

A Review on Secure Healthcare Management using Blockchain Technology

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Abstract— The major objective of our work is to develop a secure healthcare system employing blockchain technology. When taking into account real-world scenarios in healthcare, the implementation is made possible by the integrity, security, and interoperability of blockchain, utilizing the programming language Solidity and other tools and methods like Web3.js, and Athena. Blockchain is built on the Ethereum network. In the secure healthcare system, a patient can schedule an appointment simply by logging into the application, regardless of the location or time. With the use of the hash key, all of the entered data is recorded on the blockchain. A distinct hash value in the blockchain is mapped to the patient ID. Decentralized blockchain-based solutions for smart healthcare tend to boost system performance. To validate the suggested strategy, this paper simulates the healthcare system. Blockchain technology has been discovered to have been used in practically every domain due to its benefits, including crypto-security, transparency, immutability, and a decentralized data network. In the modern era, a blockchain-based secure healthcare system offers security, effectiveness, transparency, and quick and easy access.

Index Terms— blockchain , ethereum, immutable, solidity, health care, healthcare management, Security.

I. INTRODUCTION

As the name suggests, Blockchain is a series of blocks that are connected by the hash of the preceding blocks. A new transaction must first be validated by the consensus method before it can be added to the block, and the validated block is then added to the chain of blocks. Because it uses distributed ledger technology, where the blocks are shared among all the peers engaged in the transaction, it solves the single point of failure issue. Since the data in the blockchain is immutable, any modifications to a single block automatically affect the entire chain of blocks, since they invalidate the previous block and change its hash value. The blockchain can be implemented by the idea of the digital currency, Bitcoin. Figure 1 depicts the structure of a blockchain. The fundamental features of Blockchain Technology are-

- **Decentralized:** Data in the blockchain is not centralized, data is shared among all the peers who are involved in the transaction. A single block is added to the blockchain. It must be updated by all the peers.
- **Data Transparency:** Data in the blockchain is transparent, it will be visible to everyone in the network, but cannot be changed by anyone.
- **Immutable:** It is one of the important features of a distributed technology, once the transaction is validated.
- **Information Sharing:** Information will be shared by all the peers involved in the transaction, without any

change in the data.

- **Auditability:** It contains information about when the transaction has happened, and it contains detailed information about the transaction like a time stamp, so every block is auditable.
- **Security:** As it is a distributed ledger technology, the data is distributed among everyone, data may be tampered by anyone. Because of the cryptographic hash function, the data cannot be tampered, so the data in the blockchain is secure.
- **Privacy-preserving:** The data in the blockchain may contain banking transactions, or any medical data of a patient, or the login id and password of a person, even though the data is in a distributed ledger, but the sensitive data is not accessible to everyone on the network. If you are an authorized person, then access is provided to the data on the blockchain, and the privacy of the sensitive data is preserved.

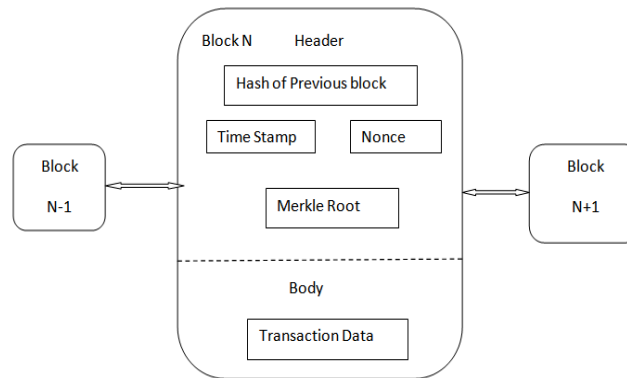


Figure 1: Structure of a blockchain

A. Types of Blockchain

1. **Public Blockchain:** Also known as a permissionless blockchain, a public blockchain does not need any permissions. Any third party can take part in this blockchain by participating in a Bitcoin transaction, mining a block, connecting as a node, etc.
2. **Private Blockchain:** Another name for the permission blockchain is the private blockchain. The blockchain is private to the general public and only open to members of the organization or chosen individuals.
3. **Consortium Blockchain:** This system combines decentralization with centralization. While other blockchains are administered by a single corporation, this type is managed by a consortium of businesses.

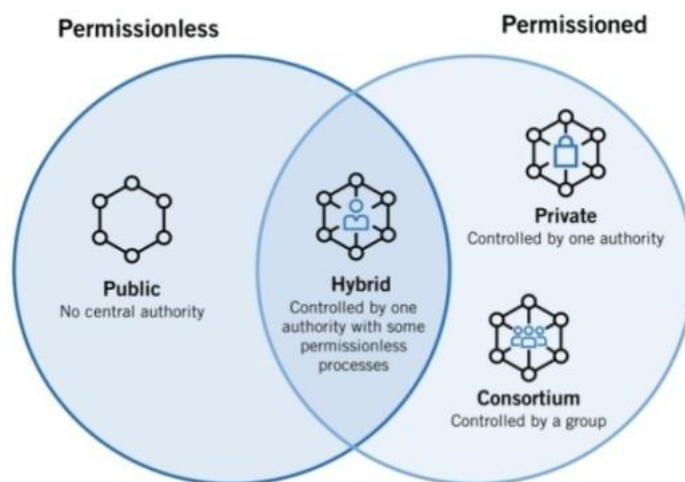


Figure 2: Types of blockchain

II. LITERATURE SURVEY

In the paper[1], fog computing is positioned as the promising technology for low-cost remote monitoring, while blockchain is presented as the promising technology for ensuring the protection of private data, building a decentralized database, and improving data interoperability. According to the paper[2], using blockchain for healthcare data management systems can inspire ideas and result in significant advancements. Integration challenges with current healthcare systems, complexity, and a talent gap in blockchain, scalability, regulation uncertainty, navigation, and interoperability. Blockchain and artificial intelligence are coming together, combining IOT and blockchain technology. In paper [3], studies on the application of blockchain technology in healthcare are thoroughly reviewed, and the characteristics of the studies that have used blockchain technology are analyzed. blockchain technology's safety in the healthcare industry. For a better understanding, characterization, and evaluation of the use of blockchain technology in current healthcare settings, further study needs to be done.

A blockchain-based data security solution is put forth in Paper [4] with user and doctor blocks in the healthcare ecosystem to safeguard medical records. The suggested system performs the cryptic operation using AES cryptography and blocks it using hash keys. The work in the future might entail safeguarding patient information in real-time scenarios where the likelihood of missing or manipulated data is high. Last but not least, a standard template or codes must be devised to ensure effective communication between the patient and doctor. The patient may find it difficult to grasp the doctor's instructions. The experiment's foundation is Android 7.1.1. The prototyping of the transaction and key transaction is done using the Java programming language. The Pima Indian diabetes dataset (PID) is used to confirm the effectiveness and viability of the block-health netchain. The paper[5] supports the use of deep neural networks (DNNs) for healthcare and COVID-19 pandemic investigation and provides a smart contract method for locating feature-extracted data (FED) from the available data. The idea would also be helpful for analyzing upcoming ailments. Blockchain as a smart contract and its enforceable rules. According to the EHRs, blockchain is a crucial demand in the healthcare sector in order to give medications for ailments in that region and to provide precautions for better treatment planning.

The [6] proposed system introduces health models, including viewership contracts on the peer-to-peer blockchain network, immutable patient log creation with Modified Merkle Tree data structure for secure storage and quick access of health records, update medical records, and health information exchange between various providers. The expanded work is based on a novel Modified Merkle Tree data structure that guarantees content integrity. HTML, PHP, and Python IDE were utilized as tools. In a publication, [7] implemented a monitoring system that analyzed personal biometric data using measurement sensors. Through the use of blockchain technology, the information in the implemented system has increased in security and dependability. Learn about the crucial contributions blockchain technology has made to resolving some of the most important and difficult problems the healthcare sector is currently dealing with in paper [8]. The use of blockchain technology in healthcare presents both potential and challenges, and this paper lists the important actors and health-related blockchain businesses that provide solutions across many applications.

A case study [9] uses smart contracts as an example to test the viability of the suggested authorization technique for medical data access between several hospitals. Future research must examine techniques for simple smart contract building because users find it difficult to write smart contract codes. Solidity-based smart contracts were implemented using Ethereum. In writing [10] to utilize a UML diagram to build the system and to model utilizing DApps from the Vexanium Ecosystem. For instance, the transaction ledger will replicate three fundamental interactions between patients, providers, and insurance. In paper [11] mainly includes the adoption of blockchain technology in value co-creation, its current and potential impact on sharing data and resources, patient participation, and collaboration between stakeholders. Training programs must be planned to increase the patient's health literacy and make them aware of their roles and responsibilities by using the new technology in health care for value co-creation. The professional must be funded in order to use the technology. The role of the government is also crucial in providing shared solutions. In the future, the blockchain can be used to build relationships between different ecosystems. It can be applied to medical tourism.

The paper [12] Explains different features, applications, challenges, opportunities, and theoretical frameworks in blockchain technology in health care. Lack of awareness of BCT and challenges faced to shift from the existing system to the new technology. Remote health care management of the patient, health Supply chain management. This paper[13] is mainly based on an IOT-based blockchain architecture for resource-constrained IOT networks along with a selective consensus algorithm by considering the scalability factor. Real-time tracking and tracking other than the agri products. Implemented using Hyperledger Fabric. This paper[14] implements unsupervised clinics without medical staff intervention, covid 19 detection using x-ray images using deep learning, and a blockchain-based Pharametical system. To deploy the proposed framework in a physical hospital as a pilot study.

Implemented using Google Collaborator, often known as Colab. In the paper [15] the applicability of IoT and Blockchain in the medical sector is explored in three major areas—drug traceability, remote patient monitoring, and medical record management. Interoperability, Security, Scalability and Storage Requirement Handling, Lack of Standardization, Data Ownership, and Accountability are the major challenges.

The paper [16] uses fuzzy set theory to filter unnecessary attributes, proposes a decision-making and experimental evaluation laboratory (DEMATEL) to manage the complex interrelationships between various aspects and attributes, and uses Interpretive Structure Modeling (ISM) to divide the hierarchy and construct a hierarchical theoretical framework. privacy protection, consider multiagent cooperative development, they still cannot contain all possible attributes, including experts in medicine, blockchain, and IoT, it was implemented using Matlab. In paper [17] blockchain-based solution for the protection of cloud-outsourced healthcare data. Evaluation and comparison of the simulation tests of the offered blockchain technology-focused studies can demonstrate integrity verification with cloud storage and medical data, data interchange with reduced computational complexity, security, and privacy protection. The major challenge was a lack of understanding of the primary influencing factors when it comes to implementing blockchain technology in healthcare services and technology. Another research topic for the future is to investigate all of the elements that influence blockchain technology acceptance. The paper [18] proposes an end-to-end Blockchain-based and privacy-preserving framework called SmartMedChain for data sharing in an s-healthcare environment. (eg Blockchain is built on Hyperledger Fabric and stores encrypted health data by using the InterPlanetary File System (IPFS), a distributed data storage solution with high resiliency and scalability. The use of multiple Blockchains may require large amounts of resources, especially in a vast smart healthcare ecosystem. In paper [19] numerous use cases of Blockchain in the healthcare industry. The symbiotic relationship between Blockchain and intelligent health is discussed. Additionally, we address many obstacles to integrating Blockchain-based applications in the health sector and several future research prospects. Challenges include Openness, confidentiality, Speed, and scalability. In paper [20] paper identifies challenges and opportunities for implementing blockchain technology in healthcare and summarizes health-related blockchain products and key players offering solutions across different applications. The major challenges include privacy, security, and full ecosystem interoperability. In the paper [21] URLs (Universal Resource Locator) are included in the authorization information to indicate the data access interface as well as separating patients' privacy data from the blockchain to improve data process efficiency. The contents of smart contracts are demonstrated in a case study to validate the usability of the proposed authorization method in medical data access between different hospitals.

III. METHODOLOGY

As blockchain is secure, immutable, and decentralized, it can be used to implement a smart healthcare network. It can also provide effective data storage and access control. As a result, the architecture of a smart healthcare network will use blockchain. To ensure the confidentiality and integrity of the data, a private blockchain network will be necessary, and Ethereum will be used for the implementation. A healthcare system has many stakeholders, including hospitals, patients, doctors, etc., and the workflow of the entire system involves numerous processes. Smart contracts will be included in the planned blockchain system for patient registration, appointment scheduling, consultation, exchanging test results between patients and doctors, patient monitoring, and billing.

- 1) *Patient Registration*: In order to avoid long waiting lines and any sort of errors in the data, the registration of patients using smart contracts is done. This process consists of health care providers like hospitals, doctors, and patients. Patients who are in need of medical treatment need to do the registration at the hospital and this encrypted data will be using the smart contract and the record will be updated in the blockchain. The smart contract will allow the health care providers to add the patient's information to the system and allow only authorized doctors and lab technicians to view the patient records.
- 2) *Scheduling appointments*: After registration, the patient may see the availability of the concerned doctor, and book an appointment with the doctor. The request will be sent to the healthcare providers with the help of smart contracts. The health care provider may see the availability of the doctor and then update the appointment date and time within the patient record. The patient will be intimated through the blockchain.
- 3) *Consultation*: The patient can go to the hospital for a consultation with the authorized doctor after making an appointment. After assessing the patient's condition, the doctor may diagnose the patient by submitting a prescription and putting the consultation receipt on the Blockchain, via a smart contract, together with the patient's medical information. The patient may then have access to the aforementioned prescription, have any necessary tests done, or obtain the requisite medication. This will facilitate quick and easy consultations.

Unique id

Search Data

Employee ID : 98

Employee uniqueid : 0a00aac7b15c5ebd6210b01356b0e11c6c149

Patient Name : Aarya

Patient Personal Number : 708456123

Doctor Employee ID : Ms. Sen

Doctor Name : Goli Feroz

Medication : 1. Paracetamol 2. ABC 3. XYZ

Add Data

Dashboard

Figure 6: Patient data stored in the Block chain using unique id

The data is added to the blockchain with the unique id, the data can be accessed with the unique id by doctors, lab technicians, pharmacists, and insurance company people. Figure 6 shows the data stored in the blockchain. The unique id is stored as a hash value.

V. CONCLUSION

With the recent improvements in internet and network technologies, there is an obvious need to improve the quality of medical and healthcare services. The current healthcare systems have several flaws that demand decentralized and distributed strategies to address them. In this situation, decentralized solutions that can guarantee the confidentiality and integrity of medical records can be provided in large part by blockchain technology. The goal of this study is to give a general overview of blockchain technology's application in the healthcare industry. This application highlights significant healthcare-related areas where blockchain technology can be used. One of the important areas has been put into practice. Major challenges in implementing blockchain are scalability, interoperability, efficiency, .In the future, the blockchain can be combined with AI and ML, IoT.

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