Transforming Healthcare: Blockchain based Digitized Medical Prescription Tracking

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***Abstract*-The objective of the project, to track the medical prescription of the patient in hospital management, using blockchain technology implemented using the Hyperledger Fabric platform, an open source, distributed ledger technology (DLT) platform, designed to enterprise context. The various parties, namely the Hospitals, the pharmacies, e-pharmacies, and the patients can be connected by hosting multiple nodes on the fabric chain. A web-based App for doctors is connected with Hospitals as well as the participating pharmacies and e-pharmacies. The Doctors can upload the patient's prescription data in the application, the pharmacies and e-pharmacies access the data and send notification to said patient if the prescribed medicines are available. In many cases, such as a long-term user of a particular medicine, say for heart medication, can be reminded to refill. Patient can check for pharmacies nearby and their medicines availability. Patient's details are highly confidential, it will be kept private and only accessed on request basics and enabled for concerned participants this is achieved by zero-knowledge proof. The patients will have their complete medical history that gives access to the doctors without having to repeat the process of conveying the relevant information.**

Keywords: **Blockchain, Healthcare, Hyper fabric ledger, Data management, Zero-knowledge proof.**

I. INTRODUCTION

Over the last century, healthcare data management has been revolutionized by a wide range of hardware, software, and networking technologies all of which aim to improve the tracking of diseases and their causes, medical treatment, the quality of medical care and drugs, and to establish worldwide prevention plans for chronic diseases. The initial paper-based records have now transitioned to Electronic Heath Records (EHRs). EHRs need to be frequently distributed and shared among different hospitals, patients, clinics, pharmacists, medical insurance providers, medical drug manufacturers, researchers, and government to provide a holistic view of a patient's medical history in order to provide accurate and timely patient care. The distribution of EHRs becomes a time consuming and expensive process when we use the traditional client-server healthcare data management system where each hospital/clinic maintains its own database of patients' medical records. A patient's treatment is further delayed if the patient moves from one hospital to another hospital across different regions or countries. Moreover, most of the time a patient has to repeat several laboratory and radiology tests. Cloud-based health data management systems have been introduced in the past to address the issues of scalability, real-time data access, single point of failure, privacy and security prevailing in the client-server-based system. The patients' medical data from different hospitals are stored in a remote cloud storage making it easily accessible by patients and healthcare providers. However, this requires the patients and the hospitals to either encrypt the sensitive and private patients' medical data before uploading it to the cloud or to trust in the cloud service provider. The former requires a large amount of memory-intensive computing which is not suitable for a hospital environment whereas, the latter may be very difficult to employ because the patients are aware of the potential risks of their data being misused. Moreover, the issue of a single point of failure along with data security and patient's privacy risk prevailing in the client-server-based system, still exist in cloud-based systems. According to the statistics provided by the Health Insurance Portability and Accountability Act (HIPAA), 13,236,569 medical records were breached in 2018 which were as twice as compared to 5,138,179 records breached in 2017.

Blockchain technology which uses a shared, immutable, and transparent ledger has a great potential to solve the issues of real-time data access, vulnerability, data fragmentation, lack of traceability, security, and privacy which exist in the current client-server architecture. Each transaction in blockchain is timestamped and a block of several timestamped transactions is created. A block is linked to a previous block by using a cryptographic technique to serve immutability.

Blockchain eliminates the need for a central database server that operates as an intermediate among the peers. The server is a single point of failure. If the server fails, the entire network will be affected. In addition, the network bandwidth usage of the server must be high in order to support high volumes of network traffic. Moreover, this centralized approach also has security concerns because the server contains all the sensitive information of the network participants. Blockchain addresses these aforementioned issues through its decentralized network architecture wherein all the network participants have equal influence over the network and share a copy of the transactions' data in form of a ledger. This replication of data gives local access to the data and also helps to improve fault tolerance when data on some of the nodes is corrupted or the

nodes behave maliciously. Furthermore, the data stored in the blockchain is immutable, i.e., once the data is stored, it cannot be modified or deleted. Any modification or deletion of the data is quickly detected by the underlying blockchain mechanisms. Each block in the chain is hashed using the hash of the previous block thereby creating an immutable chain.

II. BRIEF HISTORY

Cloud computing is delivery of different services over Internet network. These resources include tools and applications like data storage, servers, databases, networking, and software. The term is generally used to describe data centers available to many users over the Internet. The clouds now a days, are predominant and have functions distributed over multiple locations from central servers. Clouds may be limited to a single organization, or many organizations (public cloud). Cloud computing works on sharing of resources to achieve coherence and economies of scale. There are four types of cloud they are Public cloud, Private cloud, Hybrid cloud, Community cloud.

The Advantages of cloud computing are Cost Savings,Strategic edge., High Speed Back-up and restore data,Automatic Software Integration, Reliability, Mobility.

Unlimited storage capacity. Limitations of cloud computing are Centralized cloud, Risk of data confidentiality, Depends on internet connection, The level of security, Compliance, Vulnerable in the event of an attack, Data Mobility, Technical problem, Low Connection, Downtime.

Block chain technology -In recent years, research relating to blockchain and smart ledgers has gained in popularity due to the emergence of cryptocurrencies, such as Bitcoin and Ethereum. Blockchain stores and shares data in a distributed, trusted and immutable manner, removing intermediaries, and not requiring a centralized dependency for checking transactions . Transparency in blockchain provides a less complicated method for accessing ledger-based transactions over networks; it connects with different computing powers from multiple nodes in the blockchain network, making it extremely powerful with respect to calculation speed. Blockchain comprises various techniques and services, including Consensus Protocol, Hash Cryptography, Immutable Ledger, Distributed P2P Networking, and mining, which are now introduced in more detail:

Consensus protocol: In a blockchain network, certain users have individual access rights to grant transactions that are updated in the system, known as consensus protocol;

Hash cryptography: A blockchain uses SHA256 hash for adding transactions. This is developed by the NSA and is 64 characters long. Hash algorithms include features, such as one-way cryptography, deterministic, faster computation, the avalanche effect, and must withstand collisions; Immutable ledger: All transactions in a blockchain network are recorded, while the shared ledger cannot be modified or tampered with; Distributed P2P network: All transactions are broadcast over the network to different users to distribute and update the data; and Mining: Miners use blocks of nonce values to achieve hash values in the network. This requires high computation speed to achieve and obtain the reward.

It is possible to duplicate a blockchain network to another location e.g., within the same facility or healthcare delivery network, or as part of a national or international data sharing program. This ability makes it possible to share healthcare data with researchers, partner facilities, or other interested parties e.g., insurance providers. Blockchain is linked within a network, which shares data and ensures that the data within the network is accurate, reliable and consistent. We can, therefore, add data to a blockchain at one location and distribute it to one or more locations within the same network. The new locations also share the data within the network, eventually distributing the new data to the entire network, and allowing location access to the latest data.

The system will work in the following fashion:

- While went for a hospital visit, the concerned doctor may upload the patient's prescription data, Using Fabric's private transaction , the hash of this data will be added to the blockchain.
- The patient data is highly confidential, it will be kept private and access only on a request basis and enable only for concerned participants. This will be achieved by implementing a solution such as a zero-knowledge proof. With the patient permission ,Doctors able to see previous medical prescriptions of them.This will be especially useful when specialists conducting tests, diagnosis or administering treatment who need to know specifics from the patient history or existing conditions..
- Data collected through this system can also be utilil for further research and development, with patient privacy.

Use Cases

1. Minimize the need to carry prescriptions
2. Decreasing the number of orders getting rejected due to unclear as well as invalid prescriptions
3. Ensure user to get all prescriptions from one platform
4. Remove Substance abuse
5. Authenticate the medical records

6. Taking measures to avoid medicine frauds

III. CONCLUSION

The use of blockchain in healthcare systems plays a critical role in the current healthcare market. It can result in automated data collection and verification processes, correct and aggregated data from various sources which are immutable, tamper resistant and provide secured data, with reduced probability of cybercrime. It also supports distributed data, with redundancy and fault tolerance of the system. In this paper, current challenges faced by the healthcare industry are discussed. We propose a system architecture and algorithm for access control policy for participants to achieve privacy and security for patient data. Also, the implementation based on the blockchain network is given. The proposed work eliminates the central authority and a single point of failure in the system. System security is achieved through immutable ledger technology as any user cannot modify the ledger. Performance evaluation of the proposed system is completed using the caliper for various scenarios by configuring block size, block creation time, endorsement policy and proposed optimization for evaluation metrics, such as latency, throughput, and network security for obtaining better results. By optimizing the performance of the proposed system, it is improved by 1.75x and latency is decreased by 1.5x. This shows the blockchain capability and importance in various areas and proves that it could be the next revolutionary technology for replacing current healthcare systems.

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Research about blockchain and healthcare is currently limited, but blockchain is on the brink of transforming the healthcare system; through its decentralized principles, blockchain can improve accessibility and security of patient information, and can therefore overturn the healthcare hierarchy and build a new system in which patients manage their own care.