

Health Information System Using Blockchain Technology

Yash Chavan
Department of Computer Engineering
A. P. Shah Institute of Technology
Thane, India

Amey Balekundri
Department of Computer Engineering
A. P. Shah Institute of Technology
Thane, India

Hemanshu Bafna
Department of Computer Engineering
A. P. Shah Institute of Technology
Thane, India

Hiten Bhatia
Department of Computer Engineering
A. P. Shah Institute of Technology
Thane, India

Abstract:- In India majority of people use paper based medical records. Storing, accessing and sharing these paper based medical records is a difficult and time consuming task. Also, there are chances of these papers getting misplaced due to human errors or loss due to natural calamities such as floods, fires etc. Medical data is very sensitive in social aspect, so its confidentiality needs to be maintained. As said 'Health is Wealth' so it is important to keep our medical records safe. This project focuses on creating a system with the help of blockchain technology that uses digital medical records, which will enable patients to easily and securely store, access their medical records without the fear of it getting misplaced or lost and quickly share it with the doctors they trust.

Keywords:- Blockchain, Digital Medical Records, Health Information System, Digital Healthcare.

I. INTRODUCTION

A majority of Indians are still using the conventional paper based medical records. These records are stored in files, once the file capacity is full a new file needs to be maintained; maintaining multiple files is a very tedious task. If patients or doctors need to access certain record, they will have to check multiple files and pages to find out what exactly they are looking for, this is a time consuming process. Whenever patients need to share their medical records with doctors, they have to physically visit and hand over the files to doctors, travelling during sickness is a serious challenge for patients. As said earlier storing, accessing and sharing paper based medical records is both difficult and time consuming task. During an emergency one cannot afford to waste time in accessing and sharing paper based medical records with doctors.

Some of the private hospitals have an Electronic Health Records (EHR) system, which allows their patients to store and share their medical records with doctors within that hospital. However these systems may have security and privacy issues. According to 2016 Breach Barometer Report, with more than one health data breach per day for entire year, these breaches affected 27,314,647 patient records [4]. According to the 2017

Cost of Data Breach Study : Global Overview, which was sponsored by IBM Security and conducted by Ponemon Institute, the data breach cost of healthcare industry was \$380 per capita [5]. Medical data is very sensitive in social aspect, so its confidentiality needs to be maintained.

In this paper we present a system which will solve all of the above discussed problems. This system will allow patients to securely store, access and share their digital medical records with doctors. In this system medical records will be stored digitally so paper based medical records will be completely eliminated. Thereby eliminating the need to maintain multiple files and the risk of these papers getting misplaced due to human errors or loss due to natural calamities. Security concerns will also be taken care of, since the digital records will be stored and shared using blockchain technology.

Once the patients are registered, they can store and access their digital medical records in the system. Whenever they feel the need to share these records with doctors, they can search for doctors in the system and can grant access of their records to them. Doctors will be able to see patients medical records only after the patients have granted access to them. Patients can also revoke the access anytime. In this system entire control of medical records is with the patients, this increases the participation of patients in the system, also confidentiality of their digital medical records is maintained.

II. LITERATURE REVIEW

In the paper entitled "Towards Using Blockchain Technology for eHealth Data Access Management" the authors have discussed specific problems and benefits associated with blockchain technology for deployment of a secure and a scalable solution to exchange medical records. Addressing eHealth application challenges, they have proposed an architecture where patients are connected to medical sensors and blockchain through a data gateway, hospitals and doctors are connected to eHealth blockchain with smart contract, also an off chain database is maintained. Authors have suggested to use blockchain only as a tool to transfer a part of data or a pointer to where actual data is stored, because it is not feasible

to store all the data on blockchain and it may result into poor performance. So they have suggested to use IPFS as an off-chain database [1].

In the paper entitled “Health Record Management through Blockchain Technology” the authors have highlighted the issue of data breaches which occurs due to centralised approach of maintaining the health records. Since there are high chances of this data being misused, authors have suggested the need of a completely decentralized patient-centered approach. With this patient-centered approach access control rights are with the patient so data thefts can be identified and data manipulation can be prevented. Authors have proposed an idea of switching to a decentralized system from a centralized system using blockchain technology. They have suggested an approach in which a smart contract is deployed which executes when both parties agree, considering hospital admin and patients as two parties [2].

In the paper entitled “Health Information Exchange using Blockchain Technology” the authors have proposed a Health Information Exchange system which has entities such as patient, doctor, hospital, pharmacist, insurance company, research organization, emergency contact and patients private blockchain network. The proposed system will provide a way to store and share the health information in secured and effective manner. Hyperledger Fabric is used to retain privacy in the system, as it provides a way to keep certain data private from some users in network. Since all the access rights of electronic medical records are with patient, a backup access system is also provided, which will allow healthcare professionals to access critical information by scanning IOT device in case of any emergency situation [3].

III. PROPOSED SYSTEM

This project provides a blockchain based solution for securely storing, accessing and sharing digital medical records with doctors.

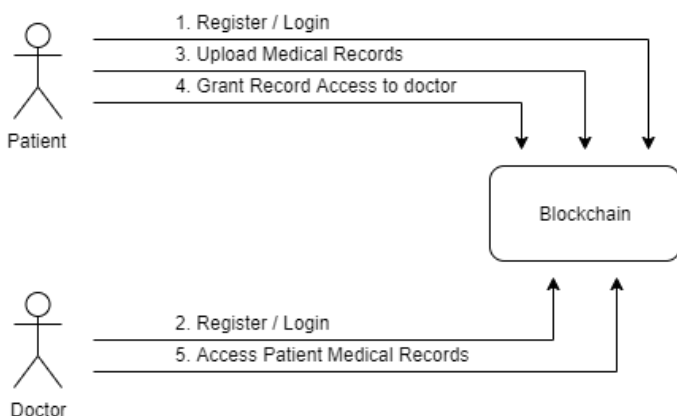


Fig. 1. High level use case

The technology stack of choice is HTML, CSS, JavaScript for front-end development, Django for the back-end, SQL for database, Solidity for smart contract, IPFS for storing medical records and Matic Network as a test blockchain. The technology stack was selected due to its efficiency in development and high performance quality.

Patient and Doctor are main entities in this system. Flow of these entities is explained further.

A. Patient :-

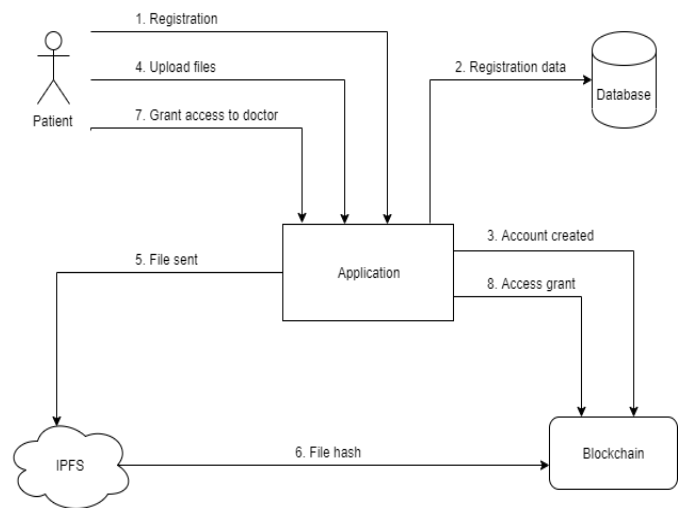


Fig. 2. Patient system flow

1. Patients need to register on the system first and then using correct credentials they need to log in to system.
2. If patients forget their password, they can reset it.
3. When a new patient is logging into the system for the very first time, they will be presented with ‘Basic Medical Information’ once they fill it up they will be presented with their dashboard. From second time login onwards patients will directly be presented with their dashboards.
4. Patients are provided with these features ‘Add Report’, ‘View Report’, ‘Access Doctor’, ‘Revoke Doctor’, ‘Basic Medical Information’, ‘My Account’ all these features are accessible through dashboard.
5. By selecting ‘Basic Medical Information’ patients can update this information.
6. When patients want to upload their medical records on the system, they select ‘Add Report’. Patients will be provided with an option to name the document/s and then upload it. Once they upload, a preview of the entire document is shown. Finally they need to click on ‘Submit’ in order to upload the document/s on the system.
7. If patients need to view their already uploaded medical records, they need to select ‘View Report’.
8. To share the medical records with doctors, patients need to select ‘Access Doctor’. Patients will be provided with two options to search the doctors. To directly search a specific doctor, patients need to type email address or phone number of that doctor and click on search. Other way to search doctors include filters option, filter doctors by their location and/or specialization. The filters search option provides search results of all the doctors according to applied filters.
9. Once patients have found the required doctor, they need to select ‘Grant Access’ to grant medical reports access to that specific doctor. This will share complete patient profile (Basic Medical Information + medical reports) with the doctor.

10. Unless patients grant access to doctors, no doctor will be able to see any of the patients profile. Patients have entire control over their medical records so confidentiality of medical records is maintained.
11. If at any moment patients feel to revoke the access of their profile which they have currently granted to doctors, they need to select 'Revoke Doctor' and then click on 'Revoke Access'.
12. Once the patients have granted access to doctors, every time they add new medical records to system, these newly added records are automatically shared with those doctors.
13. Patients can update their account information anytime by selecting 'My Account'.

B. Doctor :-

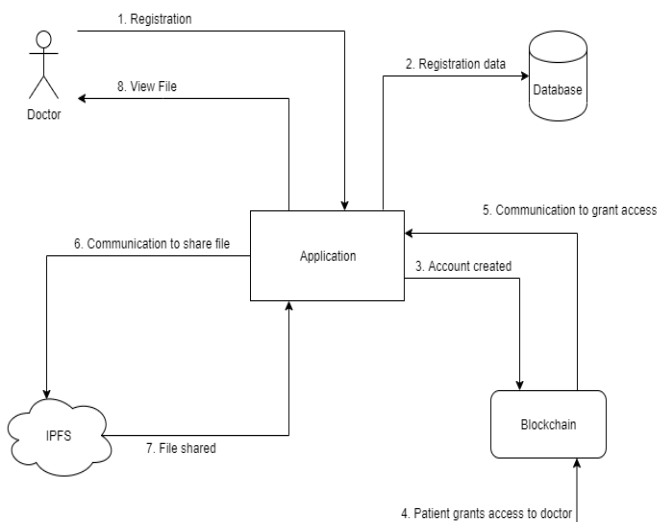


Fig. 3. Doctor system flow

1. Doctors need to register on the system first and then using correct credentials they need to log in to system.
2. If doctors forget their password, they can reset it.
3. After login, doctors will be presented with their dashboard.
4. Doctors are provided with these features 'View Patients', 'View Records', 'My Account'. All these features are accessible through dashboard.
5. If no patients have granted access yet, doctors will not be able to see anything in 'View Patients' and 'View Records'.
6. Only after patients have granted access to doctors, the doctors will be able to see patients profile. To see patients profile they need to select 'View Patients'.
7. To view medical records they need to select 'View Records'. Then they need to select the patient name and click on show. Now they will be able to see all the medical records uploaded by that particular patient till the date.
8. Doctors can update their account information anytime by selecting 'My Account'.

IV. RESULTS

Patient Dashboard shows a count of total reports uploaded and total number of doctors having access to those records.

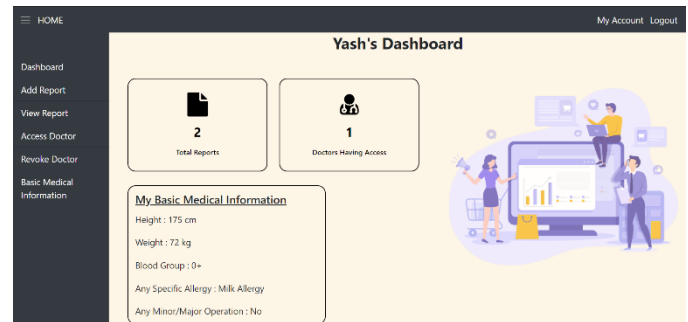


Fig. 4. Patient Dashboard

In 'Add Report' patients can upload the records and give appropriate names to those records. Before they submit any record its preview will also be displayed on the screen.

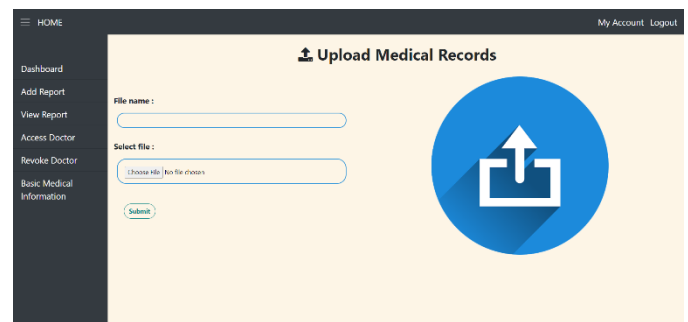


Fig. 5. Add Report

All the records uploaded by patients will be visible to them in 'View Report' along with name, date and time of upload.

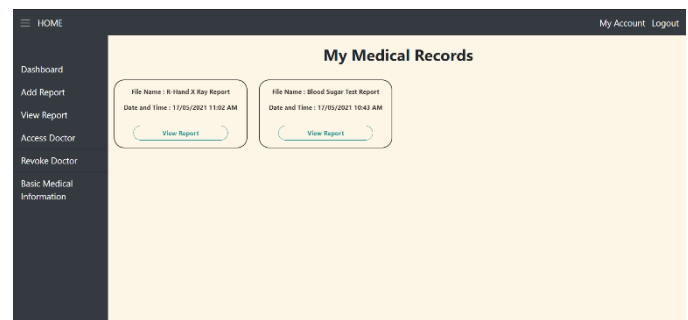


Fig. 6. View Report

In 'Access Doctor' profiles of all doctors present in the city of that particular patient will be provided by default, patients can scroll and find a doctor. Patients are also provided with options to search a specific doctor by entering that doctor's email address/phone number or they can search doctors by using city and/or specialization filters. Once they find the doctor, they need to click on 'Grant Access' to share medical records with doctors.

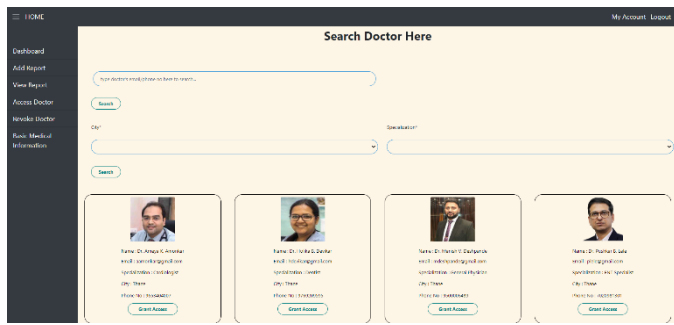


Fig. 7. Access Doctor

After granting the access, if patients want to revoke access form any specific doctor they can easily do it in 'Revoke Access'.

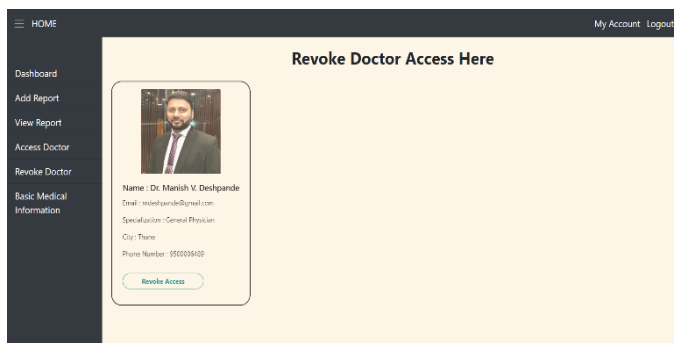


Fig. 8. Revoke Doctor

Patients can update their Basic Medical Information whenever any changes occur.

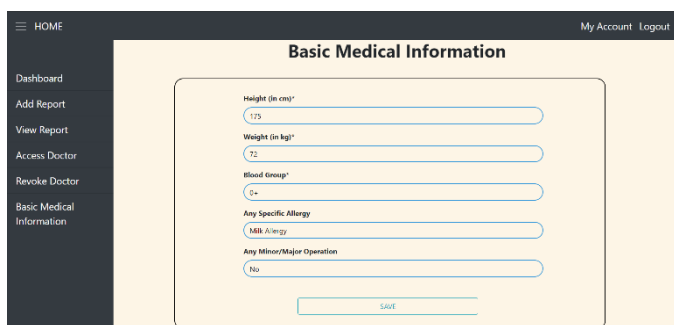


Fig. 9. Basic Medical Information

On dashboard doctors can see the number of patients who have granted them the access to their profile. All the features provided to doctors are easily accessible through dashboard.

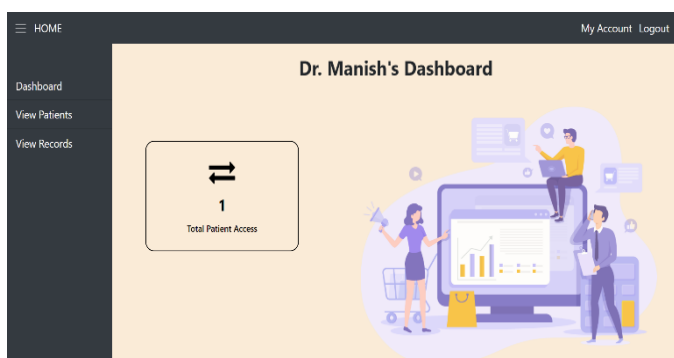


Fig. 10. Doctor Dashboard

Profile of all the patients who have granted access to that specific doctor are visible in 'View Patients'.

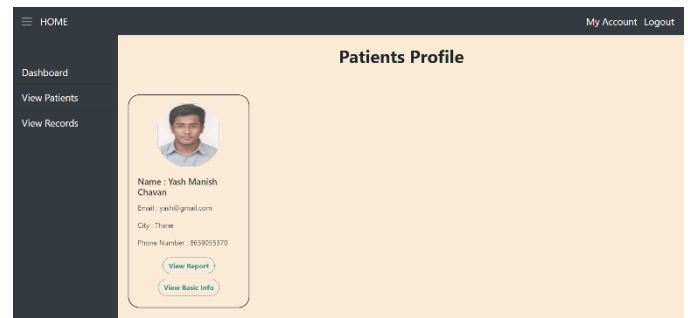


Fig. 11. View Patients

In 'View Records', by selecting patients name, doctors can access their basic medical information and all the medical records.

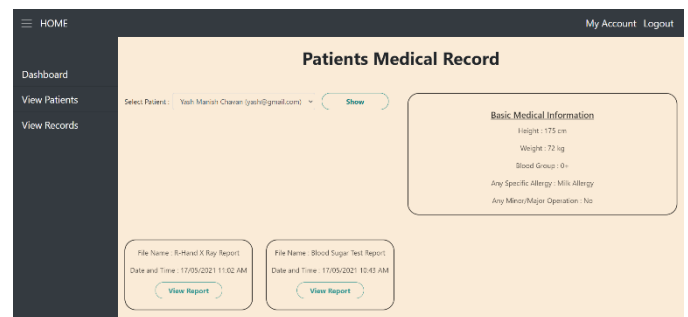


Fig. 12. View Records

V. CONCLUSION AND FUTURE WORK

The world is already moving towards digital healthcare and now it's time for India to start this journey as well. In proposed system, a blockchain based solution is provided which will allow patients to securely store, access and share their digital medical records with doctors. Patients have complete ownership of their digital medical records, only they decide who gets access to their medical records, this maintains confidentiality. The Honourable Prime Minister of India announced the launch of National Digital Health Mission (NDHM) on 74th Independence Day. We believe that our project will serve as a small contribution towards NDHM of India.

As of now the proposed system only has two entities patient and doctor. This system can be further expanded to create a national health ecosystem that has multiple entities like hospitals, clinics, labs, pharmacies, insurers, health tech companies, regulators, program managers, state governments, central government.

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