

A Study to Implement Blockchain in Health Care

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Abstract - Accurate and complete patient data is important and valuable to both patients and referrals. Due to this policy, the patient's medical records cannot be shared between different medical facilities or hospitals, and the patient must be re-diagnosed at another facility. Patients are also experiencing delays in treatment and appointments due to the high utilization of high-end government hospitals. Due to limited knowledge of the medical history, doctors cannot easily diagnose the patient. The auction of patient medical records is another risk for these institutions. Therefore, secure storage that facilitates access to medical data and privacy protection is an important issue. A decentralized and encrypted network of medical records using blockchain can help solve these problems. With this distributed storage, patients can make seamless appointments and get permission to share medical records with different hospitals, without the risk of data theft. Doctors can also view the medical history of patient and upload treatment and patient's profiles. Your doctor may help others to make a diagnosis in the future. Therefore, it has been found that creating a decentralized, encrypted network for storing medical records improves the speed and quality of patient care.

Index Terms - Decentralized System, Blockchain, Cryptocurrency, Ethereum.

INTRODUCTION

Due to different events and different architecture at different facilities, most of the patient data are now stored in a central database. Full responsibility for patient data rests with the service provider or certain operators, and not with the patient, with easy access to all data and almost impossible control over the transfer and use of personal data. Current patient data management does not guarantee the integrity or reliability of patient records, increasing the risk of data loss or misuse.[1]

Today, in this revolutionary era, blockchain technology provides a promising new framework to enable and support the digital, secure, and reliable integration of health information across diverse applications and stakeholders. To do so, we can set up a seamless distributed data platform. For example, we can collect, track, and securely manage medical records, registration proof, and location data, information about medicines and their supply chains, insurance, and claims.

A blockchain is a distributed database structure of medical data where every transaction or digital event is checked and stored by all parties involved in the database.[1] This decentralization of data and a higher level of security and transparency in data processing significantly improve interoperability, quality, and collaboration in healthcare, reduce administrative effort, and ensure information reliability and testability.[1]

Blockchain solutions provide an efficient approach for reliable data management, especially when storing and processing sensitive patient data in the medical field. Many facilities and industrial facilities are already aware of the importance of technology for healthcare and have established basic ideas, concepts, and key use cases, but concrete implementations and execution are relatively rare.

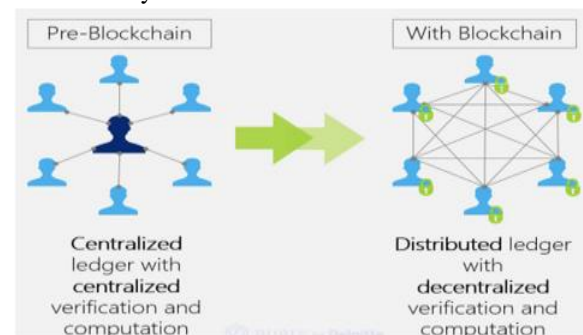


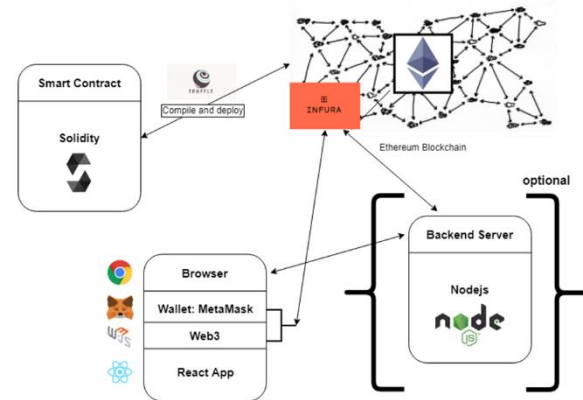
Figure 1. Centralized vs Decentralized System

OVERVIEW OF BLOCKCHAIN

Since Bitcoin introduced blockchain, research has been conducted to extend its application to non-financial use cases. Blockchain is expected to have a significant impact on the healthcare industry. Research in this area is relatively new, but it is growing rapidly. The core of the blockchain uses cryptographic primitives to bring out most of its functionality. Each participant in the blockchain network is represented as a node, and each node uses public key infrastructure (PKI) to create and propose transactions. Each participant has a public/private key pair. The public key acts as the user's public address, and the private key is used to authenticate the user. When you create a transaction, it must include the public key of the user who created the transaction, the public key of the recipient of the transaction, and the transaction message. All of these are bundled, encrypted, and signed with the user's private key, and broadcast to other nodes on the blockchain network. When this is done, the user is said to have proposed a transaction. Block is a collection of valid transaction proposals received within the specified time period. A valid transaction proposal meets the validation requirements. The validation process verifies that the proposed transaction is legitimate. For example, make sure it is from an authorized user (node). The consensus algorithm determines the order in which the validated blocks are added to the ledger. The blockchain network has a special node responsible for executing the consensus algorithm (that is, it validates the transaction and determines the order in which the blocks of the transaction are added to the blockchain). These special nodes are called miners, and the process of validating transactions and ordering them on the blockchain is called mining. When the miner receives the transaction offer, the miner confirms that the transaction is valid. The validated transaction is contained in the block. After the specified time (or block), a new block of validated transactions is linked (or chained) to the previous block, creating a chain of blocks called a blockchain. Since the blockchain is replicated between all the nodes in the network, each node has the same database or ledger for all transactions in the network. We are trying to build a Web-App that allows the user in our case the patient or the hospital authority to store

and manage medical record of patients, display medical history of the patient for rapid treatment of the patient, search medical data. We have also extended our project with the features like registering patient and doctor, book an appointment with the doctor while making payment via Ether to doctor. Also, as for the doctors, they can upload new medical records and update the existing; after registering for the same.

The System Architecture that we propose is:



TECHNOLOGIES

- a. Backend: In a true decentralized app, backend will consist only of your Solidity smart contracts. Then it basically acts as the server.
 - Solidity: Technically Solidity or some other EVM language is the only real technology that is required to write a decentralized app for Ethereum. You write your logic in Solidity, deploy the contract on the Ethereum blockchain and you are done.
 - Server: Even though you have your smart contracts as backend, often times a decentralized app will still have an additional traditional server running. One reason might just be user data management.
- b. React Native Application: React is a free and open-source front-end JavaScript library for building user interfaces based on UI components.
- c. Tools
 - Node.js: We used node.js as a tool. It allows us to run JavaScript code without a browser and a lot of tools for developing Solidity code are written in JavaScript.
 - Package Manager: Npm or yarn will be essential for Solidity development. They allow us to

manage dependencies, install/upgrade/remove other packages that are needed

- Truffle: The most important tool for compiling, managing contract deployments and running automated tests is Truffle. It comes with various boxes to get you started which are alternatives to the create-eth-app but include a truffle integration.
- Ganache: Part of the Truffle suite is Ganache. It will enable you to run a local blockchain on your computer for fast tests.
- MetaMask: MetaMask is a wallet for your browser. It will enable users to store their Ethereum accounts including private keys securely inside the browser. When your frontend applications require interaction with a smart contract, it can request MetaMask to sign a transaction and MetaMask will forward the request to the user to confirm.
- Etherscan: Etherscan is a website for tracking Ethereum transactions. It is very useful while testing to verify your contracts. Afterwards you will have an easy way to communicate with your contracts and have a nice overview of what is going on.

LITERATURE REVIEW

1. Electronic Healthcare Model Based on Smart Card for Saudi Medical Centres [5] Alabdulqader, E. and Fourar-Laidi, H., 2011. Electronic Healthcare Model Based on Smart Card for Saudi Medical Centers.

This paper suggests the use of centralized system (smart cards) for a particular country with a particular web server. This model aims to improve the quality of smart card services in the healthcare sector in a particular region.

This will restrict the use of patient's records to be used in the particular part of the world while carrying a physical card.

2. Digital and Decentralized Management of Patient Data in Healthcare Using Blockchain Implementations [1], published by Westphal, E. and Seitz, H., 2021. Digital and Decentralized Management of Patient Data in Healthcare Using Blockchain Implementations. *Frontiers in Blockchain*, 4.

This paper suggests the current research completed on the use of blockchain in healthcare and the problems experienced.

This suggests blockchain implementations in healthcare to-

- Secure Storage for Medical Records [2]
- Electronic Medical Data Access and Permission Management [3]
- Supply Chain and Health Asset Tracking [4]

3. Blockchain Technology in Healthcare: A Systematic Review [7], Agbo, C., Mahmoud, Q. and Eklund, J., 2019. Blockchain Technology in Healthcare: A Systematic Review. *Healthcare*, 7(2), p.56.

The scope of the research suggests the areas blockchain technology use cases in healthcare.

They suggest that blockchain has many healthcare use cases including the management of electronic medical records, drugs and pharmaceutical supply chain management, biomedical research and education, remote patient monitoring, health data analytics, among others.

Our research further extends the scope of the above-mentioned research by exploring the scope of blockchain technology in electronic medical records.

SUGGESTED SOLUTION

Our objective is to make a decentralized electronic medical report to manage patients' precious data by using blockchain technology. We will be developing a system which will store patient data decentralized rather than using current centralized arrangement which will provide patient data integrity and data reliability.[1]

Our research extends to the feature of booking doctor's appointment for the next medical check-up and the doctor can upload the latest report for the same through blockchain. For this feature to be used, the doctor must register with us, and this will be accompanied by a nominal fee which has to be paid in the form of cryptocurrency i.e., particularly Ethereum [8].

Scope of this project is very wide in this era where data is fuel. Everyone nowadays wants their data should be secure. And in the case of medical reports the data

became so sensitive that it should be right hands. This system will help doctors to see patient medical history and help doctors to treat the patient better.

A well-functioning health information system is one that ensures the production, analysis, dissemination, and use of reliable and timely information on health determinants, health system performance and health status.[6] A well-functioning health system ensures equitable access to essential medical products, vaccines and technologies of assured quality, safety, efficacy and cost-effectiveness, and their scientifically sound and cost-effective use.[6]

The securing of the anonymity of the patient's data to be stored de-centrally, the legal framework and the protection against data theft by criminal parties is also be considered. The latest, prototypical application is developed and established that go beyond early-stage implementations.

ETHEREUM

The Ethereum network includes its own built-in currency, ether, which serves the dual purpose of providing a primary liquidity layer to allow for efficient exchange between various types of digital assets and, more importantly, of providing a mechanism for paying transaction fees. For convenience and to avoid future argument, the denominations will be pre-labelled [8]

CONCLUSION

Current research on implementations of blockchain in healthcare industry is limited to storage of patient's medical record. Major publications were thoroughly examined in detail for the same purpose. The study shows that secure storage and access to medical data using blockchain is important. The development of a secure, reliable and digital solution for this need is increasingly linked to the principles of blockchain technology. In the future, specific guidelines for the electronic storage of patient data, medical products, devices and materials used etc. should be developed, which are important for patients and indispensable for any further treatment

Our Research is not limited to storing the data of patient's medical history but extends to the scope of booking appointment with the doctor, search medical data, register patient and doctor for further references

and easy accessibility. It also allows to patient to make payment in the form of Ethereum to the doctor

FUTURE SCOPE

Healthcare industry is an important industry and should be continuously evolving. Various new technologies are being used to develop a strong healthcare system. These developments are also demanding equally good infrastructure and implementation of these technologies in the current infrastructure. Future research might be done to connect and execute this technology directly in the hospitals to book slots and get the treatment done. For Example, the government could take necessary steps to regulate this technology, make guidelines for the use of this directly in the government aided hospitals like AIIMS to book a slot and appointment for the treatment and regular check-ups.

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