ENHANCED HEALTH RECORD SHARING USING BLOCKCHAIN

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ABSTRACT

The nation is heading towards becoming a developed country. To achieve this goal there may be many factors to be considered but the basis is a healthy nation. The health records have to be maintained properly so that the cause for any disease can be analyzed and the suitable medication can be provided accordingly. The medical records should be preserved and should not be modified without the knowledge of the respective person. It is important to share the medical records with the research organizations to cure the disease but it is also important that the individual is also aware of who are all accessing their personal information. The records contains many sensitive information in it. Millions of records are being hacked and sold in the black market [1]. According to 2017 Ponemon Cost of Data Breach Study, the cost of the data breach for healthcare organizations estimated to be $380 per record. According to 2016 Breach Barometer Report, 27,314,647 patient records were affected [2]. Blockchain gives a solution to all these problems as it helps in maintaining a decentralized patient record, the ability to track the individual or organization accessing the medical record and it also makes the data immutable.

Keywords: Blockchain, Decentralized, Immutable, Data Breach.

I. INTRODUCTION

As correctly stated by Will Durant: “The health of nations is more important than the wealth of nations”. A health record is a collection of clinical data related to the patient’s mental and physical health, gathered from different sources. Health record consists of a patient’s medical history, examination, diagnosis, treatment, results of lab investigation, scanning reports, alerts like allergic to etc. The records also stores the email address, phone number and aadhaar number being linked to the record. Earlier these records were stored and updated manually but as it was difficult to share these records and accessing these essential information during emergency was a tedious process these records were stored in digital format. The current system stores all the information at one place which is a centralized format. Gaining control over these information was not an impossible task for hackers. These information were sold in the black market and were misused against the patients. Health records
can be easily and quickly shared between medical institutions by integrating digital technologies into the healthcare system [3]. In this respect there are intense queries about the storage of patient’s data, providing authorization to access the data, security & immutability of the data [4]. These problems can be solved by developing a decentralized digital health infrastructure that is by integrating Blockchain technology into the healthcare system [5]. By implementing blockchain technology these records become immutable and more secured than the existing system. It also helps the individual to keep track of the organisation or person accessing their details and if an unauthorised person wants to access these details then the respective individual is the only person who has the right to grant permission.

BACKGROUND

With an objective of introducing a uniform standard based system for creation and maintenance of health records by the healthcare providers, ministry of health and family welfare notified EHR standards for India in 2013[7].EHR helps the providers more effectively diagnose patients, reduce medical errors and provide safer care. This results in better medication to patients. An Electronic Health Record is being shared among both public and private healthcare sectors such as hospitals, research organizations, manufacturing industries etc. for research purposes. The sharing of EHR has its own benefits and challenges. EHR face problems regarding data security, integrity and management.

1. Blockchain Technology

Blockchain is a time stamped series of immutable records that are managed by a cluster of computers not owned by a single entity. Blockchain technology is based on the three main properties that helped it gain widespread acclaim. The three properties are decentralization, transparency and immutability. The decentralized nature avoids the inclusion of third partinesso that everyone in the network can directly interact with each other[8].With this technology, each record is being shared only with the authorised communities and with the knowledge of respective individual. The blockchain is maintained by a peer to peer network. Therefore, there is no longer centralized server instead distributed and decentralized peers. The main uses of peer to peer network is file sharing. If a client server model is used, it entirely depends on the health of the server. But in peer to peer network, even one of the peers fail the remaining works without any issues. The proper work of blockchain depends on the consensus mechanisms. The consensus mechanism are protocols that ensures whether all the nodes are synchronized and agreed with each other in the network. Blockchain also uses Smart contracts that are used to control the access to the records. Smart contracts are executed only when specific conditions are met. A blockchain can be permission less or permissioned. A permissioned blockchain requires a pre-verification of the participating parties. The choice between the two types depends on the application needs.[9]
II. RELATED WORK

Blockchain is an ingenious mechanism that can be used in healthcare domain to secure and maintain the health information efficiently. Health information includes electronic health records, research data, drug details etc. The information sharing is the major reason why blockchain should be used in healthcare. The existing blockchain based frameworks such as MedRec uses a shared EHR system that uses permission less blockchain. In this framework, it can only store the access permissions and data pointers and also it uses smart contracts to provide data integrity and access control mechanisms. Another permission less blockchain based framework is FHIR chain. It can store data pointers and uses public key cryptography for managing user identities. FHIR is mainly developed to overcome the limitations of permission less blockchain. FHIR chain mainly focuses on interoperability of data. Medical chain is also a blockchain platform for securing electronic health records. Medical chain uses dual blockchains and some innovative technologies to facilitate sharing of patient information across hospitals, pharmacies and companies. Medical chain tokens or MEDTokens can be used to pay for hosting and storage of records on private blockchain. The blockchain based frameworks for healthcare industries reduces the time and work required to secure the patient’s data, access the health information and preserves data privacy.

1. Usecase Scenarios

To describe the system requirements, the following scenarios are provided. The delegates of the scenarios are users, healthcare providers and healthcare organizations. Healthcare providers includes doctors, hospitals, drug manufacturers etc.

A. Scenario 1: A patient/user reads his/her health record from a healthcare provider: A user wants to read his/her health report from the database. In this case, the registered user can login to the portal and can read the records. New users should register with the provider in order to read therecords.

B. Scenario 2: A healthcare provider reads records from another healthcare provider: A health care provider wants to read a patient’s record from another provider’s database for providing treatments or for other research purposes. In this case, the requested data can be provided to the requester if and only if they have rights to access the record and they must be authorized in the blockchain network.

C. Scenario 3: A health care provider update the details: A healthcare provider wants to read or update details in the patient’s record in the database. The healthcare provider can login to the portal using his/her credentials and after successful verification the provider can read or update the details.

III. SYSTEM REQUIREMENTS

The requirements given below are to be satisfied by our proposed framework.

1. Scalability: The system should be able to provide the results with the same response time as the database size increases. It should be scalable to multiple number of users.

2. Data privacy: The patient records stored in the blockchain are protected by using the encryption schemes. Thus it reduces the chance of unauthorized access to the privaterecords.[10]

3. Access Control: Access control is the most important part due to the sensitivity of information. Only authorized persons can access the records. An access control list is maintained by the authority. Based on this, access to records can be provided.[8]

4. Availability: Due to the decentralized nature, user can read or access the records even one node fails. The system must have single point of failure.

5. Security and integrity: The patient records should not be modified by unauthorized providers. The system should preserve the confidentiality of patient’s record.

1. Proposed Framework
This section contains the detailed discussion of the proposed framework. The proposed framework is a blockchain based framework which provides a secured storage and maintenance of electronic health records. It is a permissioned blockchain that is based on the consensus mechanism to provide faster performance and increased scalability. The proposed framework is divided into layers which includes user layer, access management layer, electronic health records storage layer.

A User Layer
A user is an individual whose records are being stored in the system or who uses the system and resources. In this case, a user has various roles including doctors, patients, health practitioners etc. The user must be able to interact with the system and can perform the tasks such as create, update and read the records. GUI layer is used to provide the basic functionalities to the users so that they can interact with the system. The patient interact with the system to read the records. The doctors interact with the system to create and update records. This layer has three modules,

a. **Registration**: The users should register themselves using a registration module. The registration module collects the details of the user. The users submit the details to the module. For example, patients provide their details such as name, mobile number, identity, insurance details etc. The doctors provide their details such as name, employee id, etc. The doctors are authorized by their hospitals. The users register with their own credentials such as password.

b. **Verification and Validation**: once the users are registered, their details are verified by this module. The registered users can access the records only if their details are verified and validated. The patients who are newly registered are verified during the first treatment. The doctor’s details are verified by the respective healthcare providers with which they are associated.

c. **Login**: The registered users can log into the system using the valid username and password. User can login into the system only if they use valid credentials. After successful login, patient can view their records, doctors can create or update recordsetc.

B Storage Layer
The electronic health records need to be stored in a database. Here we use a distributed database to store the records. A block is created for each patient records. The records should not be accessed by unauthorized persons. Data confidentiality should be preserved throughout the system. The doctor and patient can view and access the data stored in the blocks.

C Access Control Layer
This layer controls the access to the health records. It maintains an access control list based on which access is provided. Only authorized persons can access the records. Thus it maintains the integrity of the system. The patient’s records are accessed only with the knowledge of patients.
IV. CONCLUSION

As stated by Winston S. Churchill “Healthy citizens are the greatest asset any country can have”. In this paper we present a blockchain based patient information record which can be used to store the personal and medical details of the patients securely and helps the individuals to be aware of the organizations accessing their information. Implementing this system ensures that the personal details given by the patients remains safe and secured and reduces the chance of being misused.

REFERENCES

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