

Preserving EMR Records Using Blockchain

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Abstract

In recent years, the technological advancements has been booming but in the medical field the structure being used to store patient data is still outdated. Patients carry hard copy medical report with them when going for an appointment. When people usually talk about blockchain, they usually think about financial, banking and crypto markets, but we can also use blockchain technology for decentralized healthcare data storage. Blockchain used in healthcare is called as health blockchain. EMRs crave attention and work to match up with the technological advancements in ways that would make sharing of EMR between. In today's world EMRs can be stored and retrieved safely using Block Chain-based implementation which store data in blocks. These blocks are connected to each other using cryptography technology where each block is unique and it stored the data in a secure manner. Thus, securing the process of storing and retrieving EMRs.

Keywords : Cryptography, Block-Chain, EMR

1. Introduction

The current healthcare industry is growing and improving at a fast pace making it an exciting time for health care and data technology (Information Technology). Thanks to enhancements in genetic analysis and also the advancement of drugs, health care is witnessing an innovative approach to disease hindrance and treatment that includes a personal patient's genetic makeup, life style and environment. At the same time, IT advancement has made giant databases of health info, provided tools to trace health information and engaged people a lot of in their own health care.

India has a mixed system of healthcare .It consists of hospitals which are run by the state government or the central government and some are private hospitals. The usage of ICT (Information and Communication Technology) is very low in India in comparison to foreign countries. Work is going on to implement ICT projects and also includes storing patient records.

Some of the big hospitals in India such as Apollo, Max Health, Fortis, already have implemented integrated ICT systems which takes care of things from registration to billing. It can also store its laboratory and hospital data. Levels are defined to check the level of integration of ICT. Max Healthcare has already achieved a level 6 of EMR (Electronic medical record) integration model.

Our application shows the platform from the point of view of 4 stakeholders :

- The solution manager is the manager of combination of hospitals, and has high levels of access to management class. They have the ability to add a new hospital to the Organization
- The manager of an organization (hospital) is an advertisement for a particular hospital conglomerate / solution. They have a file for ability to access new users through either patient or doctor, or remove user.
- The physician (Doctor) is a user in the organization with an appropriate role and have the ability to upload their patient documents and download / view their patient documents which have been given access to.
- Patient in the organization has the ability to view and upload the required documents.

Blockchain technology has the ability to overcome the hurdles that are currently present in health IT sector and to be the technical base and structure that allows people, health care suppliers, health care entities/organizations and medical officers to firmly share electronic health information. EMRs will ease the interaction between the top user and also the skilled and therefore any can improve the accessibility.

2. Literature survey

Blockchain technology asserts to give high security and privacy of users data, still there has been some with the technology. From this paper, a brief idea is given regarding the pros of blockchain and also the recent security issue, which shows us the benefits of the technology and also the cons of the technology itself. The blockchain technology uses hash methods to securely store and verify the interactions that are made by the user without craving the need to have a centralized authority

This special issue of IEEE Security & Privacy [7] is an attempt to collect the most interesting ideas from the community of researchers and professionals working on blockchain security and privacy. Traditionally we have been storing health data in files at the physician's consulting rooms.

With the technology growing everyday there have been many ways to store health records in a much safer and better way by using PHR or personal health record, which could also use cloud computing. By paper [7] we see the possibilities as well as the security and privacy concerns. This paper shows ways to assist PHR providers in selecting a Cloud Service Provider that will store PHRs in a safe format.

From paper[3] to exploit the ubiquitous cloud services to collect users 'multi-dimensional data in a secure and privacy-preserving manner and to enable the analysis of infectious disease. Existing system has some limitations cannot be used

efficiently to deal with those attacks and makes system. Just as a real cloud changes shape as it is both fed and battered by the forces of nature such as sun, wind, and topography, cloud computing is continuously evolving due to the forces of innovative new technologies and business models and an expanding set of customer use cases and a shifting competitive landscape. The May/June issue of Cloud Computing [4] focuses on some of the major trends.

Ethereum [10] and Hyperledger [11] are both distributed ledgers. But the hyperledger is permissioned meaning the users need permission to participate in transactions but in etheum any user can participate in transactions which show the freedom of participation between these two ledgers. Hyperledger is ideal for B2B transactions whereas Ethereum is ideal for B2C transactions [12]. Because the Doctor and patient are connect in a B2C basis ethereum is the ideal ledger here. Hyperleger is a private ledger whereas etheum is a public ledger. In [13] Hyperledger has these special nodes which does the ordering whereas in Ethreum any node can become a miner and participate in ordering. This makes etheum ideal for the project.

3.Purpose and scope

The main objective of the project is to ensure safe storage of data and making it accessible for the organisations(Hospitals) and the patients to view/store and share the data with whom they are comfortable in sharing it with. Provide easy access of the documents to the user and also ease the interaction and sharing of medical record in between the user and the professional.

This is save time and also makes it easy for the user to have a safe access to his document every ready in his pocket.

4. Objective

Save all the Hospital data on cloud securely.

For longer term we have a tendency to decide to introduce a practical prototype of the projected design.

Our aims, besides the design verification, Is to judge by trial and error the quality of transactions that are supported by the blockchain. Another side to be validated is that the capability of Ethereum management framework to precise complicated pc models that are must for the introduction of real sensible contracts within the health care domain.

5. Overview of blockchain

Blockchain is a technological innovation [8] which was first conceptualized by a person with the pseudo name

Satoshi Nakamoto. Most of the crypto currencies like etherium, Bitcoin use blockchain technology which are growing popular day by day[9], it shows the security and ease of using blockchain.

A. Data Structure of a Block in Blockchain

A block in a blockchain contains a header , a hash value or metadata and data which is stored in the block.

B. Building Blocks of a Blockchain Framework

A shared or a distributed ledger, which means that the data is replicated and is spread across multiple nodes, countries or various institutions. There is no central administrator in a distributed ledger, Cryptography or encryption , consenses and smart contracts are the four pillars of blockchain. The amalगतion of all these building blocks is termed as bockhain[14].

C.Distributed Ledger

The Distributed Ledger is explained above. Distributed ledger allows having a very strong evidence of every transaction as well as it makes it very difficult for manipulating the data which keeps the data safe which is very important for EMR(Electronic Medical Report).

D. Cryptography

Cryptography or in simple words encryption is the technology which stores any given data in its hash form , which requires a particular key to decrypt and read. There are various encrypting algorithms present today, for example AES,RC4etc.

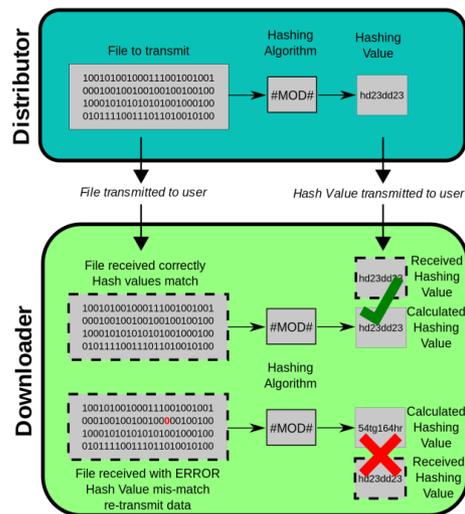


Fig 1:Hash Algorithm Working

E. Smart Contracts

Just as a printed contract happens between two people smart contract is a digital agreement between two people in form of computer code .It is stored in a public database which means it cannot be changed , thus making the data transferred secure.

6. Proposed system

We know an EMR is a very important report. EMR stands for Electronic Medical Report. We are proposing a framework to manage and share EMR information within institutions securely. This will further ease the sharing of documents in between the patient and the professional at work. Also brief summary regarding the patient record will help the professional in getting knowledge of what the patient is going through. Hence, it will make the interaction of records and history of document far more easy accessible with efficient sharing.

This framework ensures security, privacy, availability and efficient management of access to EMR data. We are using a very novel technology i.e. blockchain technology as the backbone of our infrastructure . Our work done would

significantly reduce the error while EMR sharing as well will be very secure. EMR information could be accessed by different institutions as well as patients and doctors efficiently and securely.

• *Benefits of Proposed system:*

1. Efficiency
2. Improve deciding
3. Less time consuming

The following models will be used :

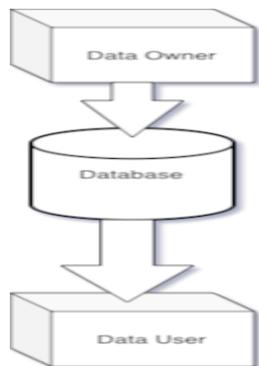


Fig 2: Model Used

• **DATA OWNER:** At this stage the data owner will do so log in with valid details. The owner of the login details will generate a profile and monitor the profile and structure of access and transfer of medical record and final exit.

• **DATA USER:** The data user will register initially with his details and login with valid information. When a user logs in they will read their own profile and look at their medical profile and finally log out.

The diagram below depicts the conclusive structure of the software system and the relationships, constraints, and boundaries between components. The data user and Data owner are two different models that are being used. The Data owner is the owner(hospital/organization). Data owner can add new profile to the database, view patient profile and also upload medical data.

The Data user is the user(patient) and is able to register, login and view his profile data.

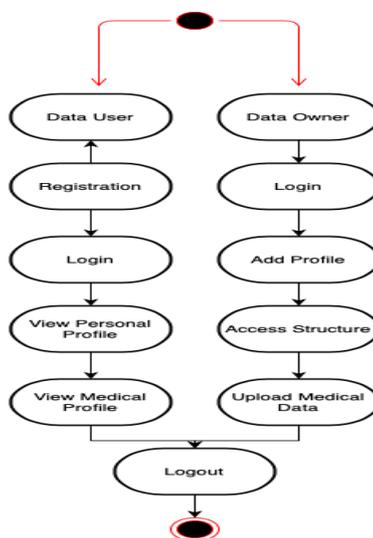


Fig 3: Architectural Daigram

The blockchain technology which we are using is a very good and secure way to handle medical records as it does not require any third party to organize or maintain data.

Implementation is done in following steps.

1. Designing a structure to help physicians and patients to access data.

The structure here is build using two users data owner and data user. We have to keep the record of the patient very secure. In this platform all the information about the patient is recorded and a profile of the patient is created. Profile of a patient consists of information about the tests, results and other things related to the patient. Also in this platform the data owner can access the data anytime.

2. Implementing Ethereum using Ganache.

Ethereum platform is very reliable, it is decentralized and has functionalities like smart contract, it does not have any downtime and also there is no interference of any third party. Ganache is a personalized blockchain which is mainly used for rapid Ethereum and Corda distributed app development. You can use Ganache across the whole development life-cycle and it enables you to develop and deploy, and test your dApps in a safe and deterministic environment. Ganache has two versions, UI and CLI.

In Fig[4] a workspace is created successfully using ganache. This workspace is then used to work further on block chain. Ganache is used to deploy ethereum which works on smart contract. A workspace is created using whose rpc server is set to a particular IP. In the workspace, all the transactions and actions that are done by the end user are visible which includes clicking on a button, uploading records, etc.

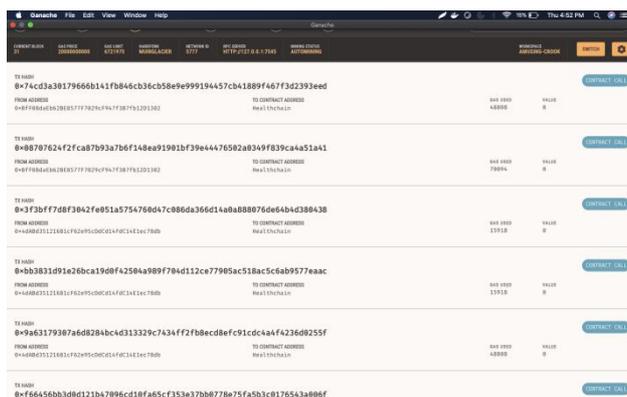


Fig 4: Workspace on ganache

Npm start command is used to deploy the react app. Fig[5] and also Npm start command is used to deploy the node js server Fig[6]. Once server is deployed all the plausible transactions can be set into action which will make the interaction between the client and the server and hence the user will be able to upload his records or access it.

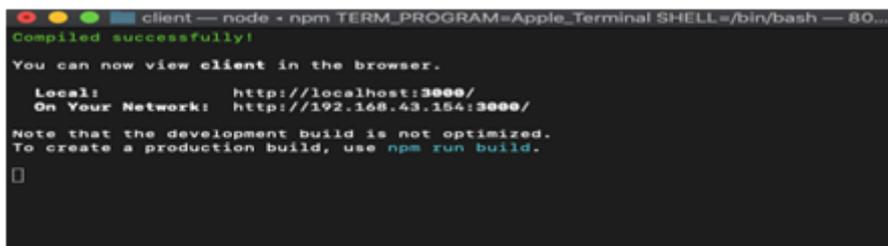


Fig 5: React app started

```
server — node - npm TERM_PROGRAM=Apple_Terminal SHELL=/bin/bash — 8...
Last login: Thu Apr 29 16:27:35 on ttys001

The default interactive shell is now zsh.
To update your account to use zsh, please run `chsh -s /bin/zsh`.
For more details, please visit https://support.apple.com/kb/HT208050.
Sreerajs-MacBook-Air:~ sreeraj.r$ cd desktop/las/healthchain/server
Sreerajs-MacBook-Air:server sreeraj.r$ npm start

> server@0.1.0 start /Users/sreeraj.r/Desktop/las/healthchain/server
> nodemon server.js

[nodemon] 2.0.1
[nodemon] to restart at any time, enter `rs`
[nodemon] watching dir(s): *.*
[nodemon] watching extensions: js,mjs,json
[nodemon] starting `node server.js`
deployment network: [object Object]
Express Listening in at http://localhost:3001
```

Fig 6: Node js server started

The UI landing registration page Fig[7] which can be used to register a user. This page can be used by doctors or end user to sign up to their roles. Once sign up is done the user will be able to sing in and make all the plausible actions and transactions according to the role of the user.

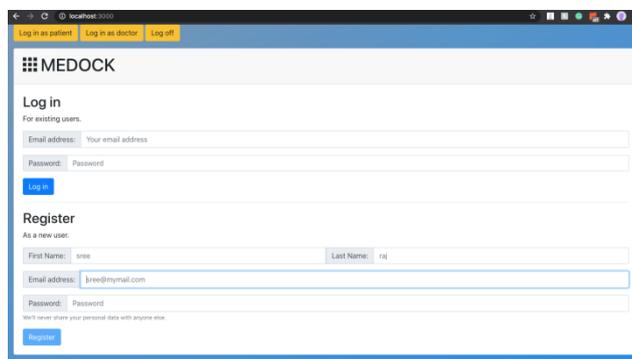


Fig 7: Registration page

7. Conclusion and future work

On longer term we have the tendency to work on a physical prototype that the users will be able to use to and be able to store the private health care data on Cloud. This will further ease the sharing of documents between the user and the professional and the professional will have a clear knowledge about the user situation. The front end and the UI is to be designed and built using flutter. Flutter is a Google based development tool that helps build hybrid application for both playstore and appstore. Blockchain will be used as the backend framework and then api integration will be done between the backend and the frontend.

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