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PERFORMANCE EVALUATION OF A BLOCKCHAIN WEB-BASED APPLICATION FOR FINANCIAL SEVICES

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ABSTRACT

Blockchain technology was initially created for digital currencies, offers revolutionary opportunities to improve financial security and efficiency. This research article examines the broad applications of blockchain technology in a number of fields, with a particular emphasis on how these applications may affect green logistics advancements in the financial sector, comparing conventional and proposed architectural systems. This study attempts to reveal the complex effects of blockchain on supply chain management in the banking industry, including operational efficiency, transparency, and sustainability. It does this by conducting a thorough analysis of the body of existing literature and the new system.

Introduction

Blockchain is a series of blocks with several transactions completed in a predetermined amount of time contained in each block. The smart contracts in the chain's first block outline the guidelines that participants must abide by in order to verify and validate their information. The use of blockchain technology in the stock market is an example of open innovation, which is the unrestricted exchange of concepts and information both inside and outside of businesses. This strategy encourages cooperation between investors, financial institutions, technology companies, and regulatory agencies. Stock markets can use blockchain technology to increase efficiency, security, and transparency while also enhancing accessibility and inclusivity of trading procedures [1] There are numerous possible uses for the Block chain Technology that are tailored to certain transactions (e.g., corporate operations, governmental services, etc.). In this study, we concentrate on the financial transactions, which have various applications in trading and investing. Divergent opinions exist on the disruptive influence of the BCT on the securities investment sector and financial markets [2].

Application of blockchain technology in financial services tackles major issues with existing banking systems, such as lowering transaction costs, enhancing processing speeds, and preventing fraud [3]. Blockchain technology promotes a more inclusive financial system by enabling peer-to-peer transactions without the need for middlemen, improving accessibility, and lowering the cost of financial services. Furthermore, data security and integrity are greatly improved when blockchain technology is included into financial operations. Blockchain technology offers an unprecedented level of security and transparency by guaranteeing that once a transaction is recorded, it cannot be changed or removed thanks to its immutable ledger [4]. This feature, which enables a verifiable and tamper-proof record of all transactions, is very helpful in preventing fraud and guaranteeing compliance with regulatory standards [5].

Comparative research has brought to light the disparities in blockchain adoption rates as well as their effects on efficiency and financial security. These variations are frequently ascribed to the technological infrastructure, legal environments, and degrees of stakeholder involvement in blockchain technology in each nation [6]. Thus, in order to fully capitalize on blockchain's prospective advantages, it is imperative to comprehend the elements driving its acceptance.
The following research questions are addressed in this paper: RQ1: How can the blockchain system's effectiveness be assessed in relation to the conventional banking system that is already in place? RQ2: What are the primary obstacles to the adoption of blockchain technology in the financial sector, notwithstanding its cost and security implications? RQ3: When implementing a new financial blockchain system, what possible risks should be taken into account?

Literature Review

Numerous researches work on the assessment of blockchain performance have been carried out using different approaches. This section gives a summary of the current strategies for digitalizing banking procedures, including permissioned blockchain and other distributed ledger technologies, as well as their developments in the financial industry. We also investigate several performance analyses models to evaluate the efficacy of these advances as shown in Table 1.

Methodology

This research utilizes a quantitative research methodology. Quantitative methods stress exact measurements and the statistical, mathematical, or numerical analysis of data gained through surveys, experiments, and other types of research, as well as the manipulation of previously obtained statistical data through the use of computing tools. Quantitative research focuses on collecting numerical data in order to comprehend a particular occurrence or generalize it across groups of people. Hence in this research, the author analyses the inner workings of blockchain systems and self-sovereign identity management systems.

Table 1: Assessment of Blockchain Performance

	AUTHOR /YEAR	TITLE	PROBLEM STATEMENT	METHODOLOGY	DISCUSSION	FUTURE WORK
1	[7])	Identity Management Systems for the Internet of Things: A Survey Towards Blockchain Solutions.	No in-depth research on digital identity management for the Internet of Things (IoT).	Blockchain and IoT	Roadmap for online identity management systems.	Access control for identity management systems.
2	[8]	Blockchain-enabled decentralized identity management: The case of self-sovereign identity in public transportation.	Breaches in data that resulted in the leakage of personal information and identity theft.	Using SSI framework and Blockchain	The result of this research removes the requirement for numerous travel cards.	The same concept can also be adopted in education, Finance, business, and many other sectors.
3	[9]	Nigeria's Digital Identification (ID) Management Program: Ethical, Legal and Socio-Cultural concerns.	Privacy, security, and reliability of Nigeria's digital infrastructure for identity management	NIMC eID Framework	Distinctive characteristics of the use of biometric technologies	qualitative study that provides a deeper understanding of social interpretations
4	[10]	Addressing identity crime in crime management information systems: Definitions, classification, and empirics.	absence of particular legislation against identity crimes may result in offenders being charged with benefit fraud or credit card fraud rather than identity crimes, which are established crimes	Classification, and Empirics.	The result of this research work shows that Identity theft and identity deception also facilitate identity fraud and other associated economic and financial crimes.	Integration of identity management and law enforcement agencies
5	[11]	Developing an IoT Identity Management System Using Blockchain.	As a result of the upsurge of Internet of Things, security, privacy, and trust issues have arisen (IoT).	Blockchain and IoT	The authors presented a proof-of-concept model for developing blockchain-based IoT ID management system.	Future research will also investigate the performance and computing time of blockchain transactions and the execution time of the proposed technique in real-world business situations, and compare it to other emerging studies.

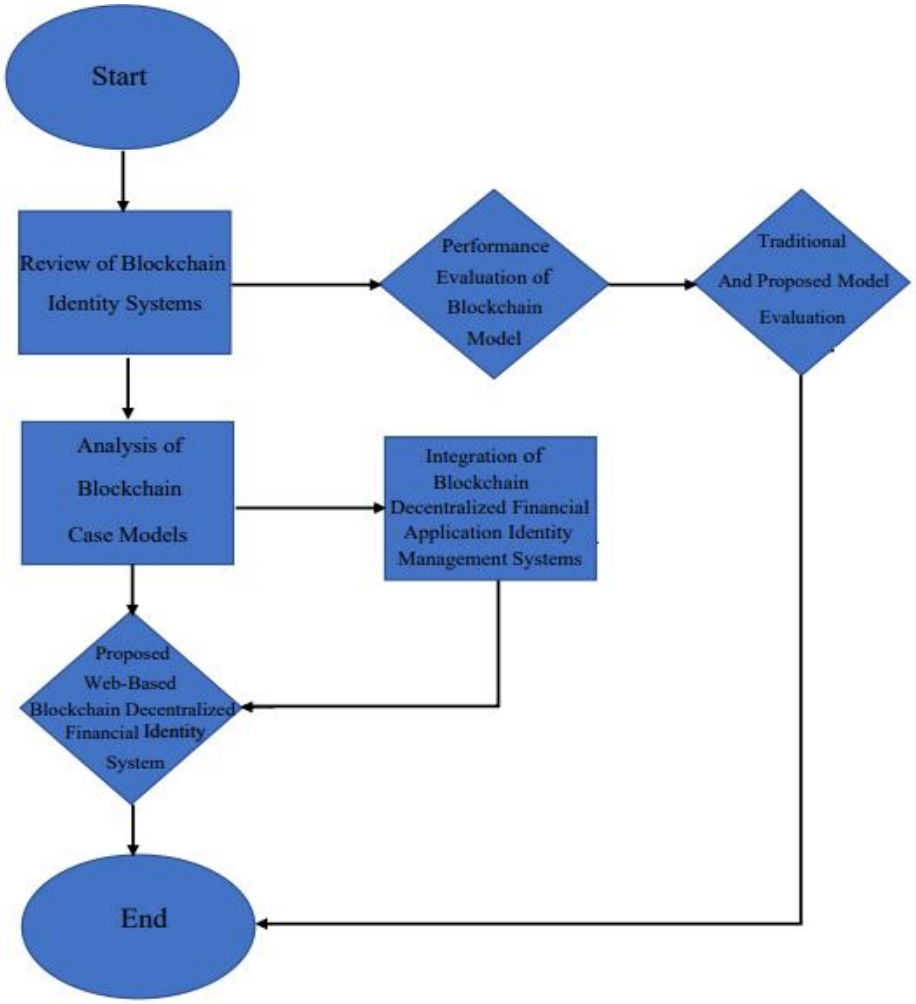

Figure 1: System Flowchart

This paper employs a single exploratory case study research design to examine the application of emerging blockchain technology within the financial services.

A use case diagram is a graphical representation of a user's potential interactions with a technology. Use case diagrams, which are typically complemented by other types of diagrams, depict the system's numerous use cases and user categories. Use scenarios are depicted using either circles or ellipses.

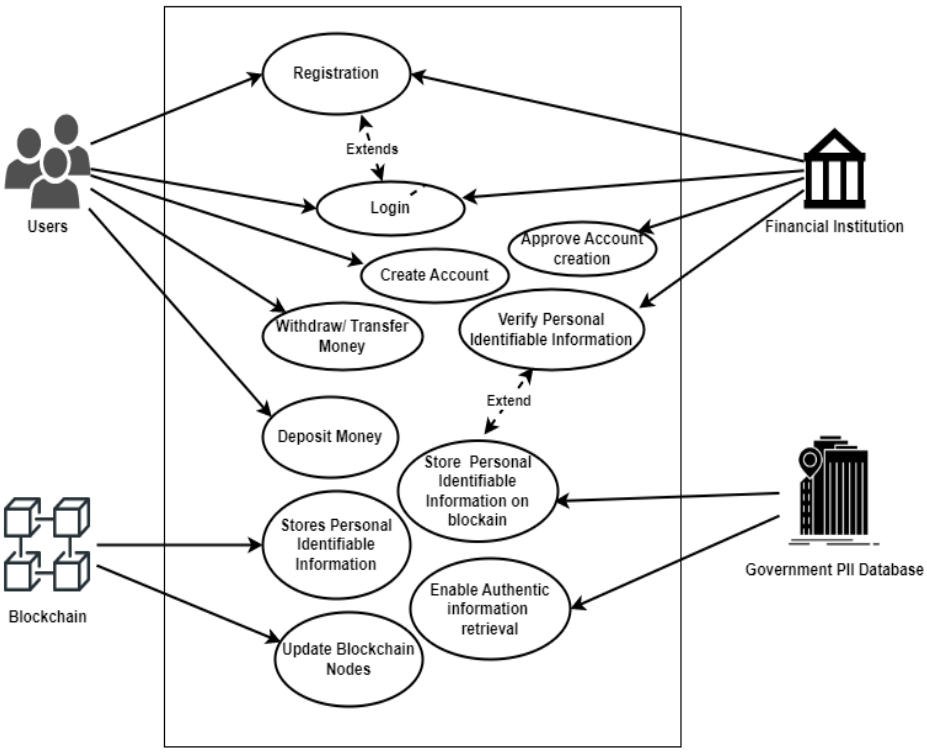

Figure 2:1 System Use case diagram

Result Analysis

The blockchain system was designed to tackle the issue of identity theft and curb banking fraud while maintaining confidentiality, integrity, and availability. The system was developed using the stand secure hash algorithm (SHA-256) to guarantee Data security and ease of business. This project will result in a decentralized identity management and financial service application that will define the future of financial services while ensuring data protection, confidentiality and fraud prevention.

A new software application or program is specified, built, tested, and implemented via systems development. This entails internal system development of specialized modules. The system is divided into 3 Modules:

i. Personal Identifiable Information (PII) Module

The PII module holds Personal information (for demo purposes, not real data). It demonstrated the government's side of the system. Instead of allowing banks to hold PII information, the government gives controlled access for banks to be able to verify the personal information of users. The Bank Admin Section Demonstrated Banking Operations and how the fuse with blockchain works.

The system Implementation is how below.

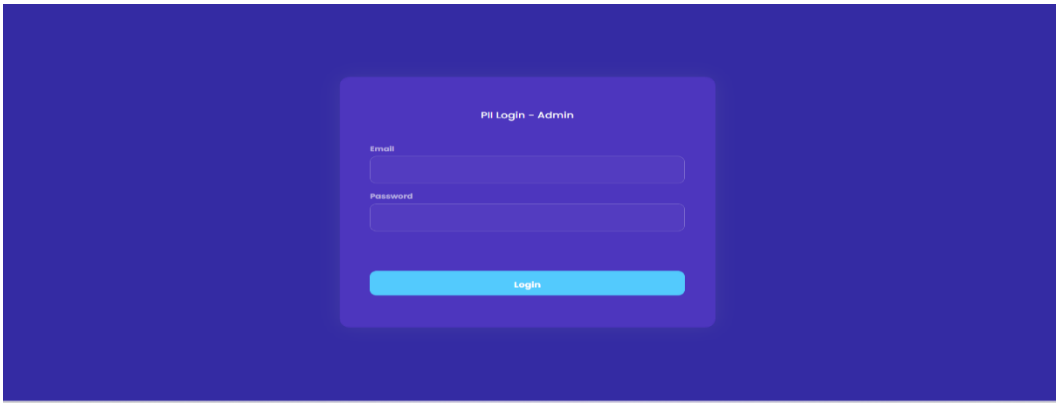

Figure 3: PII Admin Login

After login, the next stage is the multiple-factor authentication page that provides additional security.

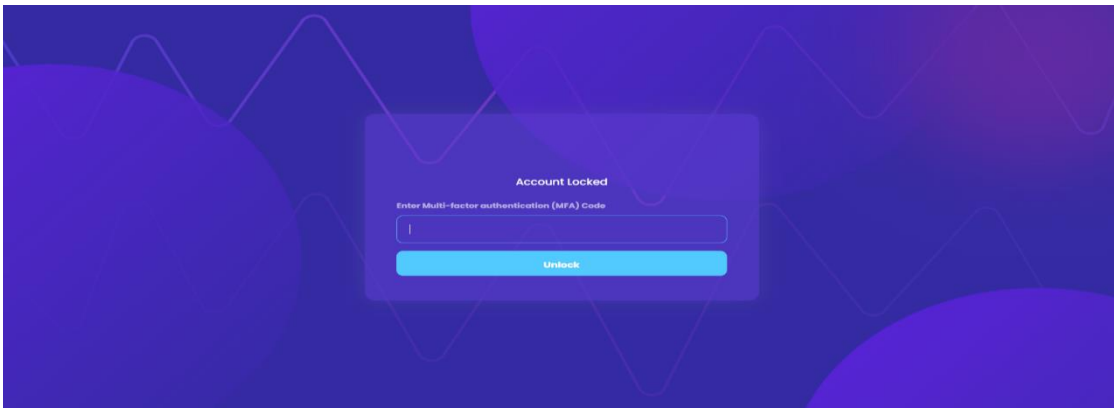

Figure 4: MFA Page

The PII modules allow the admin to perform the following Functions:

1. Register a new Admin that can access the system: This section handles the registration of new users.
2. Registration Personal Identification Information: This section allows the admin to add PII information into the blockchain system and store it as encrypted values using SHA-256.
3. Register Access for Banks: This section allows the PII admin to generate access keys for banks able to verify customer information.
4. User Records: This shows the encrypted records of users in the system.
5. Bank Records: This shows the encrypted records of bank access in the system. The bank access contains the key and access token that allows banks to verify the identity of a customer.
6. PII Records: This shows the encrypted records of People's Identities from where verification is done.

ii. Bank Admin

The banking system module demonstrated how the blockchain works by recording all the transactions of the ledger. This module is a prototype of the banking system that holds transaction information. Financial institutions verify the personal information of customers and then create accounts for them. The login module is available only to the banking admin. It authenticates the Banking admin.

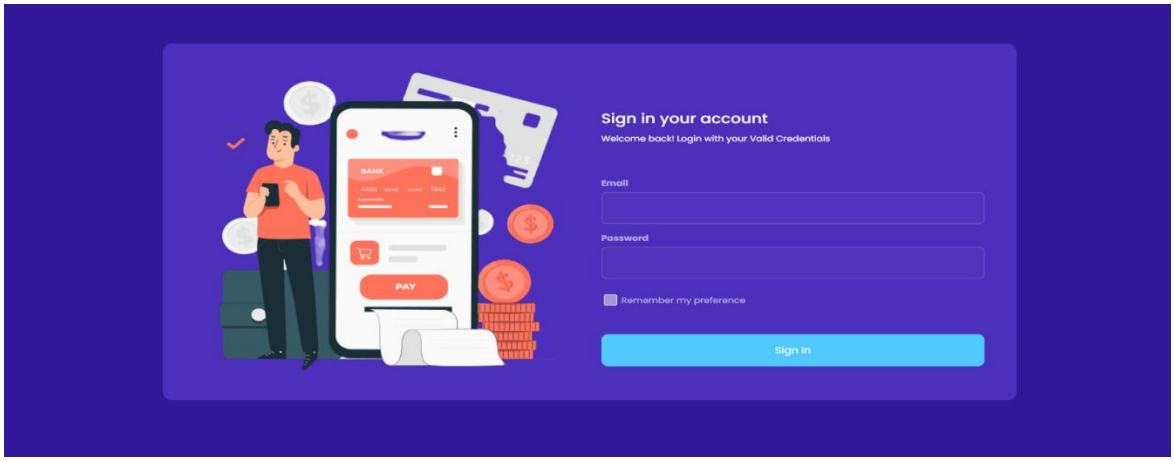

Figure 5: Banking Admin Login

After login, the next stage is the multiple-factor authentication page that provides additional security.

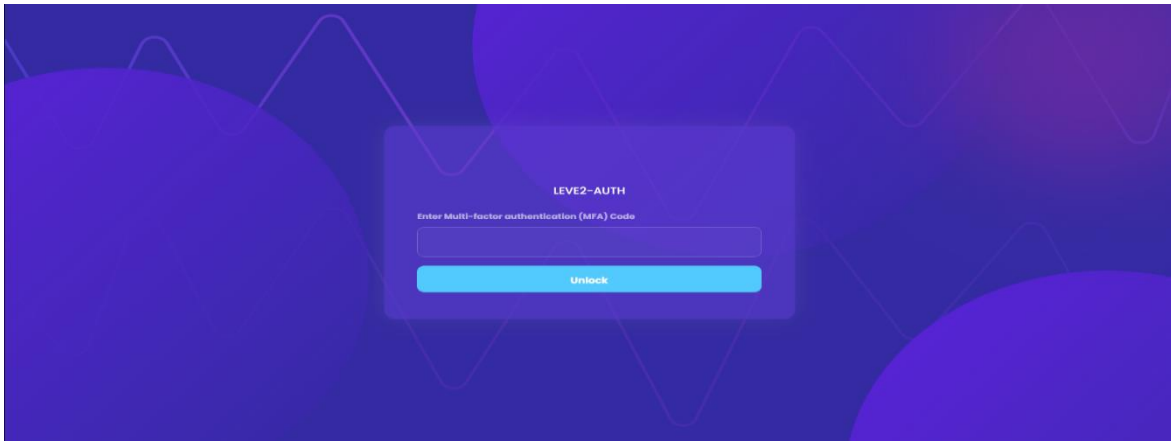

Figure 6: MFA Page for Admin

The Banking modules allow the admin to perform the following Functions:

1. Register a new Admin that can access the system: This section handles the registration of new users. The modules determine who will have access to the baking system.
2. Create Account: This section allows the admin to create a new Bank account using their BRP number. The account creation process will be successful only if the BRP provided is successfully authenticated to be valid by the PII system. The validation is done by using the bank token and access key.
3. Deposit: This section allows the admin to Deposit funds.
4. Withdraw: The modules allow the admin to help a customer with the cash withdrawal
5. Transfer: The modules allow the admin to help a customer with the cash transfer
6. User Records: The module contains the record of the banking Admin

iii. Blockchain Module

This module is a prototype of a blockchain system that shows the transaction logs of the financial institution. It is an immutable database that facilitates asset tracking and transaction recording in a financial business network. The ledger holds the transaction history of everybody as well as the time stamp.

Figure 7:2 Blockchain Records

Performance Evaluation

Therefore, the prototype system performed optimally in terms of security and transaction time making it a good solution to adopt. Taking into consideration that there is no overhead or trade-off of time for security and vice versa. (Stockburger *et al.*, 2021b) implemented a proof-of-concept that illustrates how people can better manage their identity credentials utilizing the SSI framework, based on public transportation. The system extends the work of (Stockburger *et al.*, 2021b) to prevent financial fraud and assure data

security in financial institutions.
Identity theft and financial fraud were both addressed by blockchain technology, which also maintains availability, secrecy, and integrity. The stand secure hash algorithm (SHA-256) was used in the system's development to ensure data security and simplicity of use.
Figure 8 show the architecture of conventional systems and the type of attacks the systems are prone to. Financial institutions often store sensitive information. Certain data are stored in a third-party database such as that of the government. Consequently, this means institutions will rely on API keys to send and retrieve information from this third-party database thereby creating a loophole that hackers can exploit. Key exchange done over the network is susceptible to attacks such as Man-in-the-middle, Sniffing, data theft, DDOS attack, and other forms of interception-based attacks. hence the reason for proposing the architecture in Figure 9.

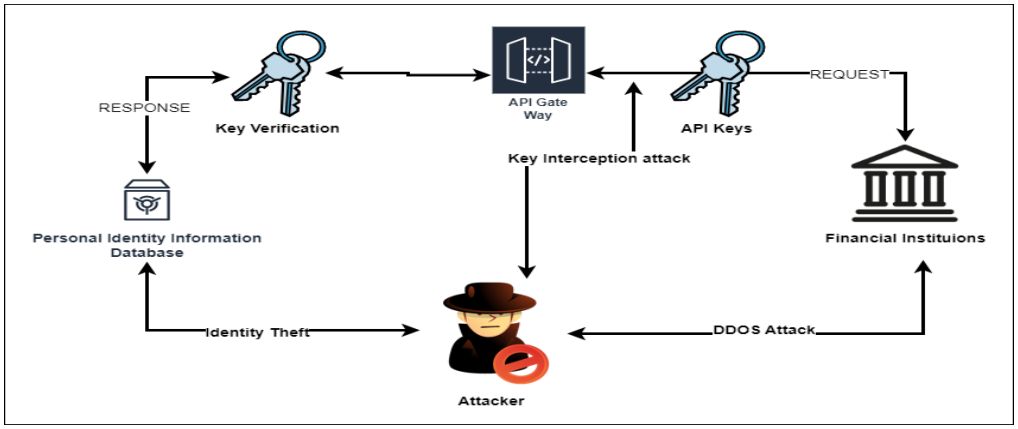

Figure 8:3 Conventional Architectural Systems

The proposed system depicted in Figure 9 uses a blockchain based identity management smart contract to register users, track users and verify users carry out a transaction in a financial institution. Since blockchain is immutable and is not prone to error, crimes like fraud, identity theft, money laundering and wire fraud can be detected and mitigated easily without violating privacy. This encourages ease of use, transparency, and data integrity.
The immutability of this blockchain and the distributed network that nodes use to update one another allow the system to always maintain up-to-date, tamper-proof data.

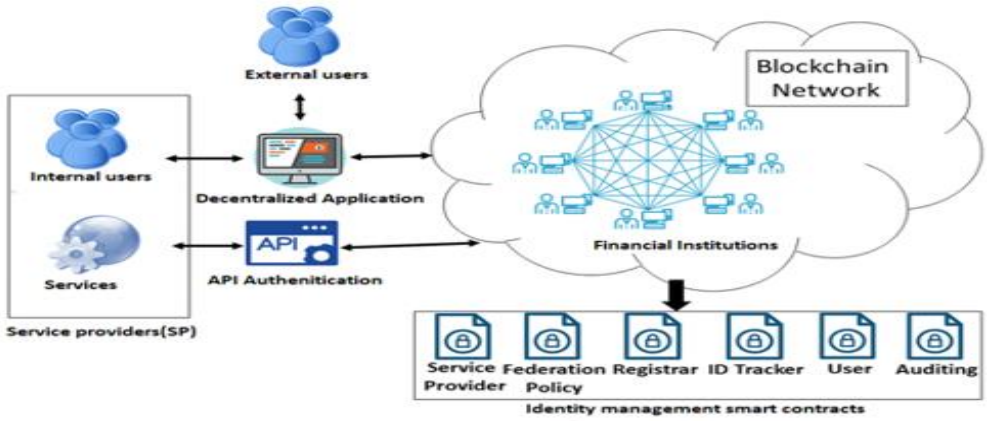

Figure 9: 4Proposed Architectural Systems

Conclusion

This study used a scenario-based simulation to show how well a blockchain system performed in comparison to the current banking system under a range of circumstances, including transaction rates, types of transactions, and tasks that affected the throughput, latency, and scalability of the blockchain network. The report demonstrated a notable enhancement in process time for various trade volume situations and throughout the three phases of trading, clearing, and settlement when utilizing a blockchain system. The amount of break-even transactions from which the trading process time is shortened was ascertained by the study. The outcomes also show

that the index value produced based on cycle and process time calculations is greatly improved by using a blockchain-based process model. When compared to the conventional approaches, blockchain implementation yields better index-value with varying transaction volumes employed in the simulation. Furthermore, the findings validate that in periods of elevated transaction volumes, blockchain-based transactions are impervious to delay, but conventional systems may permit such delays. The execution of transactions was improved by the use of smart contract and distributed ledger technologies, allowing for a more effective approach to price negotiation.

This technique aids financial institutions in safeguarding the information of their customers and preventing financial fraud by building on the work of [8]. As a result, the recently created system has good security and transaction time. The study can be expanded in the future to cover a wide range of functions, including mobile banking and USSD. The potential for evolving it as a cloud-blockchain solution can be investigated in future studies. Future research may also incorporate additional security testing stages, such as sophisticated penetration testing and more recent encryption techniques.

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