



Decentralized Electronic Health Record System

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Abstract: With a view to overcome the shortcomings of traditional Electronic Health Record (EHR) system so as to assure the interoperability by providing open access to sensitive health data, while still preserving personal data privacy, anonymity and avoiding data misuse, Decentralized Electronic Health Record System was developed. The aforementioned issue concerning traditional EHR system can be addressed by implication of emerging technology of the era namely Blockchain, together with InterPlanetary File System (IPFS) which enables data sharing in decentralized and transactional fashion, thereby maintaining delicate balance between privacy and accessibility of electronic health records. A blockchain based EHR system has been built for secure, efficient and interoperable access to medical records by both patients and doctors while preserving privacy of the sensitive patient's information. Patients can easily and comprehensively access to their medical records across providers and treatment sites using unique properties of blockchain and decentralized storage. A separate portal for both the patients and doctors has been built enabling the smart contracts to handle further interaction between doctors and patients. So, in this system, it is demonstrated how principles of decentralization and blockchain architectures could contribute to EHR system using Ethereum smart contracts and IPFS to orchestrate a suitable system governing the medical record access while providing patients with comprehensive record review along with consideration for auditability and data sharing.

Keywords: Electronic health records, smart contracts, blockchain, ethereum, interPlanetary file system

1. Introduction

Throughout the evolution of the health industry, the patient's record management has taken different paths and some of them are not relevantly different from each other, yet still improvising the delivery of the services to the patients. [2] Blockchain has been successful in solving the perennial challenges of interoperability of health data, patient record matching and information exchange. Blockchain can also handle sensitive nature of health data. Along with the technological breakthrough ushered in with the blockchain technology, issues of security and privacy are barged in as well. It has been very difficult to share medical data with different stakeholders for several purposes ensuring privacy of patient's data and its integrity. It has been a great challenge for ensuring interoperability among the different healthcare providers to view, edit and share patient data and

simultaneously accessing the updated record of diagnoses, medications and services rendered. The blockchain based EHR plays a key role to ensure secure exchange of EHR data as well as avoids systems incompatibilities at the provider level. With the help of this EHR, both the patient and the health care provider can be the part of the system. The immutable nature of the ethereum blockchain public ledger ensures that no entity is privileged to alter the providers EHR record after it is the part of the blockchain. Hence, this system aids in aggregating collective research data sets by averting information dispersal & aggregating related records. Blockchain provides an immutable audit trail and also ensures that the updated version of record is used. The system enables patients and doctors to correspond to each other with no involvement of intermediaries whereby patient be the sole owner of his medical data. The system mainly incorporates two subsystems involving two different parties, namely doctor and patient. Every doctor has to be first recognized by some other registered doctors through consensus after which they are allowed to provide service. The patient's side is somewhat easy and flexible with details to be filled and options of doctors to be consulted with.

2. Literature

Several efforts have been made for using blockchain as a technology for maintaining health records electronically. Ancile [3] uses the Ethereum blockchain framework for secure, interoperable, and efficient access to medical records by patients, providers and other third parties preserving the privacy of patient's sensitive information. Medrec [4] is a decentralized record management system to handle EHRs. It stores a signature of the record on a blockchain and notifies the patient, who is ultimately in control of where the record can travel. This signature assures that an unaltered copy of the record is obtained. This platform transfers the control from the provider to the patient, and as a result both burdens and enables the patient to take charge of management. Pokitdok [1] maintains its own blockchain called Dok-chain which can handle the financial as well as the clinical data in the healthcare industry. Fast Healthcare Interoperability Resources [FHIR] Chain [5] demonstrates a decentralized app using digital health identities to authenticate participants in a case study of collaborative decision making for remote care. It highlights on the facts that patients visit many different care provider's office during their lifetime.

3. Methods

3.1 Metamask Based Password-less Login

Metamask, an Ethereum Browser extension, that enables verified transactions over distributed applications (dApps) and access to Ethereum based smart contracts has been used for password-less login feature. Serving as a user account is a unique Ethereum Address provided by the extension i.e, basically SHA3 hash of the public key, so that the proof of ownership of account can be done by signing a piece of data with private key which is also provided in the account, bypassing the need of actual password and separate login page.

3.2 Ethereum Blockchain and Smart Contracts

Ethereum Blockchain allows the storage of preconfigured and deployed blocks of codes and agreements made amongst different stakeholders involved, in the blockchain network, called as Smart Contracts. They, in turn contain entire authorization logic along with Access Control List and store hashes of IPFS links to each record making them tamper-proof and secure.

3.3 IPFS Based Storage

As a network protocol that allows content-addressable and peer-to-peer method of storage of files

Right off the bat, patient's medicinal information may exist in different frameworks – hospital EHRs, persistent applications, drug stores, etc. Blockchain could permit these diverse applications to share and concede to a patient's restorative information, and consequently take into consideration a "solitary source of truth." A second advantage is information security. Blockchain utilizes present day cryptographic instruments to approve transactions, and this could include a critical dimension of trust to the information sharing that blockchain empowers. The principle requirement of the current framework consolidates interoperability and availability issues which were effectively tended to using the blockchain. These can be effectively accomplished in our framework with the arrangement of various Access Control List (ACL) which is exclusively dictated by the patient. To total up, the framework was gone for accomplishing decentralization in electronic health record system and it was accomplished through the guide of ethereum blockchain and the recognizable achievement was security which is very synonymous to blockchain.

5. Conclusion

EHR is a fascinating and very developing innovative headway in the field of medicinal services that has picked up unmistakable quality with the ascent of expanding worry with security and for the most part because of looking for comfort by the patients and also health care providers. As a patient, they have the right to have their therapeutic data accessible wherever they go for their consideration which is routed to very satisfiable reach out by our system. The collaborations and systems to be pursued are extremely suited to the client end and is made as lively as could be expected under the circumstances. The previously mentioned structure ideas and results is adaptable with the end goal to cook for the contemplations about specialized and also moral issues. It gives proper implies for the expressed large portion of the issues talked about before, viz. Security, accessibility, adaptation to non-critical failure and enhanced trust. In this way, in this venture, it is shown how standards of decentralization and blockchain structures could add to EHR framework utilizing Ethereum smart contracts to arrange a reasonable framework administering the therapeutic record while giving patients with complete record ownership, care auditability , furthermore, information sharing. Coordinating the outsider like insurance agency into the framework can give more utilize cases to the framework. Making use and synchronizing the information of cell phones and wearable innovation to the framework for getting quick and exact reaction can make it simple for the utilization of use.

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