Decentralised Health Information Hub

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Abstract - The sharing of healthcare records is essential tohealthcare and medical research but most of them are stored inphysical form. There are a lot of drawbacks such as carrying, organising, and sharing them will be difficult to handle.

Proposing a technological remedy for the issue "Decentralised Health information hub". The inclusion of public Blockchain technology and interplanetary file systems (IPFS) in this application is to provide efficient secure healthcare records to store patient records and sharing.

Non-fungible token(NFT) is a unique id for the community people (Patients & Organisations) that will be provided. Through the gated community, the patients can share theirdetails directly with the doctors/organisation peer-to-peer. In case of emergency, the doctors/organisation can view the health information of the patients and can mention if and only if the patient approves the request of the doctors/organisation. So no one can alter the data without patient consent. As a result, the data will be distributed among numerous peers while remaining secure and encrypted.

Index Terms - Blockchain; Gated Community; Health Records; IPFS,;NFT.

I. INTRODUCTION

Medical Field is one of the most important fields for mankind's existence and on average, a patient generates nearly 80 megabytes of data each year, "By 2025, the compound annual growth rate of data for healthcare will reach 36%."

Predicts RBC Capital Market.This growth rate is notably faster as compared to remaining many other massive industries, including manufacturing, financial services, and media and entertainment[4].

Even though healthcare has seen exponential growth in recent years there are still some issues with the way the data has been collected and organised by these healthcare organisations. Developing countries like India and others are still figuring out how to organise the data in a digital way. So the sharing of data can be easy for the data and creating a unified healthcare interface for the patients and the healthcare organisations such as hospitals, doctors, and others.

When coming to developed countries there are a series of cyber attacks have been going on these type of data . According to recent publications reports, more than 31 million patient data have been compromised by these intruded attacks and ransomware attacks. These are doubled from 2019[4]. These attacks are happening because the data has been owned by the organisations and stored on a centralised server.Because it is easy to attack a centralised system or the network[10].Even though there is a huge improvement in the technology but most of the countries are not using them upto their best potential such as blockchain, NFTs, gated communities and much more.

Medical is an important field for the survival of mankind because Everyone will visit the hospitals multiple times, eachand every time based on the conditions, situations they will be provided with the medication.

But there will be few cases where the doctor needs have the medication of the patient in order to provide a better solutions like emergency [3] cases where the doctors needs to know that whether the patient will have any allergies to any medication which he is prescribing etc.. Most of the data/records are being stored in a physical way such as papers which is very complex to store organise and retrieve and the countries which are using centralised administration may vulnerable to the cyber attacks and we know that the health information is the most sensitive one among all.

Aiming to solve these problems we came up with an idea.Where we can use blockchain, NFTs and the smart contracts so the data can be organised in a efficient way all at a single place so the user can share the data with each other easily for multiple reasons such as emergency and to prove the authenticity of his previous medical reports if there is any need for that cause few organisations such as insurance companies and national defence needs to verify the authenticity of the candidate medical status.

Through the NFTs(a unique id for the patients and doctors/ organisations) they can login in into the platform(gated community) and the patients can share there health reports with the doctors or the organisations.If he had undergone any medication or surgery then the doctor can update the same if and only if the patient is given his approval so the data can't be viewed or modified by the intruders and the data will be kept securely.
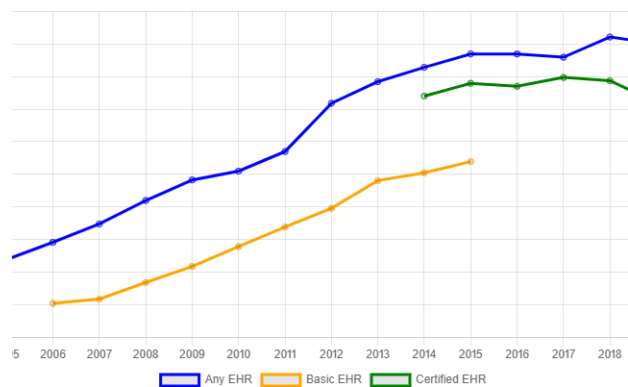

Fig. 1Electronic Health Record adaption

II. EXISTING METHOD

In the current system, a large number of organisations are using physical papers to store the data of patients. There are few organisations that are storing data digitally but they are using centralised servers. Most of the data is owned by these organisations and we all know that data

is one of the most valuable assets of a person.The major issues and has a lot of potential disadvantages some of them are stated :

A. Storing them physically has a lot of issues such as organising, storing, and sharing.

B. Centralised servers are most prone to cyber-attacks.

C. When the data is owned by organisations they can use them for their own benefits without user consent.

D. There is no unique way to monitor all the health records of a patient in case of emergency

III. PROPOSED METHOD

The proposed system will be developed on blockchain and a unique NFT will be provided for the users (Doctors/ Patients) for the login. These are more likely the gated community only authorised users can access the services. As the data will be stored on a blockchain so no centralised authority can own it. The patient can have a nominee only two of them have full access to their data. So whenever the doctor request to access the data any one of them needs to approve it. So the data is truly owned by the patient. As we are using a peer-to-peer and decentralised mechanism there are strict requirements and procedures on the way for the doctors to jointhese gateway communities.

This proposed method will overcome the drawbacks which we figured out in the current existing method and has some additional key features which are drastically improved.

- A unique id will be provided for the patient where all of his health records can be stored via IPFS, So the sharing will be easier.

- As we are using the ethereum blockchain which is decentralised in nature and can write the smart contracts. So the chances of getting hacked and data breaches are very minimal.

- Here the data will be owned by the patient themselves so without their(or the nominee's) consent, no one can access it.

- As all of the data is stored in a single place in case of emergency this data will be a lot of help for the doctors to know the patient's previous medications and health allergies for immediate next actions.

IV. WORKING OF PROPOSED MODEL

I. JOINING OF PATIENTS AND DOCTORS

The entire interaction with the blockchain will happenthrough the smart contract (a piece of code written in the language solidity).

Every one who will register will get a NFT(Non-Fungible Token) with will act as a entry pass for the platform.They can access if and only if they are having the special NFT which has given to them.The registration process for the patient and the organisation is entirely different.

Registration of the user : The user can simply register by using their name and required details and can access the platform.

Registration of the Doctors : If anyone wants to join as adoctor then he must be verified and validated by the fellowdoctors who are currently on the platform. The new doctorwill get approved to join if and only if more than the 51% of the doctors grant the permission.This will ensure that the background verification will purely be done by the doctors.
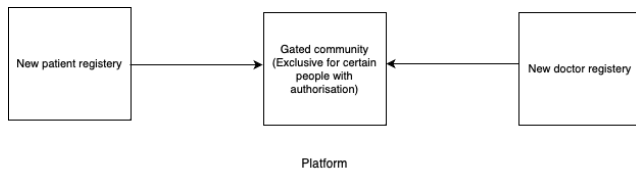

Fig 2 : Joining of the users

II. ACCESSING OF PATIENTS RECORDS

The information is very crucial and coming to the health data it is even more confidential.In order to ensure the privacy and security of the user health data we are proposing the mechanism where the data of the data is completely owned by the patients and their records will be stored in a decentralised storage platform.Here we are using IPFS(Interplanetary File System).
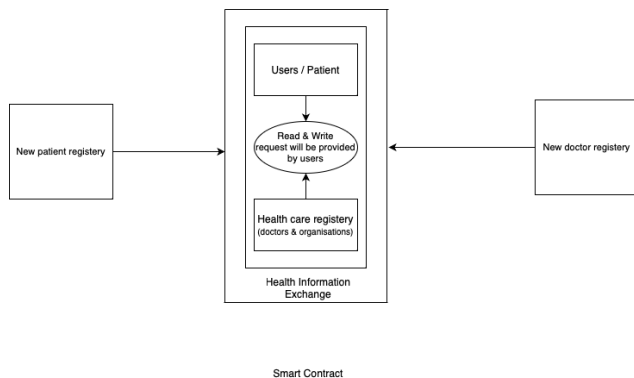

Fig 3 : Accessing of records

The doctor will request for the read view of the patient and the patient will approve the doctors request and then only the doctor or the organisation can actually see the health records of the patients.So based on his previous medicationthe doctor can provide the necessary medication or he caneven use that data to figure out if the patient has any allergy towards any medications so the doctor can perform the surgerymore efficiently.The doctor can alter or update the data of the patient only if the write access is provided to the doctor.

Here we are using blockchain so the authentic of the data can be proven easily.

III. UPDATING THE PATIENTS RECORDS

The entire data and health records like scanning reports and X-rays such data will be stored on the IPFS.So when the doctors need to request a write permission from the patient.Once the patient is approved the request of the doctor then only the doctor can add the new details like the medication or the surgery he has gone through.All of these records will be stored securely through by hashing.
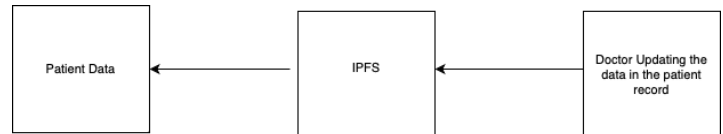

Fig 4 : Information Storage

IV. RECORD SHARING

The storage and tracking of the health records are mainly important when we are in the need of them in situations like emergency.The platform will have a option to opt an Nominee for every users.In case of any emergencies there may be the situation like the patient who owns the data can not approve them in such cases the doctor can request the nominee toprovide the access.Here the nominee can not view the data of the patient and only provide the read options to the doctors.So no one can alter the data of the patients unless with the approval from the patient himself.
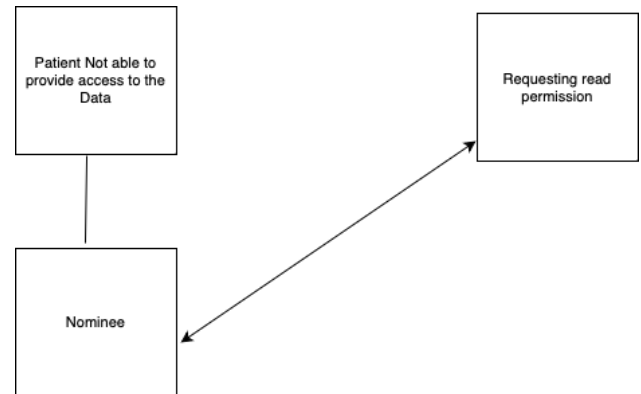

Fig 5 :Nominee Providing Access

V. TECHNOLOGIES USED

In order to achieve the goals of the proposed method we had used various technologies and tools

We developed the smart contract using solidity and deployed on the ethereum goerli test network. While developing the testing has been carried out by using remix and the hardhat a ethereum development environment and test cases and deployment code was written in javascript library. The frontend needs ethers.js to interact with the blockchain network and can perform the transactions.

Solidity : It is a object oriented programming language used to write the smart contract which can be deployed on the blockchain and these smart contracts are immutable in nature and governs all the transaction that take place over the platform.

Ethereum[6]: It is a public blockchain and can run programs on its network which uses the native currency called Ether(ETH).These programs are called smart contracts.It is a digital contract which holds ether and the logic.It is a open ledger so it can store all the transaction history and it is collection of nodes this makes it resistant to non-repudiation attacks.

Remix : It is a online web based tool used to write and test the smart contracts during the development phase. One can test the smart contract on a virtual network or on a testate such as goerli using the remix tool.

Ethers.js [8] : It is a javascript frame work which will act as a intermediate between the front-end and the blockchain.It mails uses the address of the smart contract and the ABI(Application Binary Interface) a byte code returned by the compiler of the solidity which a machine can understand and this byte code contains all the functionalities of the smart contract.

Reactjs : It is a javascript library developed by the Meta formerly know as Facebook.It is mainly popular for the development of the frontend through the concept of component.The entire frontend can be developed through small modules and we can combine them all to form a more complex application.

Hardhat[5]: It is a popular tool among the web3 community it provides all the necessary tools for the developer to develop and debug the contract more efficiently and also helps in organising the entire project in a structural way. It also provides a local test network to test the contract and a simple deploy javascript code.

Goerli : It is a test net provided by the ethereum which works on the concept of proof of stake rather than the proof of work. It is more efficient and less power consuming one.

Meta mask : It is one of the decentralised crypto wallet which support the multiple test network. The user can use the

Ether present in their meta mask wallet to perform the transactions and it also holds the NFT which is the login pass for the users in the platform.The users need to have some test ether in their wallets.

NFT : The NFT stands for non-fungible tokens which are not fungible in nature which means it only has a value when it is whole and can not be further broken into pieces.

IPFS[7]: It is a decentralised storage platform where we will store the reports of the patients.It is safe and secure planetary file system.

VI. RESULTS

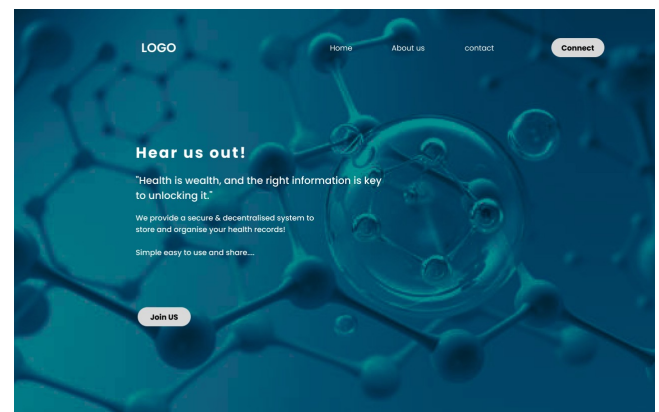To use the proposed system we need to have a meta mask wallet with some test net in it.

Fig 6 :Home Page

This is the home page of the platform whenever someone trying to access the platform they need to click on the connect on join us button these will redirect to the next page so the users can use the platform based on their profile it will be either patient or the doctor.
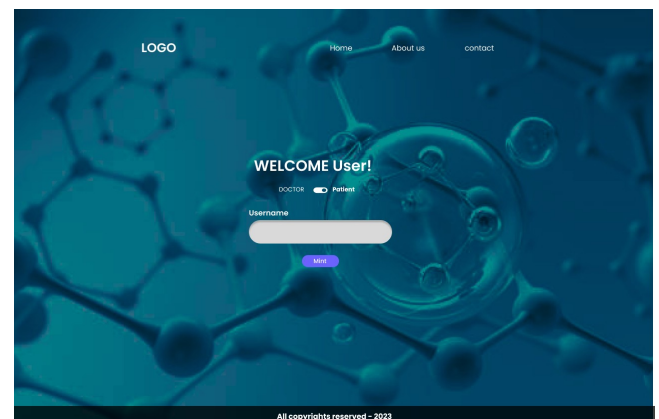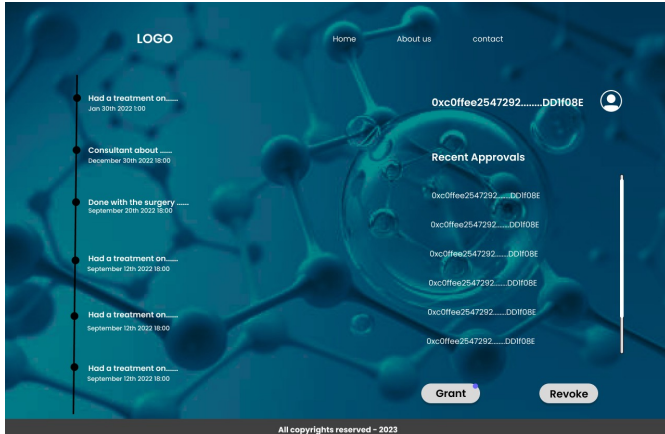

Fig 7 : Patient Login Page

The first time user need to enter the details in order to register for the platform and an unique NFT will be automatically minted to his meta mask wallet. If the user is already registered and his wallet contains a NFT,So when he clicks the connect or join us button (Fig 6) then he will be automatically redirected to his profile (Fig 8).

Fig 8 : Patient Information Page

This is the page where the user can see and control the privileges he wanted to provide to the doctor or organisations. He can grant the request for the doctor to provide read or write operations.So the organisation can't use the patients data without his consent.So the data is owned by the patient.

When the user uses toggles the button in the fig 8 then the login menu for the doctor will be provided.If the doctor hasn't joined the community before then he needs to enter all of the details present in the form.Based on the details the doctors who are already in the community can verify if the doctor is authenticated or not.
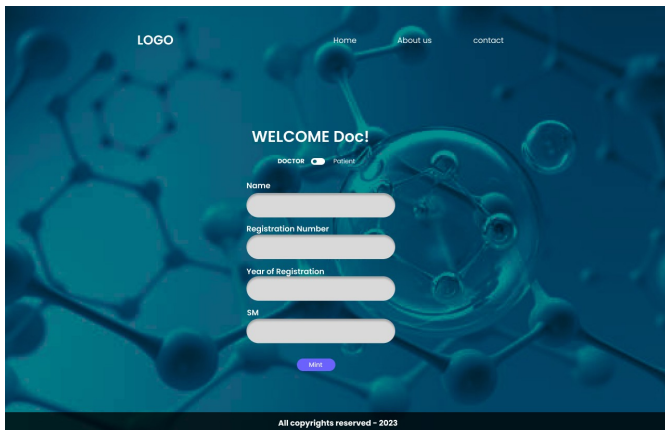

Fig 9 : Doctor login Page

The details can be cross check details on the Indian medical council desk.It is a portal where all the authorised doctors data can be found.The minimum 51% of the doctors needs to approve the registration of a doctor in order to eligible to get the privileges of the doctor in the community.

Once the user is register then they will get a NFT in the wallet which is different from the NFT offered to the patients this one will have the option to request read and write operations of the patient data.

Fig 10 : Doctor's Page
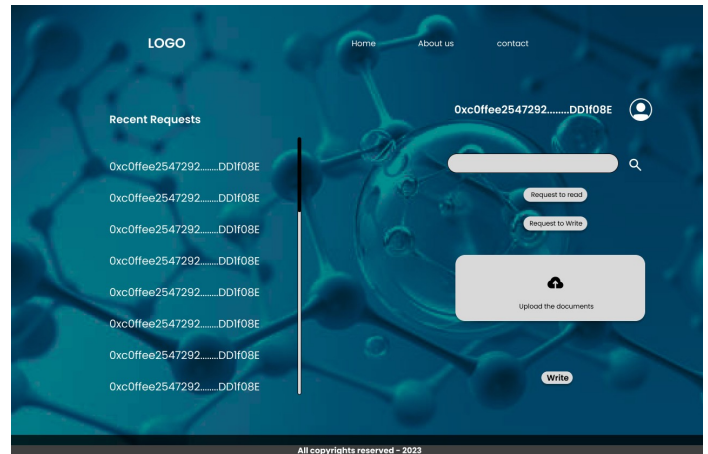
This is the doctors page here the doctor can search for the address of a particular patient and can request for the read or view privileges and the user can grant it from his profile (fig-8) and the doctor can view his previous medication and can use that data to provide more efficient and medication.

If the doctor is provided any medication or surgery he can request for the write permission and can modify it and then the patient will revoke the permission he previously provided.

VII. CONCLUSION AND FUTURE SCOPE

The proposed system will provide a mechanism where the data is owned by the patient. The data is stored on the blockchain in a secure and decentralised way, and it is immutable in nature, so the data timeline can be viewed as a proof of medical history. The data can be used by the organisation where they need a medical reports such as the government defence systems and the insurance companies and these entire gated community can be scaled to a different levels and it can be created a unified health interface on national[2] or even global level.

The system can be further improved with the mechanisms like integrating a payment gateway where the users can pay to the doctors any where in a decentralised way so the cross border payments will be done in minutes or even seconds.

A System where the patients can look a doctor who is more expert in a certain field which they are looking for like a specialist and can book an appointment so they can consult them in a easy manner no matter how long they are and where they are.

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