Decentralized Health Record Management System

Afzal Ahmed Pinjar
Computer Science and Engineering
S.D.M. College Of Engineering and Technology
Dharwad, India
afzalap163@gmail.com

Nandeesh B K
Computer Science and Engineering
S.D.M. College Of Engineering and Technology
Dharwad, India
nandeeshbk45@gmail.com

Shrinivas Dixit
Computer Science and Engineering
S.D.M. College Of Engineering and Technology
Dharwad, India
shrinivasdixit23@gmail.com

Sahil L Naikwadi
Computer Science and Engineering
S.D.M. College Of Engineering and Technology
Dharwad, India
sahilnaikwadi123@gmail.com

Abstract—**Blockchain technology has the potential to completely transform how electronic medical records are exchanged and maintained by giving healthcare practitioners safer ways to communicate medical data while safeguarding it across a decentralised peer-to-peer network. A systematic literature search was carried out to examine the existing literature on blockchain and healthcare and to identify existing challenges and open questions arising from the process, guided by the emergence of research questions related to Electronic Health Records (EHR) in a Blockchain, in order to support and facilitate understanding of this distributed ledger technology.**

In recent years, hackers have been interested in healthcare data. Decentralization can reduce the damaging consequences of health data. Decentralized ownership is made possible via peer-to-peer (P2P) networks, which let several parties store data and carry out computations while maintaining.

Index Terms—**Decentralization, Blockchain, peer-to-peer network**

I. INTRODUCTION

The health care system includes all institutions, organizations, and resources that produce activities whose primary purpose is the improvement of health. In today's healthcare world, there are two spearheads: privacy and data ownership. Confidential health records currently lack a secure infrastructure, resulting in data breaches and disastrous consequences. Many Indians rely on private health care sectors due to the lack of adequate health insurance in India, but this option is generally not available to the poor. Insurance is available and often provided by your employer to help you pay for medical bills, but most Indians don't have health insurance and spend most of their medical bills in India.

II. LITERATURE REVIEW

- Tanesh Kumar presented a model for how Blockchain provides a secure, decentralized database where operations can be performed without third-party intervention or central administration [1].
- Fouzia F. Ozair noted that in 2018 the Office for Civil Rights (OCR) of the Department of Health and Human Services received multiple reports of data breaches that exposed 13 million medical records [2].
- Sarah Saberi published a paper on today's supply chains that rely on centralized, sometimes heterogeneous and autonomous information management systems within organizations. For example, enterprise resource planning systems have their own flaws [3].
- According to Ahmed Kosba, a Hawk programmer can create a private smart contract in an intuitive manner without having to use cryptography, and our compiler creates an effective cryptographic protocol that allows contractual parties to communicate with the blockchain using cryptographic primitives like zero-knowledge proofs [4].
- Thomas Mikula proposed an identity and access management system that uses blockchain technology to support the authentication and authorization of entities in digital systems [5].
- The system proposed in 2018 by Ahmed F. Hussain and ArunKumar supports discrete wavelet transformations to improve overall safety and uses genetic algorithm techniques to optimize sequential optimization methods [6].
- Samuel J. Wang and Blackford Middleton proposed a study to estimate the net financial benefit or cost of implementing an eHealth system in primary care [7].
- Ruhi Tash, Ömer Özgür Tandyrover proposed that the blockchain is based on the concept of decentralized application (DApp) and allows its implementation. Blockchain's complexity and integration challenges require skills that differ from traditional application development approaches [8].
- Ke Ma's thesis designs systems with new storage models and query mechanisms for distributed and big data platforms. The system can provide a quick backup solution by performing data sharing integrity checks [9].

- Novikov suggested that an algorithm has been developed for the use of smart contracts in the medical field.

III. DESIGN & METHODOLGY

- Government entities will verify that the nodes joining the network are not malicious.
- All the participants of the network will have a unique hash according to their details and will have private and public keys.
- The blockchain will store the metadata of the transactions (It will not store the medical record itself).
- The Medical records will be stored using distributed storage platforms ex. IPFS, SWAM, etc.
- Blockchain will act as the pointer to the place where the data is encrypted and stored(Nodes for Distributed storage such as hospitals, Universities, and Non-profitable organizations).
- Everyone can access the network using DApp (Decentralized Application).
- Everything will be working on the Decentralized Web therefore there will be no downtime.
- Smart Contract Development (Backend) with thorough testing using hardhat environment.
- Deployment of the Smart Contract Ethereum Test Network.
- Front development and testing using React.js
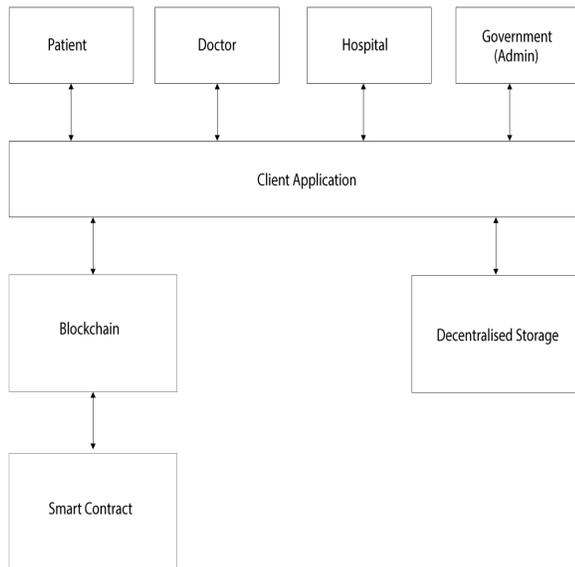

Fig. 2. Work Model

Fig. 1. Architecture Model

- In the project, the patient maintains a separate access list for doctors and hospitals who can access the medical records.
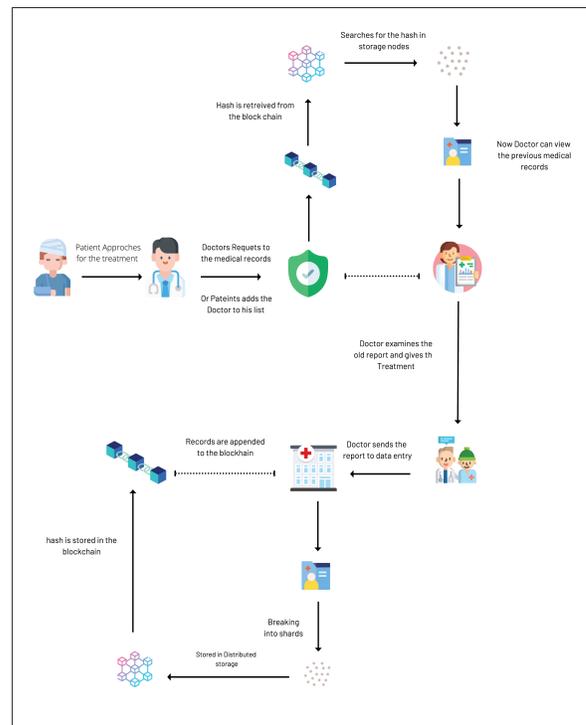
There are two ways to grant access to the medical records

- Doctor/ hospital scanning the QR code (Wallet Address) and requesting access to the patient, where a patient can grant or deny the request
- Patient scans the QR code of the Doctor/ hospital from his/her device and grants permission

- Whenever a Doctor/ hospital wants to access the records of the patients, In the smart contract will check whether the address is present in the access list and if not present in the access list then they are not allowed to access the records.
- Similarly, the doctors and hospitals maintain a list tracking the patients to which they have access.

IV. OUTCOMES

- Each patient has a unique hash ID that can be used to search for a patient.
- It is easier for patients to share their records with anyone without worrying about data corruption or damage because the blockchain is immutable and untraceable.
- The blockchain will also ensure the security of a medical card created and added to the system.

- Patients may be compensated for providing their data for clinical trials and research. In case of a change of sick leave, the medical history will be given to the doctor.
- When changing the hospital, there is no need to refill the medical history.

V. APPLICATIONS, ADVANTAGES AND DISADVANTAGES

There are so many usages of Decentralized Health Record Management System in the field of medical and research.

Advantages

- Single point failures makes the system unreliable, block chain is reliable due to no single point failure.
- Since data is managed in decentralised system there is no single point failure .
- Blockchain technology itself provides data immutability the sensitive data of healthcare cannot be tampered.
- Since everyone are assigned with unique has id's we can easily trace them.
- Due to tracebility everyone is accountable for their actions

Disadvantages

- Due to its immutability once the data is sent onto the chain we cant change it, so the data is to be carefully entered without any bias.
- The transactions sometime take too much time and may lead to inconvinience.

Applications

- Healthcare: The blockchain network is used in the healthcare system to protect and share patient data from hospitals, diagnostic laboratories, pharmaceutical companies and physicians.
- Organization: This system finds its use by many organizations and companies which undertake the healthcare of their employees.
- Research: Upon request, patient health data may be provided for research purposes

VI. CONCLUSION

Despite the advances in healthcare and technological innovation in EHR systems, they still faced challenges that were solved by a new technology, blockchain. This creates a system that is easy to use and understand for users. It also solves the problem of information asymmetry in EHR systems. In addition, using the IPFS off-chain storage mechanism, the framework offers measures to ensure that the system overcomes the data storage problem.

VII. FUTURE SCOPE

In the future, if each country integrates this into its medical infrastructure in its own way or for all, it will be possible to have cross-border communication between each country using this infrastructure, creating federal blockchains. This makes patient medical records available worldwide. So it is useful for emigrants, people traveling abroad and others.

REFERENCES

[1] T. Kumar, V. Ramani, I. Ahmad, A. Braeken, E. Harjula and M. Ylianttila, "Blockchain Utilization in Healthcare: Key Requirements and Challenges," 2018 IEEE 20th International Conference on e-Health Networking, Applications and Services (Healthcom), 2018, pp. 1-7, doi: 10.1109/HealthCom.2018.8531136.

[2] Ozair FF, Jamshed N, Sharma A, Aggarwal P. Ethical issues in electronic health records: A general overview. Perspect Clin Res. 2015 Apr-Jun;6(2):73-6. doi: 10.4103/2229-3485.153997. PMID: 25878950; PMCID: PMC4394583.

[3] Sara Saberi, Mahtab Kouhizadeh, Joseph Sarkis & Lejia Shen (2019) Blockchain technology and its relationships to sustainable supply chain management, International Journal of Production Research, 57:7, 2117-2135, DOI: 10.1080/00207543.2018.1533261

[4] A. Kosba, A. Miller, E. Shi, Z. Wen and C. Papamanthou, "Hawk: The Blockchain Model of Cryptography and Privacy-Preserving Smart Contracts," 2016 IEEE Symposium on Security and Privacy (SP), 2016, pp. 839-858, doi: 10.1109/SP.2016.55.

[5] T. Mikula and R. H. Jacobsen, "Identity and Access Management with Blockchain in Electronic Healthcare Records," 2018 21st Euromicro Conference on Digital System Design (DSD), 2018, pp. 699-706, doi: 10.1109/DSD.2018.00008.

[6] Hussein, Ahmed F., et al. "A medical records managing and securing blockchain based system supported by a genetic algorithm and discrete wavelet transform." Cognitive Systems Research 52 (2018): 1-11.

[7] Wang, Samuel J., et al. "A cost-benefit analysis of electronic medical records in primary care." The American journal of medicine 114.5 (2003): 397-403.

[8] R. Taş and Ö. Ö. Tanrıöver, "Building A Decentralized Application on the Ethereum Blockchain," 2019 3rd International Symposium on Multidisciplinary Studies and Innovative Technologies (ISMSIT), 2019, pp. 1-4, doi: 10.1109/ISMSIT.2019.8932806.

[9] K. Ma, "Research and implementation of distributed storage system based on big data," 2016 IEEE International Conference on Big Data Analysis (ICBDA), 2016, pp. 1-4, doi: 10.1109/ICBDA.2016.7509817.

[10] Novikov, Sergey P., et al. "Blockchain and smart contracts in a decentralized health infrastructure." 2018 IEEE International Conference" Quality Management, Transport and Information Security, Information Technologies"(IT&QM&IS). IEEE, 2018.