A Proposed Framework for Financial Institutions Using Blockchain Tecnology

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Abstract— Blockchain technology plays a pivotal role in the banking industry, being recognized as one of the most crucial sectors. With the financial market expanding and the demand for banking services on the rise, the need for a robust banking system capable of offering top-notch services to clients is paramount. Regrettably, the current banking system in Egypt falls short of meeting these requirements. However, there is hope on the horizon, as blockchain technology has garnered widespread interest in the global banking community for its potential to mitigate fraud and other threats to banking operations. This study offers a concise overview of various blockchain architectures and trading systems, delving into their types and the popular platforms currently being utilized worldwide., such as Automated Clearing House (ACH).

Keywords- Blockchain; Financial Markets; Forgery; ACH.

I.INTRODUCTION

The financial industry is undergoing a transformative shift with the advent of blockchain technology, a decentralized and distributed ledger system that offers unprecedented security, transparency, and efficiency. This technology has the potential to revolutionize traditional financial institutions by addressing various challenges they face, making it imperative for them to adopt blockchain solutions[28].

In the early days, the Internet brought about a revolution in communication, much like how blockchain technology is now positioned to revolutionize various industries. However, there isn't a straightforward comparison between the adoption of Bitcoin and cryptocurrencies and the way email and social networks seamlessly integrated into the Internet. Similar to the internet itself, blockchain is a transformative technology that has had a significant impact on the world over the past two decades, and its potential for even more profound changes in the next two decades is substantial. It's essential to recognize that blockchain goes beyond Bitcoin and cryptocurrencies; these are merely specific applications of the broader blockchain technology. Fundamentally, blockchain is often viewed as a sophisticated type of ledger [1].

One of the key issues in the financial sector is the prevalence of fraud and security breaches. Traditional financial systems heavily rely on centralized databases, which are susceptible to hacking and unauthorized access. Blockchain, however, employs cryptographic techniques and a decentralized network of nodes to secure transactions, making it highly resistant to tampering and fraud. This enhanced security can significantly reduce the risk of cyber-attacks, safeguarding sensitive financial data and transactions [2].

The structure of this paper unfolds as follows: In Section 2, delves into the background of Blockchain and Payment syestems. While in section 3, conducts an examination of related work. Moving on to section 4, a framework and its implementation is proposed. In addition, section 5, provides a comparison with Blockchain and Traditional Payment systems. Finally, conclusion and directions for future work are reported in section 6.

II. BACKGERAOND

A. *BLOCKCHAIN TECHNOLOGY*

Since Satoshi successfully built and introduced cryptocurrencies based on blockchain technology in 2009, it has evolved from being a mere buzzword to a pivotal aspect not only in the financial sector but also in diverse fields such as smart contracts, the Internet of Things (IoT) [3] [4], security-related services [5], the health system [6], and energy [7]. As a result, global banks have recognized blockchain as one of the most promising technologies [8].

The research [9] detailed how Stuart Haber and Scott Stornetta introduced the notion of linking blocks through cryptographic chains. They devised a system that ensures the immutability and non-tampering of information or transactions stored with timestamps. Subsequently, various methods for transaction verification and validation, including the use of Merkle Trees, have been proposed. The data recorded from the Merkle tree has been gathered, contributing to the enhancement of the quality of individual blocks [10]. In 2008, Satoshi developed the inaugural blockchain network [11].

Implemented was a hash function approach to generate blocks on the chain. The development and architecture of blockchains have seen improvement, eliminating the need for clients or users to sign. This implementation establishes a network for a cryptocurrency known as Bitcoin, where all transaction records are publicly accessible on the Bitcoin network ledger. In his study, the terms "block" and "chain" were combined into distinct words, coining the term "blockchain" [12].

In essence, a blockchain is a distributed database comprising an ordered list of unchangeable blocks. It serves as a tool for auditing transactions but extends beyond mere transparency. Companies are increasingly investing in this technology when they recognize the potential to decentralize their architecture and reduce transaction costs, leading to enhanced security, transparency, and, in certain instances, a more expedited process. Therefore, blockchain is not merely a trend but a substantial development [13].

Blockchain is also considered as a set of interconnected mechanisms that are specific functionalities are provided by the system's infrastructure, as it allows untrusted members to have a decentralized peer-to-peer network where they are capable of interfacing trusted authorities [14].

Numerous authors have offered their perspectives on defining blockchain. From their standpoint, blockchain is viewed as a dependable digital ledger capable of recording not only financial transactions but virtually anything of value that can be programmed.

The blockchain operates akin to a database, serving as a storage system for valuable data and transactions. Virtually anything can be recorded within the blockchain. Notably, blockchain technology eliminates the necessity for intermediaries, enabling individuals to conduct transactions directly with one another. It's crucial to understand that cryptography forms the fundamental basis of the blockchain [14].

Blockchain employs a distributed network of nodes to mitigate the risk of single points of failure and network attacks. Through a decentralized platform, timestamp entries effectively reduce fraud, and user information is securely stored on an immutable ledger. The utilization of smart contracts facilitates the distribution of the ledger across the network, eliminating the need for manual procedures, such as consensus and management processes between multiple isolated ledgers. This streamlined approach significantly reduces system costs. Additionally, the incorporation of various cryptographic techniques enhances the speed and security of transactions [15].

The technology based on blockchain ensures transparency across the network as transactions are visible to all connected computers or nodes. For a transaction to be approved, the majority of nodes on the blockchain must provide their approval, safeguarding it from manipulation. Any alterations in a transaction, in near real-time, require approval before being added to the blockchain. Immediate notification to all connected computers occurs if any changes transpire, ensuring a convenient and trustworthy process. From a security standpoint, data entered onto the blockchain is immutable, meaning it cannot be altered or modified. The immutability of the entered data, combined into blocks and linked back to the first block, establishes a secure and auditable trail for every transaction on the blockchain [16].

The blockchain was initially conceived as a digital construct network, with the data structures encapsulated in each block emphasizing its fundamental attributes [17]:

Immutable: Once a transaction is appended to the blockchain, it attains immutability.

Timestamp: Every record is date and time stamped, establishing an inherent audit trail for all additions to the network, and data can only be added in chronological order.

Security: Encryption of all additions to the blockchain is executed through secure algorithms employing public key cryptography, thereby mitigating the risk of data breaches and fraud.

Openness and transparency: The distributed ledger nature of blockchain ensures that all nodes in the network share the same source of record. These characteristics contribute to the accuracy and consistency of blockchains across networks.

The following figure 1 depicted how the blockchain works First, someone (node) requested a transaction, then the requested transaction is broadcasted in the peer-to-peer network that consists of all the computers which act as nodes. The nodes should validate the requested transactions and once the transaction is Openness and transparency: The distributed ledger nature of blockchain ensures that all nodes in the network share the same source of record. These characteristics contribute to the accuracy and consistency of blockchains across networks.

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verified then it is combined with other transactions on a block found on the network of the distributed ledger. New blocks are added to the blockchain in a verifiable, permanent and immutable way. Finally the transaction is completed.

B. PAYMENT SYSTEMS IN BANKING

Egyptian banks utilize two payment systems: the Society for Worldwide Interbank Financial Telecommunication (SWIFT), designed for large interbank payments, and the Automated Clearing House (ACH) for smaller payments. Both systems are utilized by the general administration and branches of all banks. It's important to note that there is no direct linkage between the customer account and service management banking system and the system used for data entry or updates. These systems operate independently, with data being entered or updated separately in each. Users send data offline between the two systems based on the permissions granted to them. Figure 2 illustrates the overall framework of the payment system employed by banks in Egypt.

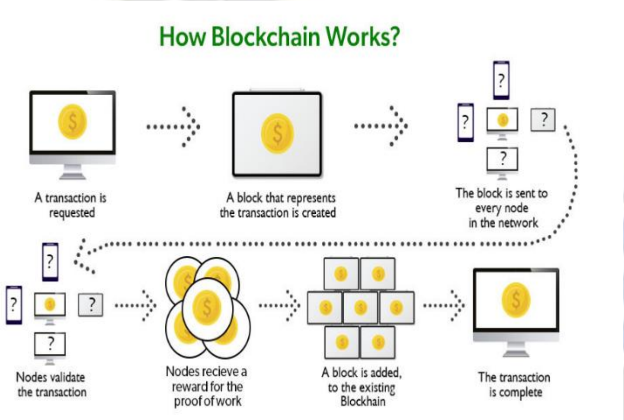

Figure 1. How the Blockchain Works [18]

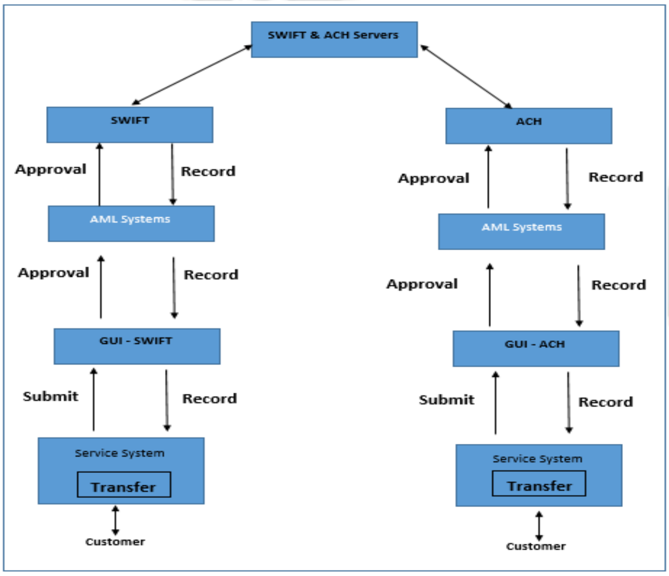

Figure 2. How the SWIFT and ACH Works

III. RELATED WORK

This section presents an exploration of Blockchain in the Financial Domain, encompassing its objectives, Blockchain network, limitations, and associated issues. The overview reveals that nine distinct works focus on frameworks and tasks related to the utilization of Blockchain in the Financial Domain.

In reference [19], the study centered on the integration of financial services in Bangladesh through the use of blockchain, with a particular emphasis on the utility of blockchain technologies such as Bitcoin and Ethereum. The research also involved an in-depth analysis of the application of blockchain in banking, utilizing primary data collected from published sources such as books, articles, journals, and newspapers, and employing a qualitative analysis approach.

n reference [20], a groundbreaking proposal was made for a decentralized banking system operating on the Ethereum blockchain platform. The paper aimed to fortify the infrastructure of banking networks by leveraging distributed ledger technology, despite incurring a significant initial cost. Challenges identified in the proposal included the need for a substantial number of network participants, influencing network size, and the limited knowledge and understanding among those adopting this technology.

In reference [21], a modular network hybrid blockchain system for Central Bank Digital Currency (CBDC) was introduced. This system utilized account systems and the UTXO scheme to record digital currencies in circulation, specifically addressing large micropayment transactions, digital assets, and smart contracts characterized by high actuation but low liquidity. The proposed modular blockchain architecture and slice data storage solution aimed to improve network concurrency. Despite incorporating the hybrid model of UTXO and account for enhanced efficiency, the model lacked adequate details in terms of measurements and comparisons.

In the work by N. Pallavi et.al. [22], a system was delineated, ensuring security through decentralized blockchain technology for comprehensive verification and validation of data. Functioning on the Ethereum platform, the system proposed the distribution of databases in the banking system to alleviate the risk of attacks. Nevertheless, the study emphasized the necessity for further exploration into the details of the blockchain network and model.

In the study conducted by N. Arshadi [23], the historical evolution of banking and clearing house legacy systems was explored. The research introduced an alternative blockchain platform for real-time payments on Ethereum. The findings suggested potential improvements in cost-effectiveness, security, and convenience for both businesses and customers. The study relied on qualitative analysis of primary data collected from published books, articles, journals, and newspapers.

In reference [24], the authors proposed functional and security requirements for Central Bank Digital Currencies (CBDCs) by conducting a comprehensive analysis of existing representative cryptocurrencies and CBDC prototypes. They introduced a CBDC framework based on blockchain technology, specifically on Ethereum. The study provided detailed explanations of decentralized digital currencies and CBDCs, emphasizing the security and functional requirements. However, it acknowledged the necessity for further exploration of details regarding the blockchain network.

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In the research presented by X. Wang et al. [25], an interbank payment system (IBPS) using Ethereum was introduced. The study also analyzed the Real-Time Gross Settlement (RTGS) system based on Hyperledger. While unveiling the IBPS, the authors recognized the need for additional efforts to improve performance and establish a more comprehensive framework for financial services.

H. Sun et al. [26] developed a Model-Based Digital Currency (MBDC) CBDC model utilizing permissioned blockchain technology on Ethereum. The model facilitated control over currency issuance and implemented a user account address protocol to isolate user IDs and transaction information. However, the study identified various issues that require attention, especially the exploration of parallel technologies for transaction execution and the establishment of block and consensus protocols to enhance throughput.

H. M. Gazali et al. [27] contended that numerous borrowers encountered challenges and presented a prototype for student loan repayment utilizing blockchain and smart contracts on the Ethereum platform. The study underscored the application of blockchain and smart contracts for the management of student loans and the National Higher Education Fund Corporation (PTPTN) in Malaysia. It granted borrowers complete access to the ledger, allowing them to review, approve, and share information, thereby facilitating the tracking of borrower status and deferred payment collection processes.

IV.PROPOSED FRAMEWORK

Financial institutions. The proposed model establishes a secure electronic trading cycle, significantly reducing the time required for clearing and trading, as illustrated in Figure 3.

A. *The suggested framework encompasses:*

1. Quantity of computers (network nodes).
2. Repository at each Node containing client data and account information, overseeing necessary validation and transaction management for these accounts.
3. Repository holding shared data across all Nodes, confirming approved transactions post-validation by respective Node.
4. Suite of backend programs and web-based front-end interfaces

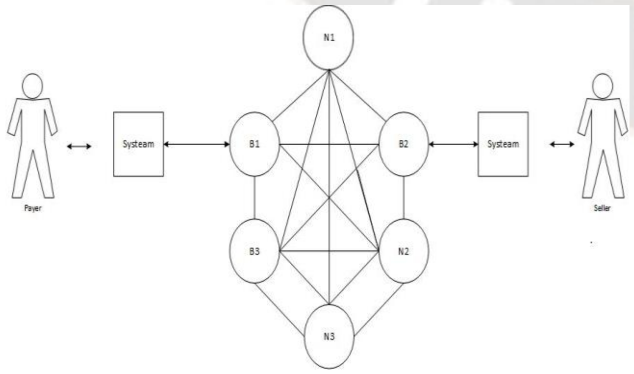

Figure 3. Proposed Framework

B. *Description of system work:*

The logic of the system implements through smart contracts that deployed at each node. Figure 4 shows a flowchart of the proposed system work.

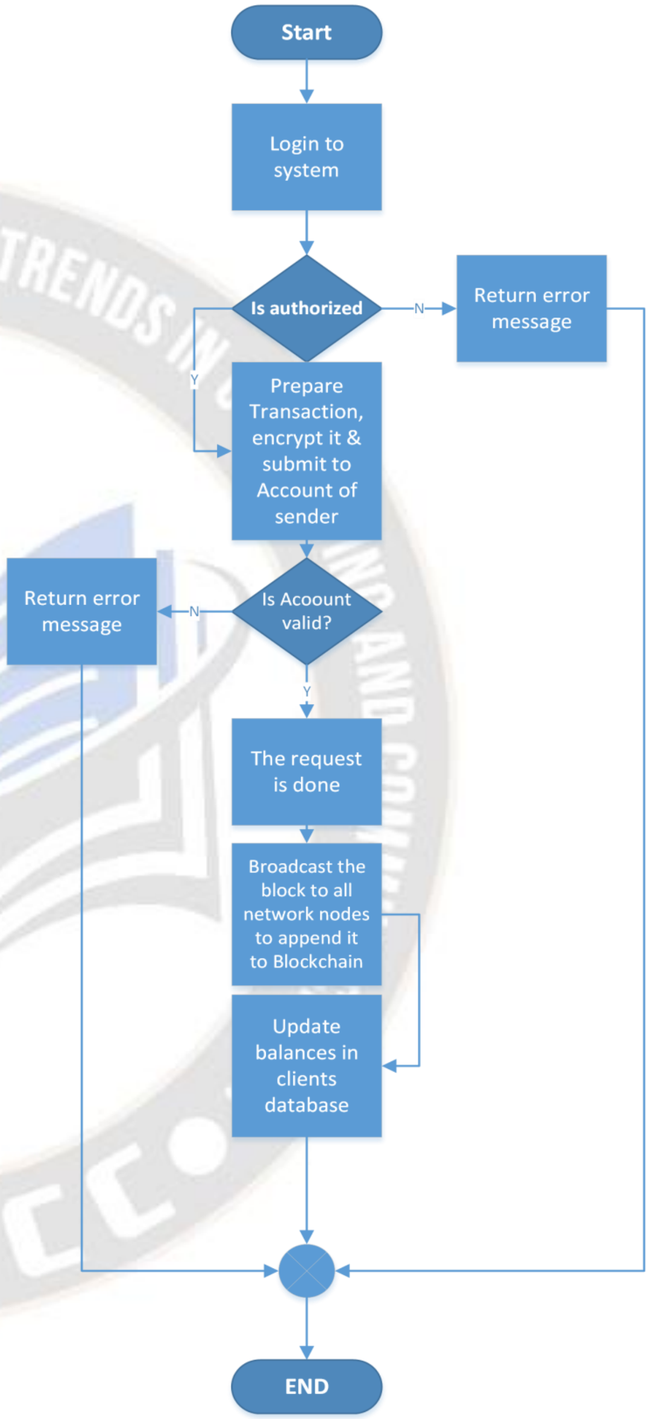

Figure 4 Flowchart of the System Work

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C. System Implementation:

The primary operations within the system can be elaborated further below. The implementation of the proposed model encompasses the following steps:

1. Create and author smart contracts using the Solidity language, then compile the smart contract to produce its binary file. Figure 5 shows a smart contract.

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.8.20;

import "@openzeppelin/contracts/token/ERC721/ERC721.sol";
import "@openzeppelin/contracts/access/Ownable.sol";

/// @custom:security-contact hossam@gmail.com
contract HossamToken is ERC721, Ownable {
    constructor(address initialOwner)
        ERC721("HossamToken", "HOS")
        Ownable(initialOwner)
    {}

    function _baseURI() internal pure override returns (string memory) {
        return "https://hossam-token.com/token/cheque/";
    }

    function safeMint(address to, uint256 tokenId) public onlyOwner {
        _safeMint(to, tokenId);
    }
}
```

Figure 5 shows a smart contract

2. Specify the quantity of nodes and prepare the network configuration. Utilize HARDHAT Network software for deploying the contract, generating a specified number of virtual nodes, and creating the Mint using Remix-Ethereum. Figure 6 shows a create Mint.

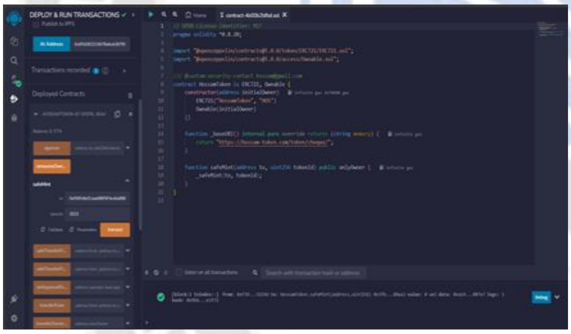

Figure 6 shows a create Mint

3. Deploy, construct, and set up a MetaMask node on every machine within the network to visualize all transactions through the GUI. Figure 7 shows transaction on GUI.

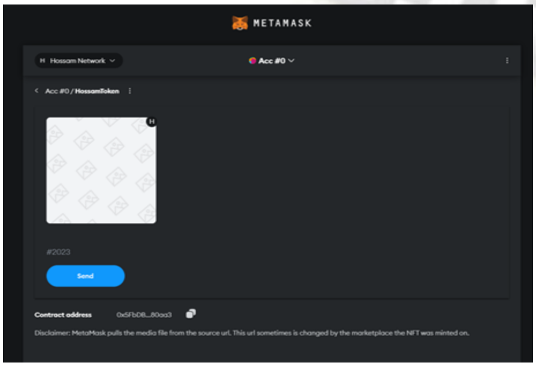

Figure 7 shows a transaction on GUI

D. Benefits of the Proposed Framework:

1. Enhancing the security of financial processes through the integration of blockchain technology.
2. Streamlining the time required for financial service execution.
3. Elevating customer satisfaction and engagement in the trading process through the application of blockchain techniques.
4. Creating a user-friendly and intuitive interface to simplify and enhance user experience.

V. DESCRIPTION OF PAYMENT SYSTEMS AND BLOCKCHAIN

The payment systems outlined below are assessed in terms of blockchain technology in Table 2. Financial services processes encounter challenges such as efficiency bottlenecks, transaction delays, and fraud. The application of blockchain technology is considered a potential solution to address various issues related to financial and operational risks. It is believed that blockchain has the capability to tackle many of these challenges and establish a more secure, transparent, and efficient system.

Table 2. Summary Description of Traditional Payment Systems in Egypt and Blockchain

	Traditional Payment systems	Blockchain
Customer Experience	▪ Rich scenario ▪ Customized service ▪ Good customer experience ▪ Uniform scenario	▪ Rich scenario ▪ Customized Operations ▪ Increase customer satisfaction
Efficiency	▪ several intermediate Relations ▪ Complex liquidation procedure ▪ - low effectiveness	▪ Transmission between two endpoints. ▪ Distributed Ledger Technology (DLT) ▪ trade = liquidation ▪ High throughput
Cost	▪ Massive manual inspection ▪ high cost	▪ Completely automated ▪ Disintermediation ▪ Low fee
Safety	▪ The storage of data in a centralized manner. ▪ modifiable ▪ Easy to compromise user confidentiality.	▪ Distributed storage of data ▪ Not possible to damaged. ▪ The Utilization of distorted cryptography

	▪ User's privacy is more secure. ▪ Safety is poor	▪ User's Individual info ▪ safer ▪ good protection

VI.CONCLUSION

This paper introduces a blockchain-based model for electronic transfers, emphasizing a high level of security through the inherent features of blockchain—immutable, tamper-proof, and irreversible. Employing asymmetric key encryption, the system ensures the integrity of transactions during transfer among involved parties, preventing data manipulation. Client privacy is meticulously upheld by segregating client identity from financial transactions. Transactions stored in the blockchain are linked to client codes and account numbers, ensuring no indication of client identity, known only within the system where the account is established. This model has significantly reduced transfer times from conventional banking systems, now taking only several seconds. This reduction encompasses the waiting time for the new block, along with the time for block creation, approval, and account updates. Furthermore, the system provides an intuitive interface, enabling clients to easily transfer funds or check account balances, provided they have system access. The combination of enhanced security, privacy preservation, and expedited transaction times makes this model a promising advancement in electronic transfers.

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