Healthcare Data Storage Using Blockchain

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Abstract – *Healthcare is an industry which needs to maintain a large amount of critical medical data. Which may include the patient's historical data, medical record, patient's private information, etc. this information is very critical and needs to be stored and maintained securely.*

Whenever people hear about blockchain their mind might typically think about banking and financial markets. But we can use blockchain technology for decentralized healthcare data storage. Blockchain used in healthcare is called as heath blockchain. It is a system for securely storing and sharing information, because of its transparency.

This paper gives the survey of techniques used by the researcher for blockchain data storage and abstract view of the proposed system that we are going to implement to increases data security and removes the cost, time, and resources required to manage the healthcare data records.

*Keywords***: Blockchain Technology, (Inter Planetary File System) IPFS, Healthcare Blockchain, Data Transparency, Healthcare Data Records.**

I. INTRODUCTION

It is a very exciting time for health care and information technology (IT). Due to improvements in genetic research and the advancement of precision medicine, health care is witnessing an innovative approach to disease prevention and treatment that incorporates an individual patient's genetic makeup, lifestyle and environment. Simultaneously, IT advancement has produced large databases of health information, provided tools to track health data and engaged individuals more in their own health care.

Blockchain technology has the potential to address the interoperability challenges currently present in health IT systems and to be the technical standard that enables individuals, health care providers, health care entities and medical researchers to securely share electronic health data.

A Blockchain Model for Health Care

Medical care has been an indispensable part of our lives and so the medical data, for example, prescriptions, previous medical records has also become a vital part of a patient's diagnosis and for further proceedings. Traditionally, medical data were recorded on paper, which was prone to get damaged and modified. Therefore, it was necessary to preserve the data electronically. However, the medical database could be tampered or deleted permanently. In medical systems, it is necessary to provide certain security mechanisms to protect the health-related data as it contains some private information. The traditional method used for maintaining the privacy of the data may leak privacy and integrity while sharing the medical data with more stakeholders for various purposes.

The main motto of the proposed system is to provide secure management of medical records and patient's private information. The proposed system provides a reliable and secure healthcare scheme using blockchain. Healthcare Blockchain [1][3][8][9] System that works in a decentralized environment [3] based on IPFS protocol[11].

Blockchain has many applications in healthcare and can improve mobile health applications, monitoring devices, sharing and storing of electronic medical records, clinical trial data, and insurance information storage. Any blockchain for health care [1][3] would need to be public and would also need to include technological solutions for three key elements: scalability, access security and data privacy [10].

a. Scalability:-

For health care to realize benefits from blockchain, the blockchain would need to function as an access-control manager for health records and data. The health blockchain would contain a complete indexed history of all medical data, including formal medical records as well as health data from mobile applications and wearable sensors, and would follow an individual user throughout his life.

b. Access Security and Data Privacy:-

The user would have full access to his data and control over how his data would be shared. The user would setup specific, detailed transactions about who has access, the allotted time frame for access and the particular types of data that can be accessed. Access control policies would also be securely stored on a blockchain and only the user would be allowed to change them. This provides an environment of transparency and allows the user to make all decisions about what data is collected and how the data can be shared.

Technical Advantages of a Health Care Blockchain

1. The health blockchain would be developed as open-source software.
2. Blockchain would run on widely used and reliable commodity hardware.
3. Blockchain technology also addresses the interoperability challenges within the health IT ecosystem.
4. Blockchain would allow patients, the health care community and researchers to access one shared data source to obtain timely, accurate and comprehensive patient health data.
5. Blockchain works with standard algorithms and protocols for cryptography and data encryption.
6. No single point of failure with blockchain distributed architecture
7. Blockchain would ensure continuous availability and access to real-time data.

II. LITERATURE REVIEW

Matthias Mettler et al.[1] focuses on the various opportunities of blockchain for usage in the healthcare sector, for eg. In public health management, user-oriented medical research based on personal patient data as well as drug counterfeiting. This paper proposed an Ethereum blockchain technology for decentralized healthcare database. Through this shared network infrastructure, deferent healthcare specialists can access the same information.

Christian Esposito et al. [2] Describes how the blockchain is important for storing healthcare data on the cloud. It also proposed data security and privacy while data storing. When new healthcare data for a particular patient is created (e.g. from a consultation, and medical operation such as surgery), a new block is instantiated and distributed to all peers in the patient network. After a majority of the peers have approved the new block, the system will insert it into the chain.

Peng Zhang et al.[3] described a set of evaluation metrics, from both the technical and domain perspectives, to assess healthcare DApps using blockchain technology and serve as an initial guide for creating future apps in this domain. Blockchain properties of decentralization, transparency, and immutability that can potentially be leveraged to improve healthcare interoperability.

Freya Sheer Hardwick, et al.[4] explores the possibilities of blockchain technology and its effectiveness in the e-voting scheme. The implementation and related performance measurements are given in the paper along with the challenges presented by the blockchain platform to develop a complex application like e-voting. The paper highlights some shortcomings and presents two potential paths forward to improve the underlying platform (blockchain technology) to support e-voting and other similar applications. Blockchain technology has a lot of promise; however, in its current state, it might not reach its full potential.

Emre Yavuz et al.[5] solves the fundamental issues that the legacy e-voting system, by using the Ethereum network and blockchain structure. The idea of the security methodology and blockchain which it uses, explicitly immutable hash chains, has been- come adjustable to polls and elections.

Daniel Tse et al.[6] introduces the concept of Blockchain technology in information security of the food supply chain and comparing it with the traditional supply chain system. The proposed system focus on the disadvantages, promoting the

blockchain in tracking, monitoring and auditing the food supply chain and helping manufacturers to record the transactions in authenticity. The proposed system is not implemented in practice, they give the theoretical idea.

Si Chen et al. discuss how to improve the supply chain quality management by adopting the blockchain technology and propose a framework for blockchain-based supply chain quality management in [7]. This framework will provide a theoretical basis for the intelligent quality management of supply chain based on the blockchain technology. Also, it provides a foundation to develop theories about information resource management in distributed, virtual organizations, especially distributed, cross-organizational and decentralized management theory.

The paper [8] described a set of evaluation metrics, from both the technical and domain perspectives, to assess healthcare DApps using blockchain technology and serve as an initial guide for creating future apps in this domain. Blockchain offers properties of decentralization, transparency, and immutability that can potentially be leveraged to improve healthcare interoperability.

Authors of this work [11] propose the usage of smart contracts deployed on a private, permissioned Ethereum blockchain to govern Clinical Trial Authorization (CTA) details and a private IPFS network to store the data structure that holds the clinical trial protocol whenever large file storage is required with an aim to improve data transparency in clinical trials.

III.   PROPOSED SYSTEM

We are developing a system "Healthcare Data Storage Using Blockchain" which provides the top-level security to all healthcare-related data records which remove cost, time, and other resources required for managing all this information. Figure 1 gives the structural design of the proposed system, followed by the system description.
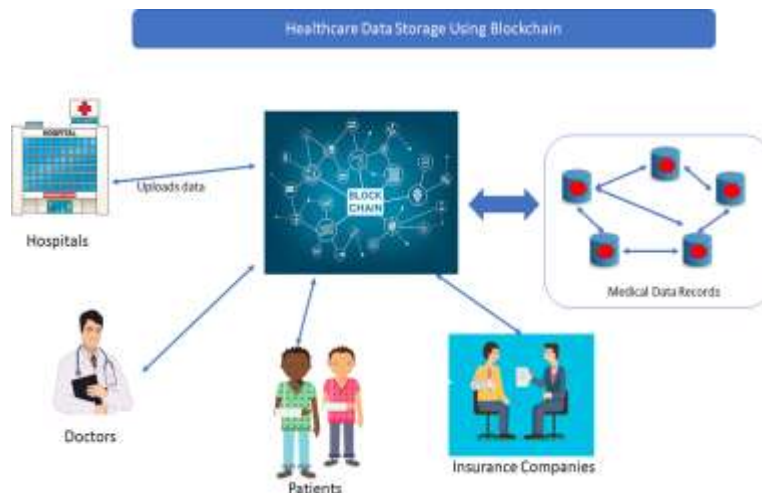

Figure: System Architecture.

1. Patient Account:

The user will add their personal information for creating their new account. It also contains their health records and medical history.

2. Report Submission:

Hospital authority will submit the patient medical report. Submitted report will append with the patient existing history. Submission of one report generates one transaction.

3. Generate Transaction:

From report submission to the billing process activity generates a number of transactions. All transactions are connected sequentially to each other like linked list.

4. Block Generation:

A block contains more than 500 transactions on average. In this phase the generated block contains all transaction of the particular user/patients. The newly generated block is added into the existing blockchain. A block is composed of a header and a long list of transactions.
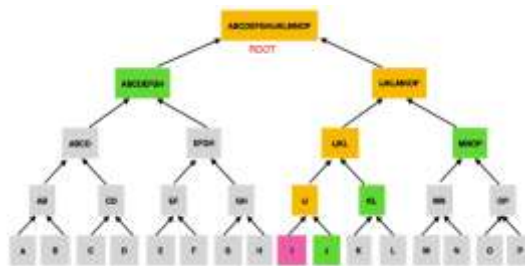
• Block Header:

It contains metadata about a block i.e. Previous block hash, mining competition, merkle tree root etc.

• Transaction List:

It contains long transaction list.
E.g.

5. Transaction Verification:

Insurance Company Officer will act as a validator. After raising insurance claim to the insurance company, the office will validate the patient transaction history.

6. Final Outcome:

After validating the patient transaction officer will approve or reject the claim. And transfer claim money to the patient account.

IV.   CONCLUSION

Blockchain is based on open-source software, Open APIs, and commodity hardware. These components facilitate easier and faster interoperability between systems. It can efficiently scale to handle larger volumes of data and more blockchain users. This paper gives the survey the different techniques used by the researcher for implementing blockchain in various sectors.

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