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REVIEWPAPER

A Comprehensive Survey on Blockchain-Based Digital Payment Systems and Their Impact on Financial Inclusion

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***Abstract*—The increasing speed at which digital payment systems are evolving coupled with the rate at which the blockchain technology is being integrated is restructuring financial systems in the world and redefining financial inclusion. Traditional payment systems might be problematic including excessive cost of transaction, lack of transparency, security risk, and access by underbanked communities. The opportunities to efficiently manage this issue can be offered by the decentralized and transparent architecture of the blockchain technology which increases the efficiency of transactions and removes the middlemen as well as adds the trust to a peer-to-peer platform. This paper has presented a detailed analysis of blockchain-based payment system in digital format in order to identify how they impact financial inclusion. It described the basics of blockchain, the various methods of making a digital payment and how it is possible to compare traditional systems and blockchain system systems. The results reveal the use of blockchain in promoting security, transparency, and financial service provision particularly in the developing nations. It was also noted in the review how blockchain has the potential to empower the unbanked and underserved, in particular, when it comes to the development of inclusive and efficient financial ecosystems. Finally, the study identifies the enduring issues, such as scalability, regulation, and interoperability, and provides some recommendations to attain sustainable and equal digital financial inclusion by innovating blockchain.**

Keywords—Blockchain Technology, Digital Payment Systems, Financial Inclusion, Decentralized Finance (DeFi), Financial Ecosystem.

I. INTRODUCTION

In contemporary societies, an increasing number of individuals are opting to use cyber payments. Individuals pay with electronic money instead of cash. This can be attributed to the numerous emerging digital technologies, which are claimed to be in development, with digital payments being one form of payment that is now globally accepted as a payment method [1]. The emergence of digital payments has introduced colossal transformations and prospects to the economy and financial institutions of the world, as well as to the consumers [2]. The number of online payments has become much higher; therefore, it is essential to investigate their disadvantages and limitations. Many third-party systems are included in the current payment gateway systems, which adds time because transactions sometimes need to pass through several third parties and increases the possibility that they won't go through [3]. The next crucial element is security, where the existing system is failing to meet consumer expectations. A payment made via digital means is referred to as a digital payment. Digital payments involve both the payer and the payee sending and receiving money digitally. It is sometimes termed an electronic payment [4]. Digital payments don't include actual cash or currency notes. All transactions involving digital payments are completed online. It's a quick and useful way to pay.

The procedure that guarantees the formal financial system's availability, use, and ease of access is known as financial inclusion [5]. The primary definition of financial inclusion is the exclusion of a particular demographic. Financial inclusion is the practice of offering vulnerable segments, namely the weaker parts, and the low-income groups, with timely and sufficient credit at the time they require it at an affordable price [6]. Financial inclusion refers to the ability of individual persons and organizations to be able to access convenient and reasonably priced financial services and products that meet their requirements, including credit, insurance, payments, savings, and transactions that are morally and environmentally acceptable [7][8]. It is regarded as one of the major stimulants of economic growth and financial prosperity [9]. Recent research indicates that financial inclusion is a multifaceted notion that encompasses the usage and possession of financial goods, such as mobile money accounts, savings accounts, risk management (insurance), credit provision, and receiving remittances [10].

The detailed approach to guaranteeing immutability and security is the distributed ledger technology (DLT), i.e., blockchain, which stores transactions in a decentralized network of nodes [11]. which, in order to prevent data modification, records and distributes transaction information among several network nodes [12]. Each transaction on a blockchain network is replicated across all nodes. Each player is given the same and irreducible copy of the ledger. Once it is written, it cannot be altered. The data or transfer details come as a series of blocks, which can be termed as blockchain [13]. The first application of blockchain is the incorporation of cryptocurrencies in existing financial systems and commercial organizations, which creates an environment too innovative in the banking market [14].

A. Structure of the Paper

The paper organized in the following way: Section II provide the fundamentals of blockchain technology. Section III outlines various digital payment systems, including blockchain-based systems. Section IV covers the effect of blockchain on financial inclusion. Section V is a review of related research studies, and Section VI is a summary of the paper's key conclusions and recommendations for future work.

II. Blockchain Technology Basics

Blockchain is a decentralized network that could ensure the transparent and secure transmission and storage of digital information [15]. A consensus process is used to verify all the transactions and affix them to a blockchain, which is some sort of digital record. The blockchain is made up of connected blocks, which, with the assistance of cryptographic hashes, enable one to possess an unalterable record of transactions. Blockchain's decentralized structure guarantees security and transparency while doing away with the need for a central authority. Transactions are verified, appended to the blockchain, and disseminated throughout the network by consensus among network users [16]. Beyond cryptocurrencies, this technology has applications in a number of other sectors, offering responsibility, security, and confidence.

A. *Types of Blockchain*

Three categories have been established for the blockchains according to their distinct needs and intended usage: public, private, and consortium (also known as federated) blockchains as shown in Figure 1. With their own distinct set of characteristics and advantages over the others, each kind of blockchain network is made to fulfil a certain function and deal with a particular problem.

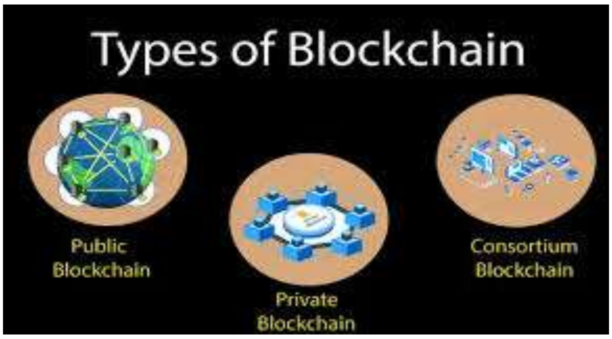

Fig. 1. Types of Blockchains

1) *Public Blockchain*

Public blockchains are a prominent type of decentralized, open blockchain. Also, this type of blockchain technology allows anyone interested in conducting a transaction to access computer networks. Both Proof-of-work and Proof-of-stake models are employed, and the validated individual essentially gets the transaction rewards depending on the validation [17]. As seen in Figure 2, a distributed ledger system is the Public Blockchain that is non-restrictive and does not require any form of authorization. Permission to examine any part of the Blockchain or its data can be given to anybody with access. Additionally, this kind of blockchain enables the verification of both current and historical documents.

Fig. 2. Public Blockchain Technology

2) *Private Blockchain*

Private blockchains include access features, they are locked and not available to the general public. The transaction is enabled by this blockchain with the assistance of the system administrator. These systems, which were developed using private blockchain technology, contain the following features:

- Full of privacy,
- High efficiency,
- Faster transaction,
- Better scalability,
- Faster and speediness.

This type of blockchain is limited to closed networks and systems, which are useful in companies and organizations where participation is restricted to certain persons. This type of blockchain has the necessary security, rights, authorizations, and accessibility, as shown in Figure 3. According to experts, private blockchains are used for a variety of functions, including asset ownership, voting, supply chain management, and the discovery and administration of digital identities.

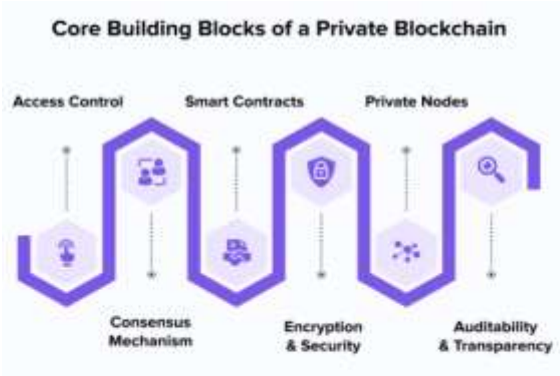

Fig. 3. Private Blockchain Technology

3) *Consortium Blockchain*

A consortium blockchain is a permissioned, semi-decentralized blockchain network that isn't controlled by a single company or open to the public, but rather by a certain set of pre-selected organizations. In contrast to private blockchains, which are run by a single company, and public blockchains, which are completely open and decentralized, consortium blockchains restrict access to a designated group of users while maintaining decentralized governance to prevent monopolization by any one participant, as shown in Figure 4.

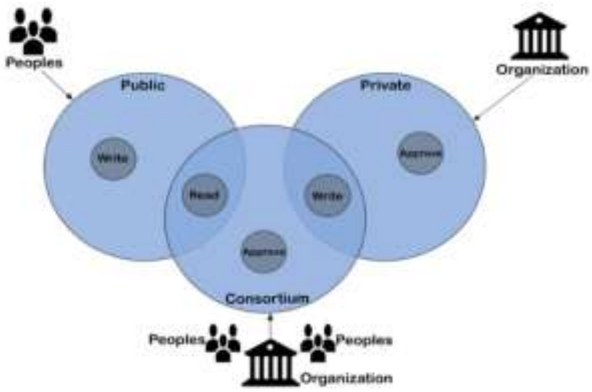

Fig. 4. Consortium Blockchain Technology

Table I presents the comparison of various types of blockchain networks, namely, public, consortium, and private in terms of such significant aspects as access control, decentralization, transparency, performance, privacy, and governance. It illuminates the fact that public blockchains are highly transparent and decentralized, whereas the privatized blockchains are more private and highly performance in a centralized control

TABLE I. COMPARISON OF PUBLIC, CONSORTIUM, AND PRIVATE BLOCKCHAIN TYPES

Feature	Public Blockchain	Consortium Blockchain	Private Blockchain
Access	Permission-less	Permission-ed	Permission-ed
Decentralis-ation	High	Medium	Low
Transparency	High	Medium	Low
Performance	Low	Medium	High
Privacy	Low	Medium	High
Governance	Decentrali-sed	Partially Centralised	Centralised
Examples	Bitcoin, Ethereum	Hyperledger Fabric	Any private blockchain platform

The suitability of private, consortium, and public blockchains for different use cases and needs determines which one is best. Applications that prioritize decentralization, transparency, and security are ideally suited for public blockchains [18]. Applications that place a high value on efficiency, secrecy, and governance are best suited for private blockchains. Applications that must strike a compromise between decentralization, efficiency, and secrecy are ideally suited for consortium blockchains.

B. Blockchain Based Consensus Mechanism

The foundation of any blockchain-based application is made up of consensus processes. Because the blockchain is decentralized, a set of guidelines is needed to determine how users can reach a consensus on a certain state. These recommendations are provided by the consensus approaches. The Bitcoin blockchain was the first to use the Proof of Work (PoW) consensus method [19]. In order to meet the needs of blockchain applications, many consensus methods have been developed since then. The next section describes the common consensus procedures.

III. DIGITAL PAYMENT SYSTEMS

Digital payment systems enable customers to pay for goods and services whenever and wherever they choose, as well as to ease business transactions [20]. Given its obvious advantages, users must utilize them in order for them to be fully realized [21]. Convincing people to use digital payments instead of traditional ones, such as cash, for everyday transactions, is crucial to achieving the intended degree of success in putting digital payments into practice. Consequently, it is critical that decision-makers, including governments, banks, and applicators, recognize and comprehend the key elements that significantly influence consumers' and people's adoption of digital payments.

A. Traditional Payment System

The use of money as a means of transaction dates back a very long way. Payments between economic actors were mostly limited to simple bilateral transactions for a long time, according to the documents. A customer would use fiat or commodity money to purchase a thing produced by an agent [22]. The foundation for the development of payments economics had to be established, which required the creation of banks.

B. Blockchain Based Payments

- **Bitcoin:** Bitcoin is a popular virtual currency that was created using the cryptocurrency idea. A public ledger is updated with verified Bitcoin transactions that have been verified by PoW consensus [23]. First, a block created by sorting and storing all of the transactions that were created during a specific time frame. Following validation by the other nodes in the public blockchain, the newly created block then be appended to the blockchain via the inverse referencing technique. Due to its P2P network architecture, Bitcoin is susceptible to decentralized network assaults like double-spending attacks.
- **Ethereum:** Ethereum moved from Proof-of-Work (PoW), where miners compete to solve cryptographic puzzles, to Proof-of-Stake (PoS), where validators are chosen based on their stakes. Ether Bitcoin relies solely on PoW, with block creation times of 10 minutes, while Ethereum's block time is approximately 12 seconds. Ethereum's blockchain supports Turing-complete smart contracts, enabling programmable state machines and decentralized applications, whereas Bitcoin's scripting language is intentionally limited and not Turing-complete.
- **Hyperledger Fabric:** Hyperledger is a collection of technologies that are used to build new blockchains. Applying Hyperledger Blockchain technology to corporate operations increases accountability, transparency, and algorithmically ensures business partners' confidence [24]. The technologies developed under Hyperledger projects are often referred to be Third Generation Blockchain systems, with Ethereum and Bitcoin being the first and second generations, respectively.
- **IOTA:** The Internet of Things Application (IOTA) is a next-generation DLT designed to address the blockchain's scale constraints while maintaining the same security features, including transparency, immutability, and traceability [25]. IOTA's exceptional scalability is due to the Tangle data structure, which is a DAG made up of several interconnected nodes that hold transactions.

Table II presents a comparison of Blockchain vs. traditional payment systems, and how Blockchain provides direct, secure, low-cost, and faster transactions as compared to traditional systems involving intermediaries, high fees, slower transfers and increased security risks.

TABLE II. COMPARATIVE ANALYSIS OF BLOCKCHAIN BASED PAYMENT AND TRADITIONAL PAYMENT SYSTEMS

Aspects	Blockchain System	Traditional Payment Systems
Multiple sponsors and intermediaries	The buyer and seller transact directly from peer to peer; there is no need for an intermediary.	Each of the several sponsors (brokers), including Visa, PayPal, and Amex, has certain requirements.
Degree of safety	Financial processes happen much more quickly, fraudsters have less time to enter the system without authorization, and the data becomes unchangeable.	Hackable and susceptible, even if just slightly, to attacks by scammers and data thieves.

Taken cost	The cost drops from 0.001 to 0.1% of the total when fewer intermediaries are involved.	The cost is between 1% and 3% inside the state due to the numerous middlemen. When it comes to online payments, PayPal (1.9–3.4%).
Identity secrecy	In addition to incorporating the security protocol, these systems are totally anonymous and extremely secure because they don't require a third party.	Hackers or even the government may compromise privacy and confidentiality for monitoring reasons[26].
Transaction speed	Even international transactions are completed in a matter of hours (no middlemen), which is a faster pace than transactions conducted using conventional means.	Considered quick for domestic transactions, overseas transfers might take one to five days because of the numerous middlemen and potential loss of data.

IV. Impact of Blockchain on Financial Inclusion

The blockchain technology has also been increasingly receiving focus as a disruptive technology that can overcome the primary obstacles to financial inclusion. Initially created as the backbone of cryptocurrencies [27]. Blockchain has come to be a diversified technological platform that also provides decentralization, immutability, transparency, and security [28] . The latter features predispose it to be especially effective in increasing trust, minimizing transaction costs, promoting transparency, and facilitating processes within financial services. Financial inclusion has a potential that can be substantially enhanced through blockchain technology because it is decentralized, cost-effective and secure, and enables marginalized communities to empower themselves. These ideas are represented in the image that is provided [28]. Blockchain may affect digital financial inclusion in many different ways. The diagram shows a visual illustration of the probable events, such as decentralization and cost cutting, better access by the unbanked, greater openness and security, and better speed of transactions.

A. *Financial Inclusion*

The growth-promoting factors to the developing country have been identified to include financial inclusion (FI). The financial literature lacks a consensus definition of financial inclusion because of its multifaceted character and the different approaches taken by different jurisdictions. Nonetheless, it may be simply described as the accessibility and utilization of official financial services by households and enterprises, including opening a bank account with a reputable financial institution [29][30]. Financial inclusion is more broadly defined as a state in which a significant number of people and families have timely and sufficient access to credit and other financial goods at reasonable rates, to the majority of financial services.

B. *Digital Financial Inclusion*

A digital financial service consists of a digital transactional platform, retail agents, and a device (usually a mobile phone) that both customers and retail agents use to perform transactions through the platform [31]. A digital transaction platform is the cornerstone of every digital financial service [32]. Consumers that utilize a digital transactional platform can electronically store value with a bank or non-bank that is authorized to do so, as well as transmit and receive transfers and payments via a device. Additionally, the client can use a non-bank that has been given permission to store money electronically. When engaging with retail agents who have digital devices connected to the communications infrastructure to transmit and receive transaction information, clients can exchange cash for electronically stored value and vice versa.

C. *Problem*

There are both fixed and variable charges for every FI. Many contemporary financial institutions have branches and rely on staff to interact with clients and manage back-office duties like compliance (KYC/AML). They also incur expenses when making foreign payments via their country's payment system and correspondent bank accounts. The financial institution pays more for a lot of little payments since the fees for using the present payment system are often fixed at a rate for each transaction.

D. *Solution*

When utilizing a blockchain, neither physical branches nor payments via the national payment system are required. Since FIs may provide more services online, they won't need as many employees to interact with clients. The addition or withdrawal of funds can be done through agent networks and other means (such as cardless ATM services). Smaller payments are more practical since the cost of transferring money over the blockchain is a fraction of the value transmitted.

V. Literature Review

In this section, the study highlights related research on the incorporation of blockchain technology into digital payment systems and financial inclusion, demonstrating its contribution to improved transaction security, transparency, efficiency, and accessibility. All the works mentioned collectively show how blockchain enables secure, low-cost, and inclusive financial ecosystems that address the problems of traditional payment infrastructure and facilitate trust and financial empowerment for underserved communities.

Assaqty et al. (2025) proposed that Supachai is a revolutionary permissioned blockchain smart contract-based lightweight SCM authentication method with PUF of IoT. The proposed framework is demonstrated to be efficient in resisting various threat scenarios, including man-in-the-middle, non-repudiation, impersonation, and replay attacks, among several other security features, in connection with the formal and informal security analysis (using AVISPA and BAN logic) of the suggested framework. For blockchain-based SCM, the processing time (~13.8 ms) is also superior to the current lightweight approach [33].

S et al. (2025) investigated how blockchain technology might be used to circumvent these constraints, and it gives a thorough introduction to the several safe payment methods now in use that are based on blockchain. The report concludes by examining the possible effects of blockchain-based secure payment solutions for electronic commerce on the industry globally. This study was written for academics, industry experts, and policymakers interested in learning more about blockchain's applications in the realm of digital trade [34].

De Silva Thakur and Breslin (2024) presented xPayment, a decentralized payment system intended to make cross-domain and end-to-end transactions for digital products possible using payment channel networks (PCNs). The notion of cyclic exchange is presented, and its atomicity is proved in a formal way, serving as the basis of the xPayment protocol that provides an independent, interoperable payment system embedded into ownership transfers done in blockchain. It is shown by both theoretical and empirical evidence that it is atomic, exhibits minimal merchant opportunity cost, and offers customisable privacy [35].

Samonte et al. (2024) gives varied methods and strategies for overcoming transaction troubles and can recommend policies that should help in addressing those concerns adequately. Such tools are Fintech cybersecurity solutions, secure architectures for online transactions, data security prescriptions, applications of blockchain technology, and policies to assist financial inclusion and regulation compliance. Blending the wisdom from different sources, this review plays a vital role in setting up the foundations for the future, which allows the creation of a safe, responsible, and sustainable payment ecosystem in a digitized economy and also addresses the needs and potential problems of all actors in the digital economy [36].

Tressa and Priya (2023) shown the decentralized feature and use of smart contracts of Blockchain help the transactions to be immutable, more secured and distributed. The usage of high degree cryptographic encryptions and usage of appropriate consensus algorithms can make the data purely tamper proof. This paper describes the features that should be possessed by a Blockchain technology enabled UPI system that help to have high security for all the financial activities and transactions [37].

Islam et al. (2023) proposed that the auditable currency that powers unspent transaction output-based transactions on a consortium blockchain network is the foundation of that inexpensive, smooth cross-border payment system. The blockchain is governed by participating nations utilizing an equal rights, energy-efficient proof of authority consensus method. Unlike conventional cryptocurrencies, dynamic decentralized identifiers (DIDs) can be used as transaction addresses to provide self-manageable authentication on-chain without requiring a connection to a reliable third party [38].

Haque et al. (2022) used the proof-of-work process and decentralized open ledger architecture to authorize every transaction block. The consumer and the filling station authorities do all of their transactions using a digital wallet, which is quick, easy, and completely safe. The suggested approach features minimal transaction costs per transaction and is decentralized compared to the current payment system. The transactions are not subject to modification, and no other parties are involved in this process [39].

In Table III, the research on digital payment systems, based on improved security, transparency, and efficiency, is suggested. Although these types of solutions can result in financial inclusion, such issues as scalability and regulation are present, and future employment is determined by the directions of interoperable and sustainable blockchain system

TABLE III. SUMMARY OF RELATED STUDIES ON BLOCKCHAIN-BASED DIGITAL PAYMENT SYSTEMS AND FINANCIAL INCLUSION

Reference	Study On	Approach	Key Findings	Challenges / Limitations	Future Directions
Assaqty et al., (2025)	Secure authentication in blockchain-based Supply Chain Management (SCM)	Proposed SPUFChain, a lightweight permissioned blockchain authentication scheme using Physical Unclonable Functions (PUF) for IoT.	Demonstrated resistance to multiple attacks (MITM, impersonation, replay, etc.); faster processing (~13.8ms) than existing SCM schemes.	Complexity of implementing PUF-based authentication across heterogeneous IoT networks.	Extend SPUFChain to large-scale SCM and integrate AI-driven anomaly detection.
S et al., (2025)	Blockchain for secure digital payment systems and e-commerce	Examined safe payment methods based on blockchain technology and how they may enhance digital trade and e-commerce.	Demonstrates how blockchain may improve the security, dependability, and transparency of digital transactions.	Theoretical study — lacks empirical validation.	Explore interoperability, regulation, and real-world implementation in e-commerce.
De Silva, Thakur & Breslin (2024)	Decentralized payment protocol for digital goods	Introduced xPayment, a decentralized protocol for cross-domain transactions via Payment Channel Networks (PCNs) with cyclic exchange.	Ensures atomic transactions, minimal merchant cost, and privacy; validated both theoretically and empirically.	Integration challenges with existing payment systems.	Enhance interoperability with multiple blockchain platforms and improve scalability.
Samonte et al., (2024)	Secure architectures and policies for digital payments	Reviewed FinTech cybersecurity tools, secure architectures, blockchain use, and compliance policies for financial inclusion.	Emphasizes blockchain and cybersecurity frameworks in building safe, sustainable payment ecosystems.	Regulatory and technological adaptation barriers in developing countries.	Develop unified policy standards and adopt adaptive cybersecurity frameworks.
Tressa & Priya (2023)	Blockchain-enabled UPI payment systems	Discussed decentralization and smart contracts in UPI-based financial transactions using blockchain.	Blockchain ensures immutability, transparency, and security via cryptography and consensus algorithms.	High implementation cost and limited scalability.	Design hybrid UPI-blockchain systems with optimized consensus protocols.
Islam et al., (2023)	Cross-border cryptocurrency-based payments	Proposed a consortium blockchain payment system using Proof of Authority (PoA) and Dynamic Decentralized Identifiers (DIDs).	Enables low-cost, auditable, and self-authenticating international payments without intermediaries.	Adoption barriers due to cross-border regulations.	Implement pilots and explore CBDC integration for cross-border payments.
Haque et al., (2022)	Blockchain for decentralized fuel payment systems	Used proof-of-work blockchain for transactions between customers and fuel stations via digital wallets.	Provides secure, transparent, and low-cost transactions without intermediaries.	High energy use and slower transaction speed due to PoW consensus.	Shift to energy-efficient consensus like PoS or PoA and improve scalability.

VI. Conclusion and Future Work

The digital payment systems in the form of blockchain are transforming the financial system of the world by offering a more secure, transparent and decentralized system other than the traditional financial system. The blockchain technology eliminates the need for intermediaries, improves transaction efficiency, and instils confidence in peer-to-peer networks. The paper has elaborated on the application of blockchain in financial inclusion and digital payment systems. It discussed the nature of blockchain, the different varieties of digital payments, and the advantages they offer over existing systems. The findings indicate that blockchain not only enables faster, more cost-effective transactions but could also help underbanked populations gain better access to financial services. It has a distributed and secure architecture that enhances its security, visibility, and credibility with users. However, numerous problems still remain, including scalability, energy consumption, and legal requirements, and this is why research and innovation must be conducted on a continuous basis. Overall, blockchain-based payment systems would facilitate inclusive financial services, promote sustainable economic development, and empower the poor by minimizing the digital gap through effective, secure, and equal financial systems.

Further research is needed on technical and regulatory constraints to support the adoption of blockchain technology for digital payments. There is a need to pay attention to scalable, low-energy-consumption consensus mechanisms, the compatibility of blockchain networks, and their integration with other technologies, including AI and IoT, to improve fraud detection and transaction monitoring. The research directions are also expected to yield both prospective applications in central bank digital currencies (CBDCs) and cross-border financial inclusion.

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