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Blockchain Technology in Healthcare Industry

Reddy Kumaraswamy[1], Advin Manhar[2]
[1]Research Scholar, Amity University Chhattisgarh, Raipur, Chhattisgarh, India
[2]Assistant Professor, Amity University Chhattisgarh, Raipur, Chhattisgarh, India

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ABSTRACT

Blockchain is one of the most growing technologies that is playing a vital role in the professional world today. Blockchain is the technology that is going to revolutionize many industries in the future including healthcare. It is simply defined as a decentralized, distributed ledger that records the provenance of a digital asset. Blockchain is used as a backbone for many industries such as cryptocurrencies, bitcoin, and many more. Although its capability and application have to be extended far beyond. The objective of blockchain is to allow digital information to be recorded and distributed, but not edited.

In the last couple of years many industries finding new ways to implement blockchain technology with a wide range of domains. And this sudden increase in technology also provided many new application opportunities, including financial services, smart contracts, energy trading, supply chain, healthcare, etc.

In this paper, we know briefly about blockchain technologies and some of their applications. We also show how blockchain is going to revolutionize the healthcare industry in the future.

Keywords : Blockchain, Financial Services, Smart Contracts, Energy Trading, Supply Chain, Healthcare

I. INTRODUCTION

Blockchain is an expanding list of records, called blocks, that are linked using cryptography. Each block contains a hash of the previous block, transaction data, and the hash of this block. Blockchain is a modification resistant to its data. This is because once data is recorded, the data in any given block cannot be altered retroactively without modification of all subsequent blocks. It is identified as a distributed ledger technology for peer-to-peer (P2P) network digital data transactions that may be publicly or privately distributed to all users.

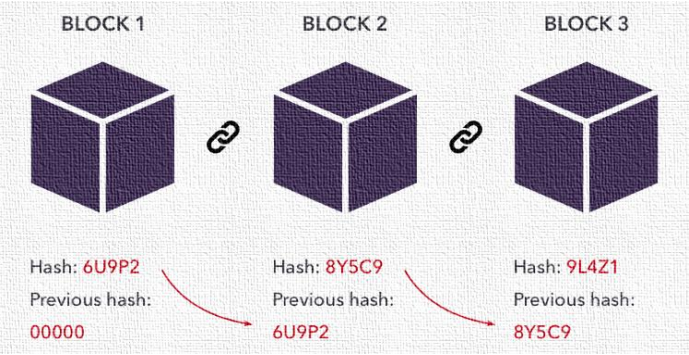

Figure 1. Structure of a Blockchain

Blockchain technology provides transparency and eradicates the need for third-party administrators or intermediaries. It uses consensus mechanisms and cryptography to confirm the legitimacy of a transaction in a trustless and unreliable environment. In a distributed P2P network of transactions, the receiving node checks the message; if the message is correct, then it stores it in a block. A consensus algorithm is then used to verify the data in each block; this is called "Proof-of-work (PoW)". The block will be added into the chain after performing the consensus algorithm, every node in the network admits this block and incessantly spreads the chain.

Its potential benefits include a reduction in costs and complexity of transactions between parties, enhanced security, improved transparency, and regulation. Blockchain technology was first largely applied in the financial industry that allowed bitcoin to operate. It has applications for many more industries including healthcare, insurance, pharmacy, e-voting, legal contracts, tourism, energy, manufacturing, and the travel industry.

One of the most leading applications of blockchain technology is healthcare. The potential of blockchain in healthcare is to overcome the challenges that are related to data security, privacy, sharing, and storage. One of the requirements of the healthcare industry is Interoperability. It is the ability of two parties, either human or a machine to exchange data or information precisely, efficiently, and consistently. The goal of interoperability in healthcare is to facilitate the exchange of health-related information, such as electronic health records (EHR), among healthcare providers and patients so that the data can be shared throughout the environment and assigned by different hospital systems. Interoperability also enables provides to share patient's medical records securely, in any case of the provider's location and the trust relationship between them. This side of interoperability is resolved by using blockchain technology which showed the potential to store, manage, and share EHRs safely amongst large healthcare communities.

A recent report of Market Research Future (MRFR) shows that blockchain technology in the healthcare industry is expected to generate over 42 million in value and reach a compound annual growth rate of 71.8% by 2023. Another recent (Deloitte, 2018) survey shows that understanding of technology varies due to its fact of what purposes are served. Even though with little knowledge, 55% of US senior executives are planning to invest more than $1M in blockchain technology over the next couple of years.

Electronic Health Records (EHRs):

EHRs are the collection of patient's medical records in digital format. Electronic medical records are stored electronically which is maintained by the hospital or clinical over time. These medical records comprise all the important clinical data which is crucial to that patient's care stored with a specific care provider, including MRI reports, past medical examination, immunization, laboratory reports, and any form of allergies of the patient. These records are real-time records, patients' specific records that readily available for a patient or a doctor. They have improved the accuracy and clarity of health information by reducing the occurrence of errors in records.

Nowadays many hospitals and clinics are using blockchain technology to securely store their patients' medical records. When a medical record of a patient is generated and tested, then it can be added to the blockchain network. These personalized health records could be encrypted and kept on the blockchain network with a private key, which allows only verified users to access the health records in crucial time, thereby ensuring the privacy of the patient.

EHR System Design & Architecture:

Blockchain network is divided into three main components: Participants, Assets, and Transactions. In the implementation of the EHR system using blockchain, EHR consists of four main participants:

- Patients
- Doctors
- Labs
- Admin

Patients play a very important role as participants in the EHR system as they own their health records that have been created and added to the blockchain. They have the authority to regulate who all can access their records.

Doctors/Clinicians are the care providers who will collect medical data of patients through diagnoses. They are responsible for updating the health-related information in the records of the patients who have verified them as authorized doctors/clinicians and have been permitted to write into their records.

Labs are responsible for conducting tests then generating test results and updating that information in the records of patients who have verified them as authorized labs and have been permitted to write into their records.

Admin is the one who deploys the blockchain network, implements various contacts various contracts in the network, generates the key, and handles the encryption-decryption of the transaction data.

In this system, medical records are the asset of the network. Each medical record is owned by some patients who are registered on the network. Whenever a transaction has been executed the value of the asset changes.

The transaction is the actions performed mainly on the asset in the network like adding a participant in the network, creating medical records, retrieving specific information from the network, update in the participant's information, giving access to the clinician or lab, and revoking access from them. For the execution of some of these transactions, there is a need to have a relationship between the two participating nodes. For example, the person whose medical records are to be accessed must be a patient of the clinician/doctor who wants to get access to the medical record of the patient. The permission rules are also described in the system. This helps in restricting access to all the resources of the system. Only authorized users get to manipulate or read specific records only.

EHRs System Implementation:

We use a blockchain-based framework Hyperledger Fabric and Composer tool to implement the project.

Hyperledger Fabric is a blockchain framework implementation founded by the Linux Foundation. We use this framework as it allows components, such as consensus and membership services, to be plug-and-play. It helps container technology to host smart contracts, called "Chaincode".

Hyperledger Composer is an open-source tool for building a blockchain network. This tool helps business owners and developers to create multiple smart contracts and blockchain applications for solving various business problems.

Following steps to be followed to implement this blockchain-based HER network:

1. Collection of data.
2. Wallet allocation.
3. Deploying a blockchain network using Hyperledger Fabric and Composer.

4. Creation of different nodes in the system.
5. Creation of medical records.
6. Creation of transactions.
7. Addition of node to the system.
8. Specification of various permissions granted to the user.
9. Execution of transactions.

II. CONCLUSION

Blockchain Technology is gaining large attention from individuals, as well as organizations of nearly all kinds and dimensions. This technology is capable of transforming the traditional industry with its features, including decentralization, anonymity, auditability, and persistency. This technology is expected to reshape the healthcare industry. In this technology not only, the process will be transparent and secure, but also the quality of healthcare will be increased at lower costs.

In this paper, we have discussed how blockchain works, the implementation of blockchain, how it will revolutionize the healthcare industry, and the system design of EHRs. Specifically, we presented current research on healthcare data management and how blockchain will empower patients and streamline the sharing process of health data. The blockchain slows for health records to be time-stamped so that no one can tamper with them after becoming part of the distributor ledger. The patient will have the right to decide who can and cannot access their data and for what purpose.

There are still some open challenges that require further investigation. For example, cross-border sharing of health data where different and often conflicting jurisdictions exist may hinder the benefit of blockchain's data sharing. Indeed, the expectation of an individual's privacy varies from one country to another based on government regulations. Another potential problem that is under-researched is the capability of the blockchain to store and process massive data access transactions on time. As the volume of transactions increases, the delay of mining blocks in private or public blockchain will increase exponentially. Therefore, there is a need for innovative mechanisms and algorithms to minimize mining delays.

For blockchain technology to work in such an environment, we need research that investigates blockchain mechanisms that promote a single global access policy for the whole network. Moreover, since the network consists of nodes and computers that are spatially separated, there is a need for synchronization mechanisms to identify the order of block additions.

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