

Electronic Health Record

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Abstract—The Electronic Health Record (EHR) is an essential aspect of all the citizens in any country. EHR makes the workflow of patients & hospitals very efficient. As EHR contains information about the patients' health history. This information should be kept very confidential and safe. On the dark-web, the price of a single patient's health record is nearly \$1000. By this we can see how important this is for the bad actors. This is where blockchain technology comes into the picture. By leveraging all the features of data sharing & security of a blockchain, we will implement EHR on it. This paper further discusses more about the fusion of EHR and Blockchain.

Keywords—*blockchain, health, hospitals, patients, record.*

I. INTRODUCTION

We will consider a basic scenario which happens frequently with most of the patients and hospitals. Patient A needs medical data while having a medical appointment at X hospital, but the data was created at Y hospital. In this case, A is a regular patient and X & Y are the hospitals who keep the medical data with them. By analysing the scenario, many questions arise. The main question that comes up is, How to find and access patient's A health data? Other questions such as how will the data exchanges between hospitals take place? Who will access which part of the data?

Absence of EHR in India:

The adoption of EHR in India is too low. Because of the poor infrastructure in the hospitals and clinics makes it infeasible to maintain EHR. Divergence of hospitals which are maintained by different bodies like in the public sector, there are state and central government runned hospitals and in private sectors there are big names in the field. 2% of the whole budget is allocated to the healthcare from which only 30% is used to improve the infrastructure. The large portion of this goes to the prominent institutions like All India Institution Of Medical Studies (AIIMS) and Post Graduate Institute Of Medical Education And Research (PGIMER) which consist of world class ICT infrastructure. Due to capital investments in private hospitals, there is a good infrastructure of computers and internet connectivity. Even if we gap the problem of infrastructure, there is the other problem of interoperability. Private hospitals maintain EHR only for its internal functioning. They don't share it with patients and other organizations. So there is a need for all the players in the field to come together to make a difference.

Importance OfBlockchain In EHR:

Blockchain brings the decentralized nature of the EHR. No one entity will hold the patient's data. It will create a mechanism of access control which will be useful in sharing the permission of the data between the stakeholders. Blockchain will maintain privacy and security of data while bringing interoperability to the system.

EHR 101

An electronic health record (EHR) is a digital version of a patients paper chart. These are real time patient centered records that make information available instantly and securely to a authorized user. They contain a patients medical history. They allow access to evidence based tools that providers can use to make decisions about a patients care. They automate and streamline provider workflow.

It contains Administrative and billing data, Patient demographics, Progress notes, Vital signs, Medical history, Diagnoses, Medications, Immunization Dates, Allergies, Radiology images, Lab and test results and all the other health data.

WHY NORMAL INTERNET CAN'T BE USED TO DEPLOY EHR:

ERROR 404 NOT FOUND



FIGURE.1 : ERROR NOT FOUND

This is the error we have encountered many times while using the internet. This error is a HTTP response code that means the browser communicated with the server, but it did not find what was requested. This occurs when links or files are broken. This would be a very huge problem when it comes to EHR. We can't risk the missing of patient's health data in any case.

HACKING



FIGURE.2 : ARTICLE ON EHR



FIGURE.3 : ARTICLE ON EHR

This is one of the most severe problems. In the year 2019, more than 25 million patient records were breached. On the dark-web, the cost of data about the credit card of one person is about \$100 and information of health data of one person goes about \$1000 and the whole EHR database would be worth \$5,00,000 .

Centralized



FIGURE.4 : ARTICLE ON INTERNET TRAFFIC

In 2013, Google servers were down because 40% of internet traffic dropped. Google holds a huge amount of the internet traffic. Making EHR on a centralized structure will cause many problems. Server shutdowns will cause problems in accessing health data which will be a big problem during medical emergencies.

Why are big companies not adopting this technology?

In Q4 of 2017, Google earned \$31.91 billion from which 27.7 were from its ads business. That is almost 85.5% of the total revenue. This is the main reason why tech giants are not adopting this technology as they will lose a big amount of their revenue because blockchain does not allow for centralization. This feature of blockchain blocks tech giants from having the data and using them to show ads to the users.

BLOCKCHAIN 101

It is the underlying data that stores a permanent history of all the transactions to ever occur.

The first time blockchain came into its core existence was when white paper of bitcoin was published in October 2008 by Satoshi Nakamoto. Bitcoin was the first successful implementation of blockchain.

Data Structure:

It is a virtual format for organizing, retrieving and storing information.

There are four basic operations that can be performed on any data structure. That goes by the acronym CRUD.

C - Create | R - Read | U - Update | D - Delete

Difference between the normal data structure and blockchain data structure is that the deletion operation is not allowed. It is an append only ledger, meaning that any information added to the ledger cannot be deleted.

RECORD KEEPING

Every update to the distributed database, is a batch of transactions grouped into what are called blocks. Every block is built off, or chained to, a previous block. Altogether, this form a magical data structure known as a blockchain.

In this way, blockchain efficiently keeps track of not only the transactions in any given update but also gives the database discrete states. Every block is an update, and a chain of blocks represents a history.

Every block contains information about the previous block, as every block is built off the previous one. If any block is mutated, intentionally or not, information within this block and all the future blocks will change. This makes the blockchain tamper-evident, as tampering with a transaction from the past would invalidate any future blocks linking back to it.

UNIQUE PROPERTIES OF BLOCKCHAIN:

Pseudonymous: users use pseudonyms, not real world identities to make transactions.

Decentralized: every user possesses the same copy of transaction history.

Immutable: it is close to impossible for any user to change the network transaction history in their favour.

Trust less: users don't need to trust anyone they are transacting with to be sure that their transactions will be accurately recorded by the rest of the network.

II. MATERIAL AND METHOD

There will be two main stakeholders in the system:

Data Owner: All the individuals who are in the network using EHR for medical purposes.

Data User: All the hospitals, clinicians, labs and research teams who need data for their operation.

Technology stack used for the implementation is

1.1 Ethereum Private Network

It is a decentralized platform designed to run smart contracts. It's like a distributed computer to execute a code. It is turing complete protocol that uses its coin ether as fuel

1.2 Smart Contracts

These are a code that facilitate, verify or enforces the negotiation or execution of a digital contract. Smart contracts in ethereum are like autonomous agents that live inside of the ethereum network. They react to the external world when poked by transactions (which call specific functions). They contain address, associated contract code and persistent storage. They have direct control over internal ether balance, internal contract state and permanent storage. Smart contracts generally serve four purposes:

- 1.2.1 Store and maintain data.
- 1.2.2 Manage contract or relationship between untrusting users.
- 1.2.3 Provide functions to other contracts.
- 1.2.4 Complex Authentication.

1.3 IPFS

Its full form is Interplanetary File System. It is a protocol and peer-to-peer network for storing and sharing data in a distributed file system. It is here to replace HTTP. It uses content-addressing to uniquely identify each file in a global namespace connecting all computing devices.

1.4 Web3.js

It is a collection of libraries which allows you to interact with a local or remote ethereum node, using a HTTP or IPC connection. The web3 java script library interacts with the ethereumblockchain. It can retrieve user accounts, send transactions and interact with smart contracts.

1.5 HTML and CSS.

III. DESIGNED METHODOLOGY

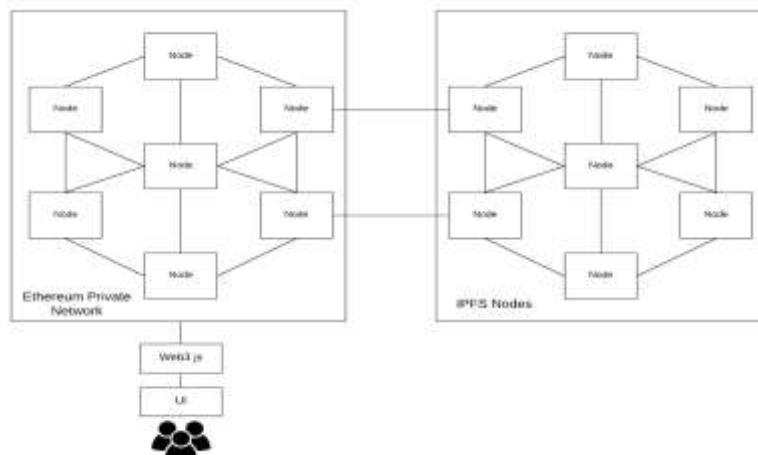


FIGURE 5:SYSTEM ARCHITECTURE

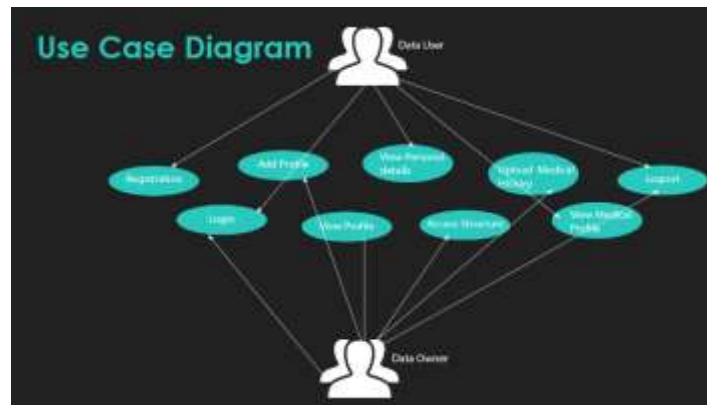


FIGURE 6:Use Case Diagram

We will be setting up an ethereum private network.

The nodes will be run by the hospitals, clinicians, labs, pharmacies and others related to the medical cycle.

All the medical data will be stored on the IPFS network in an encrypted state and the pointer to the location will be saved in the block of the patient.

Whenever there is a need for data, it can be accessed from the pointer and decrypted using the encryption key.

The process of logging data for small clinicians and big hospitals will be made using optical character recognition (OCR).

Using this it will be able to extract data from the formatted papers and log it, so the institutions can do more of what they are best at.

This is especially useful in India, because the doctors are more busy in treating patients and can't allocate time anywhere because of the tight schedule.

There will be a mobile app for the civilians to see data and give or revoke access of their data to the institutions. This is the brief overview of the proposed mode .

IV.Conclusion

This proposed model successfully deploys EHR on Ethereumblockchain. This way we can keep the data secure and safe. No one will misuse the data or no one entity will own the data. There is a decentralization concept in the solution. We can add many more features to the solution. This will work perfectly in any condition. In India, there is a very much need for efficient working of the medical chain.

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