BLOCKCHAIN FOR ELECTRONIC HEALTH RECORDS

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Abstract

For a very long time, blockchain technology has been a fascinating research topic, and many different businesses have taken use of its advantages. Similar to other industries, the healthcare industry has a lot to gain from blockchain technology because of its security, privacy, secrecy, and decentralization. The Electronic Health Record (EHR) systems do, however, have issues with data management, security, and integrity. This essay explores the potential for blockchain technology to alter electronic health record (EHR) systems and offer a resolution to these problems. We offer a framework that might be applied to the adoption of blockchain technology for electronic health records in the healthcare industry. Our suggested framework aims to safeguard the preservation of electronic records by creating granular access controls for users in addition to first implementing blockchain technology for HER.

Keyword: *Blockchain, health records, electronic health records, decentralization*

1. INTRODUCTION

Innovation's new progression is changing the way that we use and see things, which affects each part of human existence. Like the enhancements innovation has achieved in various different circles of life, it is additionally finding new techniques to propel the medical services industry. The key benefits that innovation headways are bringing to the medical services industry remember an improvement for security, client experience, and different regions. Frameworks for electronic clinical records (EMR) and electronic wellbeing records (EHR) gave these benefits. Information uprightness, client possession, and clinical record security are only a couple of models. Using a state of the art innovation like Blockchain could be the solution to these issues. This innovation vows to give a protected, secure stage for facilitating clinical records and different information relating to medical services. A pattern

towards EHR frameworks, which coordinate paper-based and electronic clinical records, was available in the medical care industry (EMR). In its different parts, these frameworks were used to store clinical notes and test discoveries. Because of the benefits it offers, especially the upgrade of safety and its expense viability, the EHR frameworks have been conveyed in various medical clinics all through the world.

They are viewed as a fundamental part of the medical care industry since they provide the business with a great deal of usefulness. INTEROPERABILITY way for various data frameworks to trade data between them. The data ought to be interchangeable and should be usable for additional reasons. A significant part of EHR frameworks is its Health Information Exchange (HIE) or overall information sharing perspective. With various EHR frameworks being sent in different emergency clinics they have a fluctuating degree of wordings, specialized and useful capacities which makes it to have no generally characterized standard [6]. Additionally, at specialized level the clinical records being traded ought to be interpretable, and that deciphered snippet of data could be additionally utilized.

2. LITERATURE REVIEW

Blockchain technology was designed by Nakamoto [1] The primary concept was to create a decentralised money that was cryptographically safe and useful for financial transactions. In the end, the blockchain concept was applied to many other spheres of life; the healthcare industry is one of them and plans to employ it. Numerous researchers have conducted research in this field, with their studies focusing on the viability of the idea of integrating blockchain technology in the healthcare industry. They also describe the benefits, risks, issues, and difficulties that come with using this technology. Some researchers have talked about the difficulties of really putting this into practise on a bigger scale.

A study on smart contracts and their applicability in blockchain technology was carried out by Wang et al. [3]. They start out by introducing smart contracts, their operational structure, operating systems, and other key ideas associated with them. The authors also cover how smart contracts might be used to the novel idea of parallel blockchains. They point out that the decentralisation provided by the programming language code used to create smart contracts on the blockchain is the basis for their use. The author then went over the fundamentals of smart contracts and the numerous blockchain layers that work together to maintain the system operational.

Eberhardt and Tai [2].conducted research to discover projects that aim to address the scalability issue with blockchains as well as explore potential solutions. Blockchain is described as a collection of different computational and economic principles built on a peer-to-peer network. This study sought to determine what information will be stored on-chain and what information may be stored off-chain. This study proposed five models for off-chain data storage, together with their fundamental concepts and implementation frameworks. On-chain data, according to the authors, is any data that is saved on the blockchain by way of transactions. Off-chain data storage, however, involves storing data somewhere on any other storage medium, not on-chain, and it also excludes

Zhang et al. [4], a scalable approach to the blockchain for medical records was put out. This study's main objective was to create an architecture that meets with the standards set out by the Office of the National Coordinator for Health Information Technology (ONC). This study identified the main challenges that this technology faces, including worries about privacy, blockchain security, scalability issues related to the massive volume of datasets being transmitted on this platform, and lastly, the absence of a globally enforced standard for data exchange on blockchain.

Vujicic et al. [5], offered a summary of bitcoin, Ethereum, and blockchain technology. According to the authors, the environment of information technology is continually evolving, and blockchain technology is advantageous to information systems.

They described bitcoin as a decentralized peer-to-peer network utilized for bitcoin transactions. Along with defining the notion of blockchain mining, they also established the proof-of-work consensus algorithm. The authors stress that blockchain scalability is a serious issue, and that several solutions, including as SegWit and Lightning, Bitcoin Cash, and Bitcoin Gold, have been proposed to address this issue. The article also described Ethereum and its dependencies and distinguished its blockchain from that of bitcoin.

3. OBJECTIVE

This technology was introduced by Nakamoto [13], for his popular work of digital currency or crypto-currency, i.e., bitcoin. Nakamoto used blockchain technology to solve the double spending problem of bitcoin but soon this novel technology was being used in many other applications.

Blockchain is a chain of blocks that are connected together and are continuously growing by storing transactions on the blocks. This platform uses a decentralized approach that allows the information to be distributed and that each piece of distributed information or commonly known as data have shared ownership. Blockchains holds batches of transactions that are hashed thus providing them security and they are managed by peer-to-peer networks. A blockchain has certain benefits such as security, anonymity, and integrity of data with no third party intervention. These benefits make it a reasonable choice to store patient's medical records on it, because the innovation of technology in the healthcare industry has made the security of patient's medical data a top priority. A number of researchers have also identified that using blockchain technology in healthcare would be a feasible solution

4. RESEARCH METHODOLOGY

As they are used to complete principal errands like overseeing jobs and patient records, savvy contracts assume a critical part in DApps. These agreements are utilized to allow clients admittance to the DApp and complete CRUD procedure on understanding records. The sole motivation behind the Patient Recordssmart contract is to complete the usefulness of the recommended engineering. Alongside doing CRUD assignments, it likewise lays out jobs for admittance to these capabilities. OpenZeppelin's savvy contract library's brilliant agreement. You could use the brilliant agreements in this library, which execute various capabilities, to fabricate your own shrewd agreements. The use of this library was spurred by the benefits it offers, to be specific tried and local area supported code.

The following is the calculation for making the Patient Records savvy contract. It frames every one of the moves initiated inside it as well as the numerous conditions that encompass them. It likewise portrays how the jobs are stayed up with the latest to permit admittance to a particular usefulness.

Calculation Smart Contract for Patient Records:
Dole out Roles:
capability Define Roles (New Role, New Account)
add new job and record in jobs planning
end capability
Add Data:
capability Add Patient Record (contains factors to add information)

on the off chance that (msg.sender == specialist),
add information to specific patient's record else Abort meeting
end if
end capability
Recover Data:
functionView Patient Record (patient id)
in the event that (msg.sender == specialist || patient)
in the event that (patient id) == valid
recover information from indicated patient (id)
return (patient record) to the record that mentioned the recover activity
else Abort meeting
end if
end if
end capability
Update Data:
capability Update Patient Record (contains factors to refresh information)
on the off chance that (msg.sender == specialist),
on the off chance that(id == patient id && name == patient name)
update information to specific patient's record bring accomplishment back
else return fizzle
end if
else Abort meeting
end if
end capability

Erase Data:
capability Delete Patient Record (patient id)
in the event that (msg.sender == specialist)
in the event that (id == patient id), erase specific patient's record bring accomplishment back
else return fizzle
end if else Abort meeting
end if
end capability

5. ANALYSIS & FINDINGS

Average Execution Time:

The more exchanges there are, the more it takes to execute. These exchanges are completed on the side of the various shrewd agreement includes whose calculation is depicted in Section V. At the point when just a single individual is signed in, the framework's Assign Roles, Add Patient Records, and View Patient Records tasks would execute in 18.29 seconds, 1 moment, 48 seconds, and 50 seconds, separately. At the point when 100 clients are using the framework on the double, the time would increment.

Throughput :

The few functionalities that are essential for the brilliant agreement of the recommended system are made sense of in Algorithm 1. Using JMeter, we made a recreation of 100 to 500 individuals utilizing the framework and completing its different exercises over a time of 10 to 35. JMeter estimates throughput in information/time, or KB/sec, units. We tried the framework's presentation while doing the preliminaries while reenacting the previously mentioned number of clients. The proposed structure is utilized to direct these reproductions, and throughput is analyzed at the end. Over the span of this examination, it was found that the throughput of the framework fundamentally developed straightly as how much clients and solicitations rose.

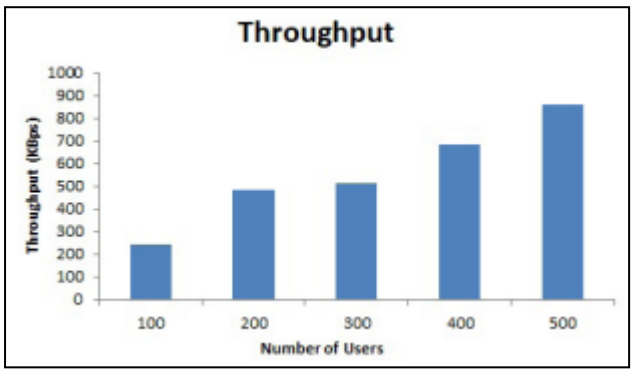

Figure 1: Throughput

Average Latency:

Inertness known as the postpone that happens when a framework part is sitting tight for one more part of the framework to answer an activity. As far as time it very well may be alluded as the distinction of arrangement and finish season of exchange. . The contrast between these two activities is characterized as inertness. Here we have assessed the normal inactivity of the

proposed structure by utilizing JMeter. While assessing the idleness of the proposed structure we reproduced the quantity of clients by JMeter. In JMeter idleness is estimated with regards to milliseconds. The accompanying diagram Figure 5 gives an outline of normal inertness of the framework alongside the throughput of the proposed structure. The most elevated kept idleness in this examination is 14ms.

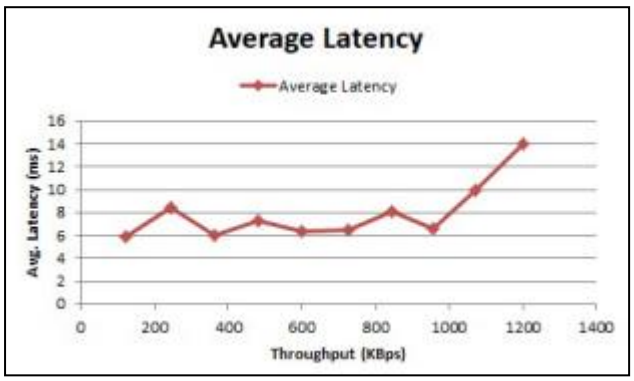

Figure 2: Average Latency

6. LIMITATIONS & FUTURE SCOPE

Challenges Faced by Blockchain Technology

1) Scalability and Storage Capacity

Storage of data on the blockchain causes two main problems, i.e., confidentiality and scalability. The data on the blockchain is visible to everyone that is present on the chain this makes the data vulnerable which is not a desired outcome for a decentralized platform. The data stored on the blockchain would contain patient medical history, records, lab results, X-rays reports, MRI results and many other reports, all of this voluminous data is to be stored on the blockchain that would highly affect the storage capacity of blockchain [18].

2) Lack of Social Skills

The way the blockchain technology works is understandable by very few people. This technology is still in its initial phases and is constantly evolving. Moreover, the shift from trusted EHR systems to the blockchain technology would take time as hospitals, or any other healthcare institutes need to completely shift their systems to blockchain.

3) Lack of Universally Defined Standards

As this technology is still in the initial phases and is constantly evolving so there is no defined standard for it. Due to this the implementation of this technology in healthcare sector

would also take more time and effort. As it would require certified standards from international authorities that overlook the standardization process of any technology [19]. These universal standards would benefit in deciding upon the data size, data format and type of data that could be stored on the blockchain. Moreover, the adaptation of this technology would become easier due to the defined standards, as they could be easily enforced in the organizations.

7. FUTURE SCOPE

Blockchain technology holds promise for augmenting health information exchange and fundamentally enabling greater data transparency, safer patient care, improved healthcare efficiency and more robust medical research. Despite the upside, there are several fundamental issues that must be resolved prior to a safe and successful widespread implementation.

As with any disruptive technology, healthcare organisations must appropriately assess blockchain in the context of their needs and equip providers with the skills to use these tools effectively. Although blockchain may offer a superior platform for information exchange, it is simplistic to assume that the aforementioned benefits will automatically ensue after implementation of a blockchain system. In order to achieve its full potential, blockchain platforms will need to possess a balance of guidelines to allow for broad use as well as flexibility to accommodate local practice variation. Furthermore, emphasis cannot only be placed on technical solutions but must include consideration for human factors that otherwise limit the use of any digital platform.

Just as blockchain fundamentally opposes a siloed approach through principles of decentralisation, solutions too must be decentralised and involve a broad group of multidisciplinary experts including healthcare providers, legal professionals, technology developers and patients, in order to optimise information exchange while preserving patient safety. We intend to integrate the payment module into the current framework going forward. In order to decide how much a patient would pay for a doctor's consultation on this decentralized system operating on the blockchain, we need to take a few factors into account. We would also need to specify a few guidelines and laws that adhere to the standards of the healthcare industry.

8. CONCLUSION

In this essay, we addressed the benefits of blockchain technology for the healthcare industry and how it can be applied to electronic health records. Despite the expansion of the healthcare industry and technological innovation in EHR systems, there were still some problems that this new technology, or blockchain, was able to solve. Our suggested framework combines safe record storage with fine-grained access controls for those records. From doing this, a system that is simpler for users to use and comprehend is created. Additionally, because IPFS uses its off-chain storage approach, the framework suggests steps to ensure that the system addresses the issue of data storage. Additionally, the system gains from role-based access because only people who are related to and trusted can access medical records. Additionally, this resolves the EHR system's information asymmetry issue.

9. REFERENCES

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