5. Blockchain and Artificial Intelligence (AI) Integration for Revolutionizing Security and Transparency in Finance

A. AI-Enhanced Blockchain Security and Efficiency

AI can significantly enhance the performance of blockchain advanced analytics. AI combined with blockchain technology greatly increases operational effectiveness and security. Blockchain guarantees decentralized, impenetrable

ledgers, and AI improves its capacity for threat detection, anomaly identification, and predictive maintenance [28]. By detecting fraudulent activity like double-spending or illegal access in real time, machine learning models may improve cybersecurity.

B. AI for Blockchain Data Analytics and Pattern Detection

A sector with a wealth of data and high-quality information is banking and financial services. Data analytics is quite significant in this context [29]. The capacity of data analytics to provide value and solve problems across a range of bank activities has made it vital in the face of growing digitization. Analytics not only solve problems but also automate procedures and provide solutions. This industry was among the first to employ data analytics to anticipate market trends, improve efficiency, and evaluate and lower credit risk.

The following discusses several significant areas where Analytics has already made inroads:

- **Pre-Approved Personal Loans:** Existing clients who qualify are notified by email or SMS. As a result, online and mobile banking are used to approve rapid loans.
- **Early warning System:** Alerts given to operational personnel whenever stress signals in standard accounts have been recognized. So that the bank may reduce credit risk by taking remedial measures and preventing slippage.
- **Marketing & Sales:** able to create and recommend items that are appropriate for clients and comprehend their buying habits. So that the bank may optimize income by maximizing sales at the lowest possible cost.

C. Blockchain for Auditable AI Decision Making

Decision-making in contemporary financial systems is made transparent and auditable by the integration of AI and blockchain technology. Although the use of AI models in banking is becoming increasingly common for risk assessment, algorithmic trading, fraud detection, and credit scoring, concerns about regulatory compliance and accountability are raised by their opaque, "black-box" nature. To provide a verifiable audit trail, blockchain technology offers an immutable, time-stamped ledger to document AI inputs, decision logic, and results [30]. By using this, stakeholders and regulators may verify adherence to financial and ethical norms, track down choices, and identify bias through the combination of blockchain systems with smart contracts, enhancing governance, data integrity, and confidence in digital financial ecosystems.

D. Challenges and Risks in the Convergence of Blockchain, AI, and Fintech

Some of the challenges and risks in the convergence of blockchain, AI and Fintech are given below some point:

1) Data Privacy and Ethical Concerns in AI-Powered Financial Services

Much transactional and personal information is needed by AI-powered financial services to create insights, make independent decisions, and improve customer experiences. However, this data dependence presents humongous tasks around permission, ownership, and data privacy. Data protection regulations are yet to be developed in most developing economies

2) Scalability and Adoption Challenges of Blockchain-Based Solution

Blockchain has a variety of possible benefits, including decentralization, immutability, and transparency, but financial services sector adoption and scalability are major challenges. These constraints make them less applicable to high-traffic financial systems, such as payment and remittance systems, that require real-time data processing. Scalability of Blockchain is a major challenge to its widespread implementation as financial transactions continue to increase in quantity and complexity.

3) Cybersecurity Risks and Resilience Strategies

Complex cybersecurity challenges are ushered in by the convergence of fintech, blockchain, and AI, which also expands the attack surface for attackers. Adversarial attacks or poisoned datasets can compromise the reliability of AI systems' decisions. Similarly, while blockchain is commonly targeted by phishing attacks, smart contract vulnerabilities, and wallet security weaknesses, a trivial breach can lead to widespread financial and reputational loss as financial systems grow increasingly data-reliant and interconnected.

4) Inefficiency of Data Storage

Blockchains automatically keep an unchangeable ledger of all transactions and status updates [31]. This guarantees accuracy and openness, but it may raise storage expenses. AI, in particular, needs the effective processing and storage of enormous volumes of data.

V. LITERATURE REVIEW

This section presents earlier studies on AI- and blockchain-driven innovations in the banking sector. Table I provides a structured comparison of previous research, focusing on the use of blockchain and AI in FinTech applications, emphasizing how these technologies may improve security, transparency, and operational effectiveness while also underlining the difficulties that arise in contemporary financial environments.

Guo (2025) a blockchain-based method for integrating financial AI algorithms, aiming to leverage the decentralization, security, and transparency of blockchain, along with AI's predictive powers and effective data processing. By designing a robust blockchain architecture and optimizing AI algorithms, this research develops an integrated system that enables efficient management of financial data and intelligent decision support. Experimental results demonstrate that the proposed integration method significantly enhances system security, optimizes algorithm performance, and improves data processing efficiency this method in real-world financial scenarios, providing strong support for the further development of financial technology [32].

Nuritdinovich et al. (2025) Fintech 4.0 integrates Artificial Intelligence (AI) with Blockchain technology to enhance smart accounting systems in Industry 4.0, ensuring transparency, automation, and security. Traditional accounting methods such as data manipulation, lack of real-time verification, and inefficiencies in auditing processes, the proposed Blockchain-assisted Decentralized Ledger System (BC-DLS) leverages AI-powered smart contracts and distributed ledgers for automated auditing, ensuring real-time validation and fraud detection. Ensures secure, immutable, and transparent financial records, minimizing discrepancies

and improving trust in financial systems Demonstrating that BC-DLS significantly enhances efficiency, reduces operational costs, and strengthens fraud prevention mechanisms, making it a robust solution for modern financial ecosystems [33].

Singh et al. (2024) artificial intelligence (AI), and cloud computing as key components of financial technology (FinTech) the financial system, with a focus on intelligent finance investment, including blockchain's disruptive potential, how it promotes extensibility, formability & cost-efficiency inside financial Institutions. It reveals linkages that open the path for novel methods and significant developments, emphasizing the convergence of cloud, AI & blockchain. These FinTech territories, the inherent obstacles and dangers while also providing thoughts on legislative and ethical implications, emerging trends, predicting the long-term influence of novel innovations on the financial environment [34].

Kapoor et al.(2024) The banking and financial sector has undergone significant change as a consequence of the financial technology (fintech) revolution, which has increased efficiency, accessibility, and client happiness. New technology like mobile banking, blockchain, and artificial intelligence has changed the way banks operate, which is one way fintech has affected the financial sector. Fintech has redefined the competitive landscape for financial institutions. It offers faster transactions, reduced operational costs, and improved risk management. However, there are also regulatory hurdles, data security concerns, and implications for workforce dynamics in the banking industry. Regulatory frameworks aim to balance innovation with consumer protection effects of fintech, and traditional banks are constantly adapting to keep up with these technological advances [35].

Kumar et al. (2024) AI and blockchain technology might make many sectors safer, more open, and more efficient. It proposes an autonomous AI-based solution that leverages blockchain and machine learning to address industry issues, such as theft, data security, and inefficiency. The recommended response utilizes AI to track patterns and estimate blockchain smart contracts ensuring data exchanges remain secure and unchangeable. In banking, Transaction speed, data quality, fraud reduction, and operational efficiency were the main success factors. That AI with blockchain may simplify decision-making, data security, and operations [36]

Gopal, Gupta and Minocha (2023) According to theory, fintech is a part of the development of financial innovation, which has been acknowledged as both dangerous and advantageous. Fintech has grown as a result of the creation of innovative, cutting-edge, and emerging technologies such as 5G, digital twins, cryptocurrencies, smartphone apps, AI, VR, and the Industrial IoT. Blockchain integration and risk management are two recent technology developments in the fintech and banking security sectors. Additionally, fintech companies are investing in cybersecurity measures to protect against hackers and fraud. These developments are driving the fintech industry's growth and transforming the way financial services are provided [37].

Noman, Shahid and Alam (2023) The application of blockchain and AI as a catalyst for the growth of financial services by closely examining relevant market trends is part of the dynamic interplay between these two revolutionary

technologies and their transformative impact on the realm of financial technology (Fintech). This application takes into account the individual strengths of blockchain and AI, as well

as their combined potential to enhance security, efficiency, and innovation within Fintech [38]

TABLE I. TABLE I. COMPARATIVE ANALYSIS OF AI-BLOCKCHAIN INTEGRATION AND FINTECH APPLICATIONS IN BANKING

Author (Year)	Focus Area	Key Findings	Challenges	Future Work
Guo (2025)	Blockchain-based integration of financial AI	Developed an integrated system leveraging blockchain and AI for financial data management; improved security, algorithm performance, and data processing efficiency	Real-world deployment and interoperability with existing financial systems	Expand large-scale deployment and optimize integration for diverse financial environments
Nuritdinovich et al. (2025)	FinTech 4.0, AI & blockchain for smart accounting	Proposed BC-DLS with AI-powered smart contracts for automated auditing and fraud detection; enhanced transparency and reduced operational cost	Implementation complexity and regulatory compliance	Enhance scalability and explore cross-industry applications of BC-DLS
Singh et al. (2024)	Convergence of AI, cloud computing, and blockchain in FinTech	Highlighted benefits of intelligent finance, cost-efficiency, and blockchain's disruptive potential	Ethical, legal, and operational risks of new technologies	Develop frameworks for ethical governance and risk mitigation
Kapoor et al. (2024)	FinTech transformation in banking and finance	Emerging tech like blockchain, AI, and mobile banking improved transactions, risk management, and customer experience	Data security, regulatory hurdles, and workforce adaptation	Continuous regulatory evolution and deeper customer-focused innovations
Kumar et al. (2024)	AI & blockchain for secure and efficient financial operations	Proposed AI-driven pattern tracking with blockchain smart contracts; improved fraud reduction, transaction speed, and operational efficiency	Data privacy and system integration challenges	Broader industry adaptation and autonomous financial decision-making
Gopal, Gupta & Minocha (2023)	Technological evolution in FinTech and cybersecurity	Identified IIOT, AI, VR, 5G, and blockchain as enablers; emphasized cybersecurity and risk management in banking	Cyber threats and rapid technological change	Focus on advanced cybersecurity measures and secure FinTech ecosystems
Noman, Shahid & Alam (2023)	Augmented and blockchain technology's use in financial technology	Better safety, more productivity, and new ideas in banking made possible by AI and blockchain technology	Limited industrial adoption and standardization	Formulate best practices for large-scale FinTech adoption and innovation

VI. CONCLUSION AND FUTURE WORK

Financial Technology (FinTech) represents the innovative use of emerging technologies to enhance, automate, and optimize financial services, transforming banking, payments, lending, wealth management, and insurance into real-time, data-driven, and customer-centric ecosystems. Credit scoring, Predictive risk assessment, algorithmic trading, and fraud detection are all made possible by artificial intelligence (AI), which also increases intellect and adaptability. At the same time, blockchain provides decentralized, tamper-resistant, and auditable transaction infrastructure that ensures security, transparency, and trust in smart contracts and automated compliance, enhancing efficiency and financial inclusion. Despite these advances, widespread adoption faces challenges including regulatory ambiguity, cybersecurity threats, Scalability constraints, data protection issues, and the opaqueness of AI-driven decision-making. Future work should focus on developing standardized regulatory frameworks, privacy-preserving AI models, cross-border

interoperability, and explainable AI (XAI) integrated with blockchain to ensure transparent and auditable financial decisions. Emerging directions, including quantum-resistant cryptography, edge AI for decentralized banking, and interoperable DeFi protocols, present opportunities for building secure, scalable, and sustainable digital financial ecosystems. By overcoming current limitations, the convergence of AI, blockchain, and FinTech will define next-generation global banking, promoting innovation, resilience, and inclusive economic growth.

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