A Project Report On

Health Information System Using Blockchain Technology

Submitted in partial fulfillment of the requirements

In

Computer Engineering

By

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Approval Sheet

This Project Report entitled ***"Health Information System Using Blockchain Technology"*** Submitted by ***"Yash Chavan (17102024)", "Amey Balekundri (17102015)", "Hemanshu Bafna (17102032)", "Hiten Bhatia (15102044)"*** is approved for the partial fulfillment of the requirement in ***Computer Engineering*** from ***University of Mumbai***.

Prof. P. P. Adivarekar
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Prof. S. H. Malave
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Place : A. P. Shah Institute of Technology, Thane
Date:

CERTIFICATE

This is to certify that the project entitled ***"Health Information System Using Blockchain Technology"*** Submitted by ***"Yash Chavan (17102024)", "Amey Balekundri (17102015)", "Hemanshu Bafna (17102032)", "Hiten Bhatia (15102044)"*** for the partial fulfillment of the requirement for award of a degree ***Bachelor of Engineering*** in ***Computer Engineering***, to the University of Mumbai is a bonafide work carried out during the academic year 2020-2021.

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Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, We have adequately cited and referenced the original sources. We also declare that We have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

_____

(Signature)

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1. Project conception and initiation

1.1 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.

1.2 Objectives

- Eliminate the usage of paper based medical records. Thus eliminating multiple problems associated with it, such as maintaining multiple files, sharing those records by physically visiting the doctors, papers getting misplaced due to human errors or lost due to natural calamities
- Allow patients to securely store all of their digital medical records in a single system
- Allow patients to easily access their digital medical records, so that they can go through any of their medical documents with ease
- Allow patients to quickly share their digital medical records with doctors they trust, thus enabling more coordinated and effective treatment
- Enhancing privacy and security of patients digital medical records by using blockchain technology
- Providing entire control of digital medical records to patients, thus increasing patients participation in system

1.3 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 EMRs 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].

1.4 Problem Definition

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.

1.5 Scope

This project consists of creating an Health Information System using Blockchain technology. Using this system, the patients will be able to securely store, access and share their digital medical records with doctors.

1.6 Technology Stack

Front-end	: HTML, CSS, JavaScript
Back-end	: Django
Database	: SQL
Test Blockchain	: Matic Network

Along with above mentioned stack, IPFS is also used to store the medical records. The technology stack was selected due to its efficiency in development and high performance quality.

1.7 Benefits for environment and society

- We believe that our project will serve as a small contribution towards National Digital Health Mission (NDHM) of India
- This system will act as a single platform for patients to securely store and access all of their digital medical records
- Patients can share their digital medical records with doctors situated in different geographical regions, without actually visiting that region. Thereby saving patients time and money
- Medical data is sensitive in social aspect and its confidentiality needs to be maintained, so this system provides a blockchain based secured solution to store, access and share digital medical records with doctors
- Saving papers by using digital medical records

2. Project Design

2.1 Proposed System

After taking into consideration various problems as discussed earlier, we propose “Health Information System Using Blockchain Technology”. Using this system patients will be able to securely store, access and share their digital medical records with doctors.

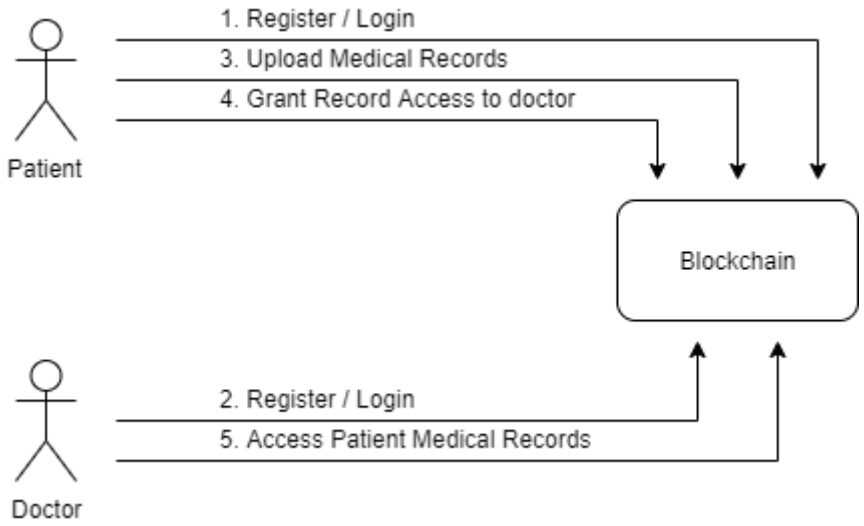

Fig. 1. High level use case

2.2 Design (flow of modules)

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

Patient :-

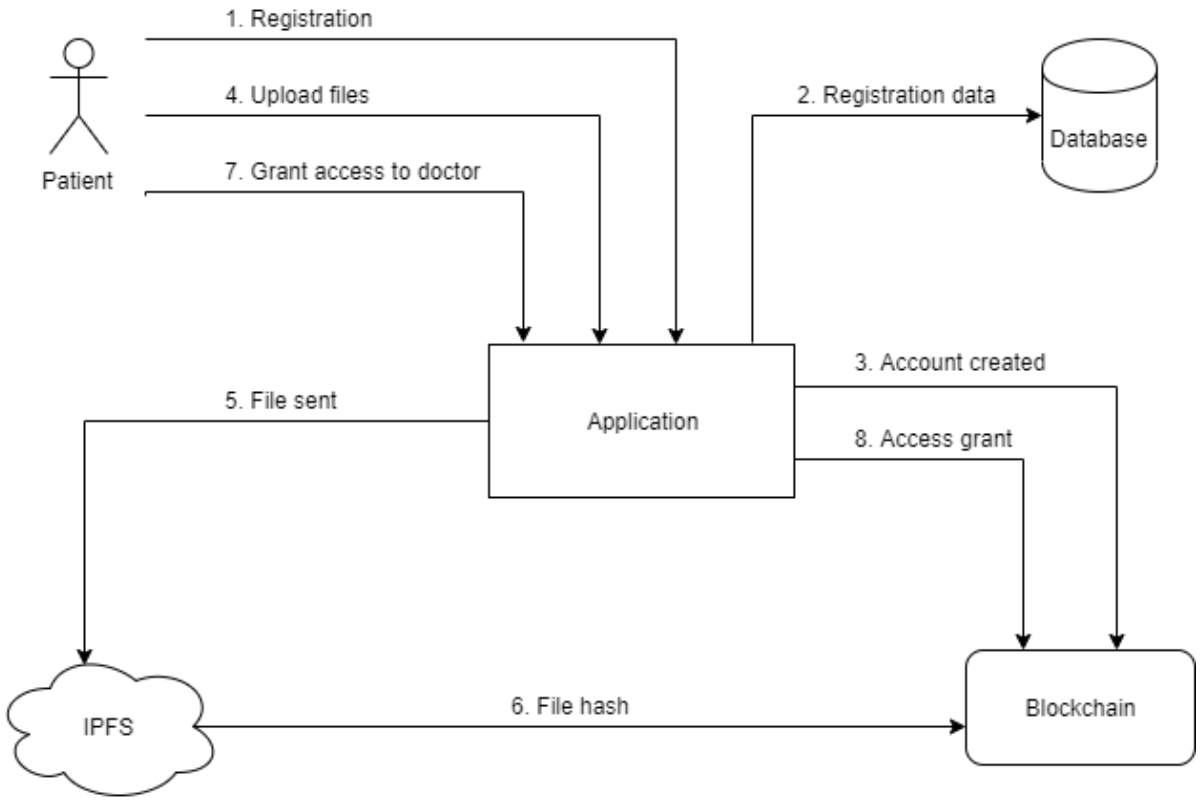

Fig. 2. Patient system flow

a. Patients need to register on the system first and then using correct credentials they need to log in to system.
b. If patients forget their password, they can reset it.
c. 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.
d. 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.

e. By selecting ‘Basic Medical Information’ patients can update this information.
f. 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.
g. If patients need to view their already uploaded medical records, they need to select ‘View Report’.
h. 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.
i. 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.
j. 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.
k. 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’.
l. 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.
m. Patients can update their account information anytime by selecting ‘My Account’.

Doctor :-

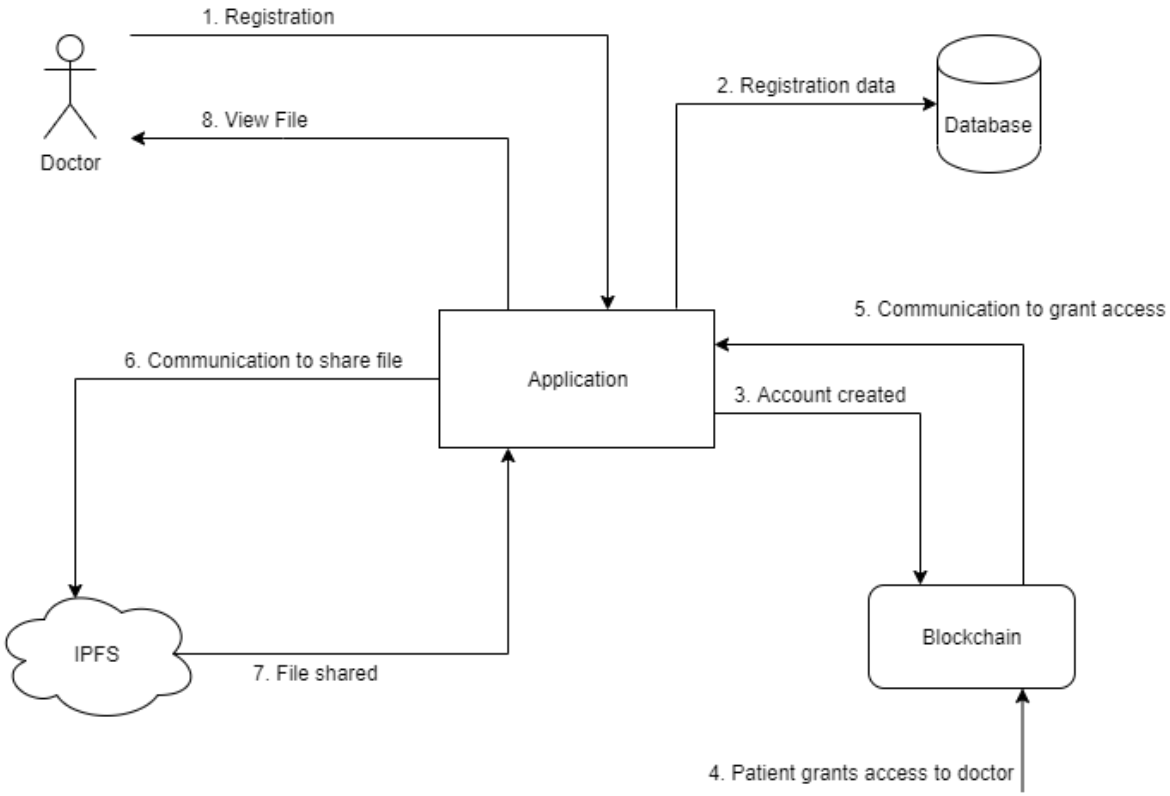

Fig. 3. Doctor system flow

a. Doctors need to register on the system first and then using correct credentials they need to log in to system.
b. If doctors forget their password, they can reset it.
c. After login, doctors will be presented with their dashboard.
d. Doctors are provided with these features ‘View Patients’, ‘View Records’, ‘My Account’. All these features are accessible through dashboard.
e. If no patients have granted access yet, doctors will not be able to see anything in ‘View Patients’ and ‘View Records’.
f. 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’.
g. 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.

h. Doctors can update their account information anytime by selecting ‘My Account’.

2.3 Class Diagram

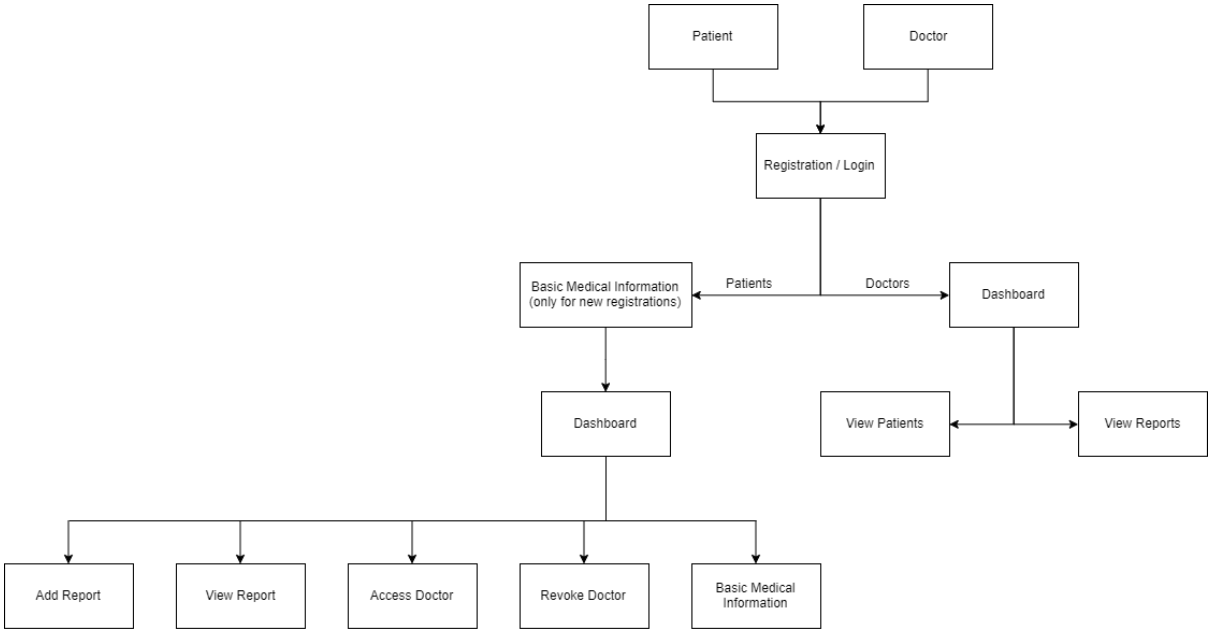

Fig. 4. Class Diagram

2.4 Modules

1. Registration / Login
New patients and doctors need to register on the system by providing the required details, and then using correct credentials log in to use the system.

2. Dashboard
Both patients and doctors have a different dashboard. Through dashboard they can access all the features provided to them.

3. Add Report
Patients can add new digital medical records and name those records for future references. Before finally uploading the records to system, preview of selected record will be shown to patients.

4. View Report
Patients can view their previously uploaded digital medical records. Record name, date and time will also be shown to patients.

5. Access Doctor
Patients will be provided with two options to access doctors. To directly search a particular doctor, patients need to type email address or phone number of that doctor and click on search. Other option includes 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. Once they find the doctor they were searching for, to give access to their medical records, they need to click on grant access. This will share patients profile to the selected doctor.

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

7. Basic Medical Information
Patients can update this information whenever any changes occur.

8. View Patients
Doctors can see all the patients profile who have granted them the access to their records.

9. View Reports
Doctors can view the medical records and basic medical information of patients who have granted them access.

10. My Account
Patients and Doctors can change their account information here.

3. Implementation

3.1 Proposed System

In this project, we propose a Health Information System Using Blockchain Technology, which will enable users to securely store, access and share their digital medical records with doctors. These digital records will be stored, accessed and shared with the help of Matic Network (test blockchain) and IPFS. System is designed in such a way that patients and doctors will find it quick and easy to use.

3.1.1. Pseudo Code

Pseudo code for smart contract –

Define Solidity version
Enable features of compiler/language
    Define contract “Health”
        Mapping structures to be used
        Define structure “Patient”
        Define structure “Doctor”
        Define structure “Report”
        Define modifier “isPatient”
        Define function “addPatient”
        Define function “patientInfo”
        Define function “addReport”
        Define function “grantAccessToDoctor”
        Define function “revokeAccess”
        Define function “viewReport”
        Define modifier “isDoctor”
        Define function “addDoctor”
        Define function “doctorInfo”
        Define function “viewPatientReport”

3.1.2. Platform for execution

1. Matic Network
Matic Network is a blockchain scalability platform which provides secure, scalable and instant transactions.

2. IPFS
InterPlanetary File System (IPFS) is a file sharing system that can be leveraged to more efficiently store and share large files.

3. Azure
Azure is a cloud computing service created by Microsoft for building, testing, deploying, and managing applications and services.

4. Visual Studio Code
VS Code is a freeware source-code editor made by Microsoft for Windows, Linux and macOS.

4. Results

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

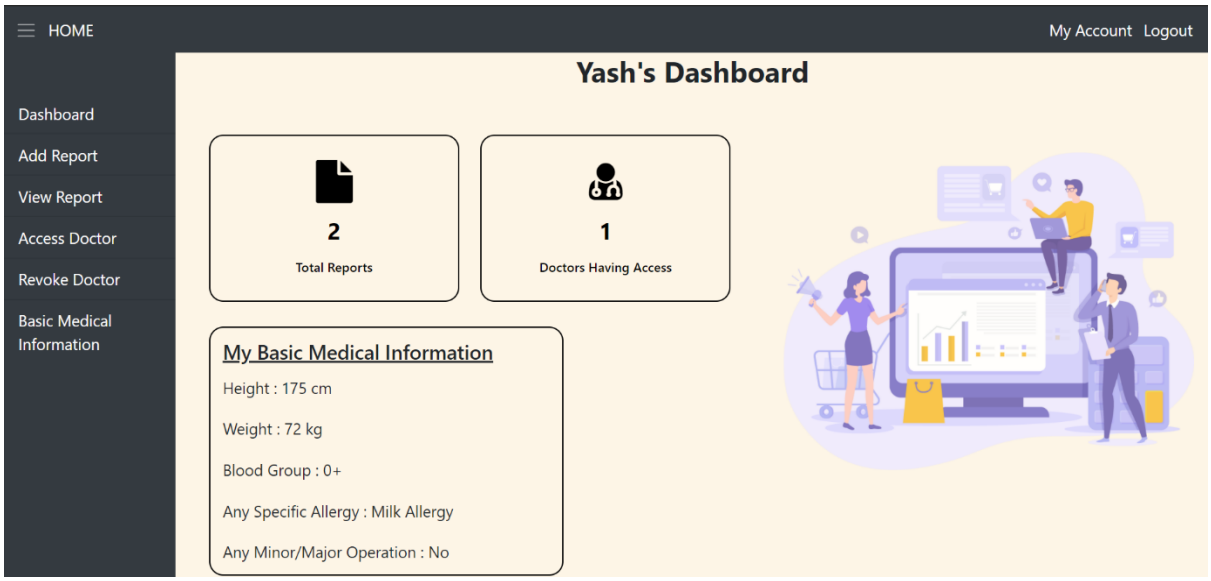

Fig. 5. Patient Dashboard

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.

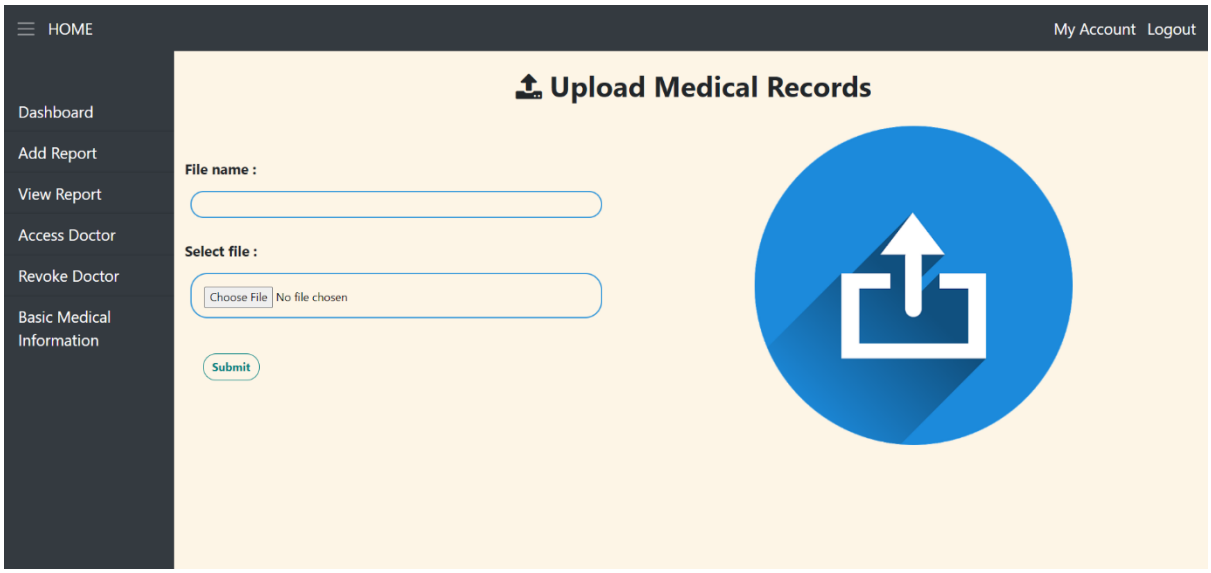

Fig. 6. Add Report

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

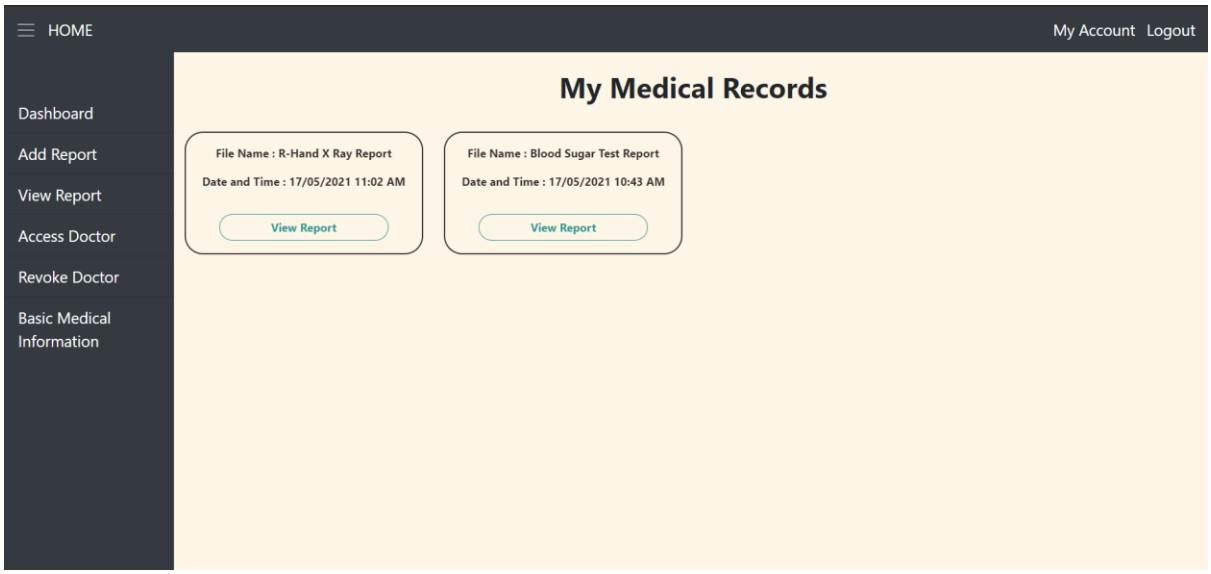

Fig. 7. View Report

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.

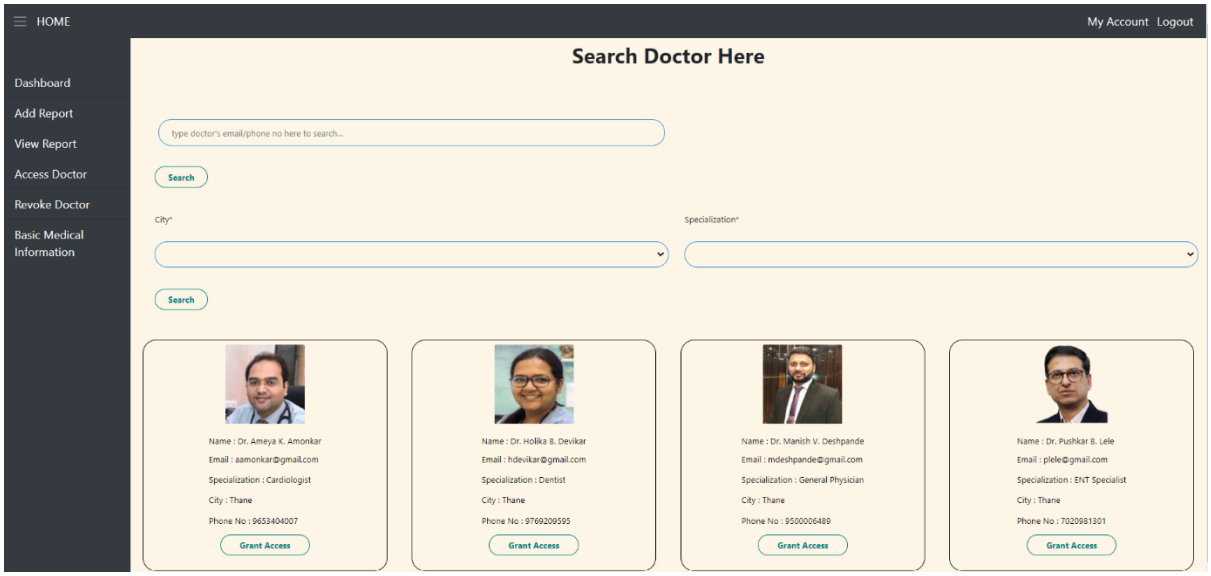

Fig. 8. Access Doctor

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

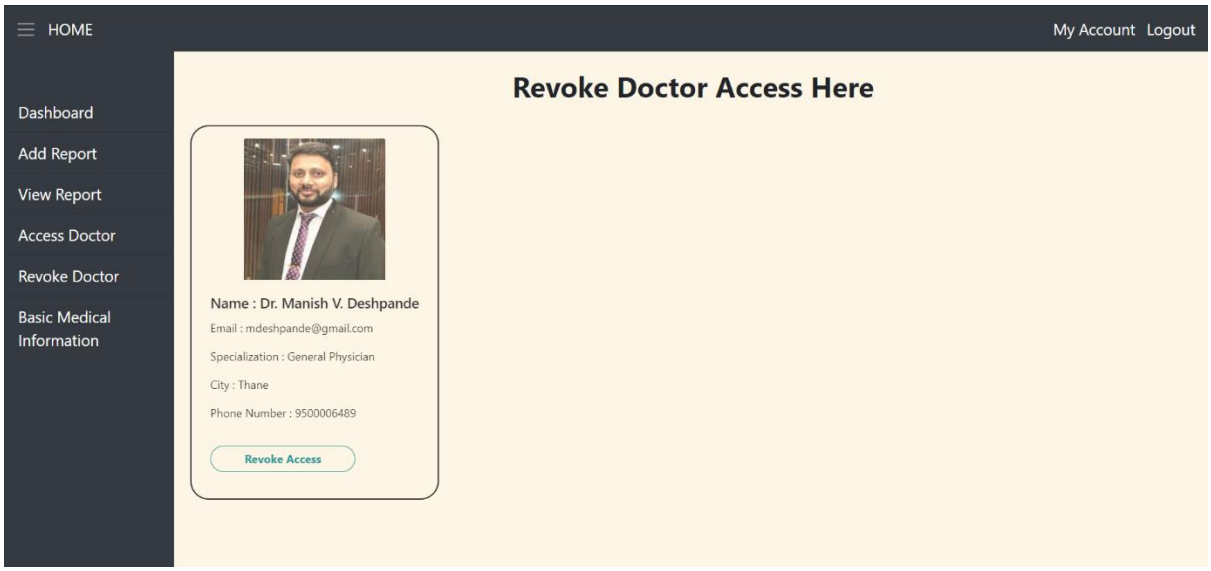

Fig. 9. Revoke Doctor

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

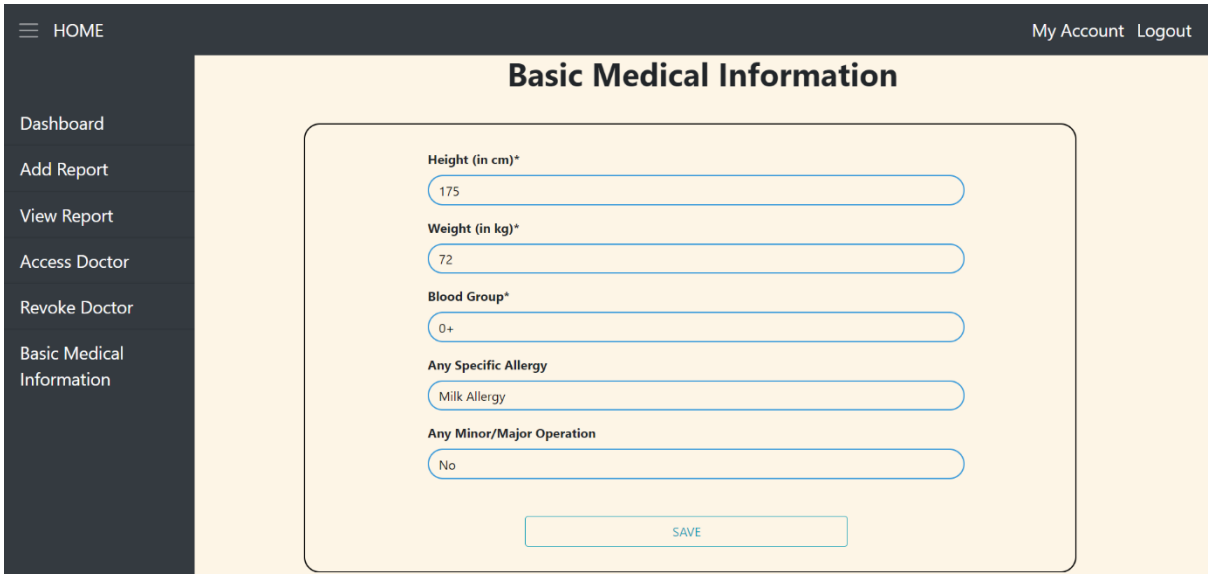

Fig. 10. Basic Medical Information

Patients can update their account information in ‘My Account’.

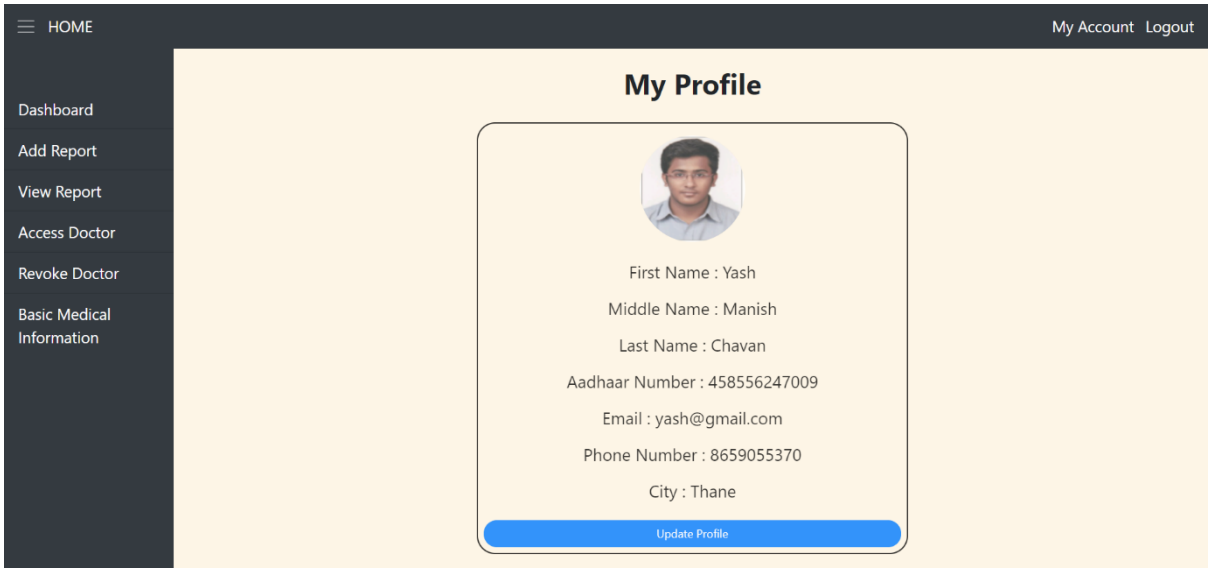

Fig. 11. My Account (Patient)

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.

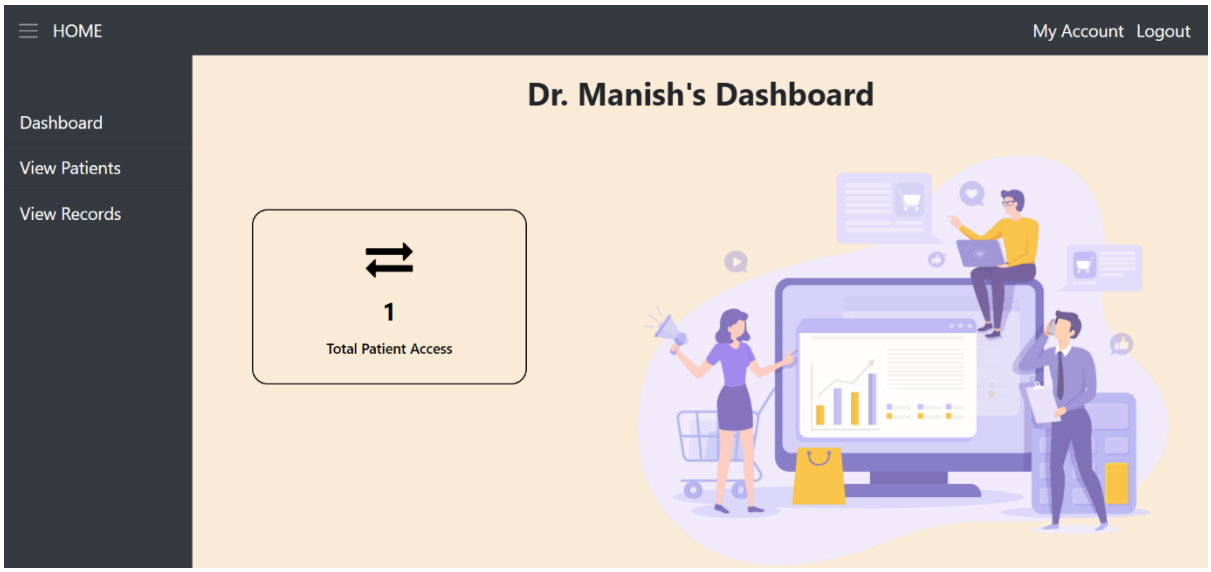

Fig. 12. Doctor Dashboard

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

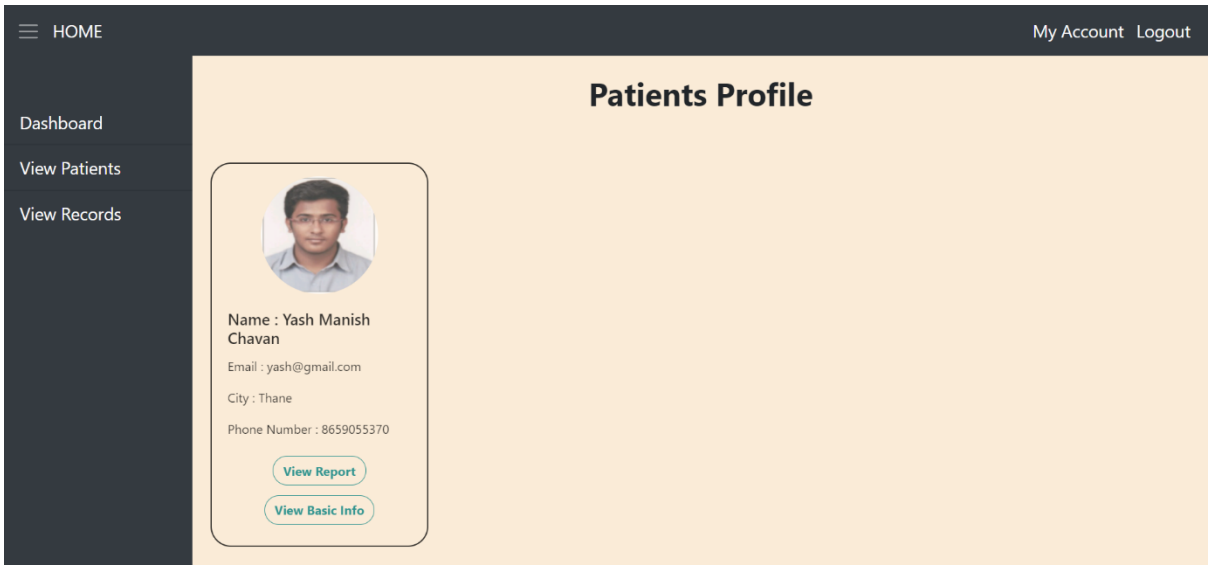

Fig. 13. View Patients

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

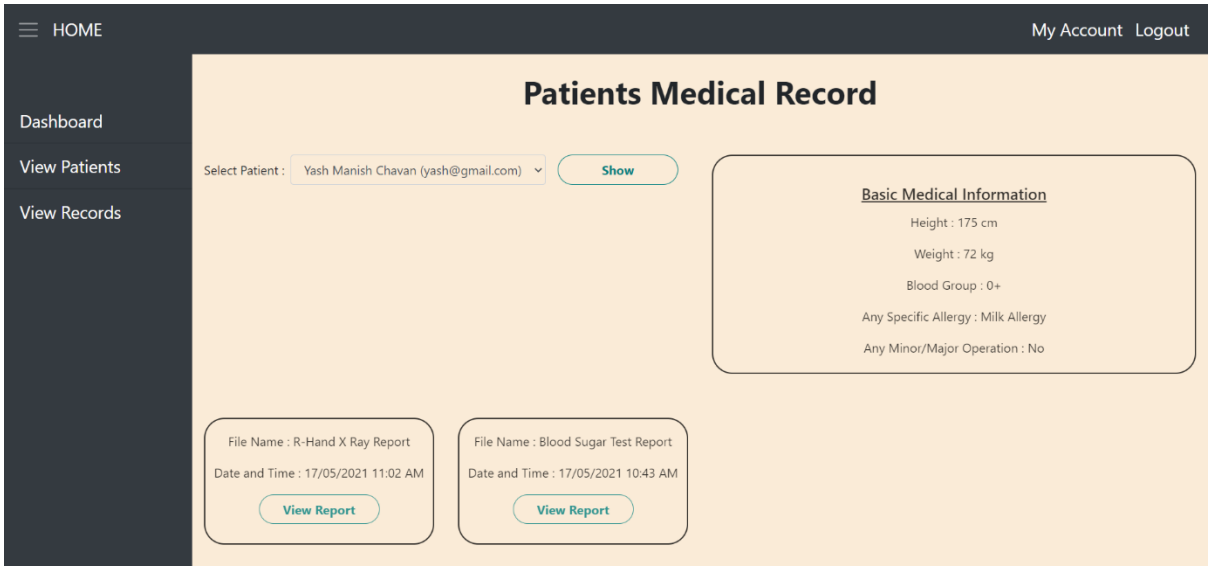

Fig. 14. View Records

Doctors can update their account information in ‘My Account’.

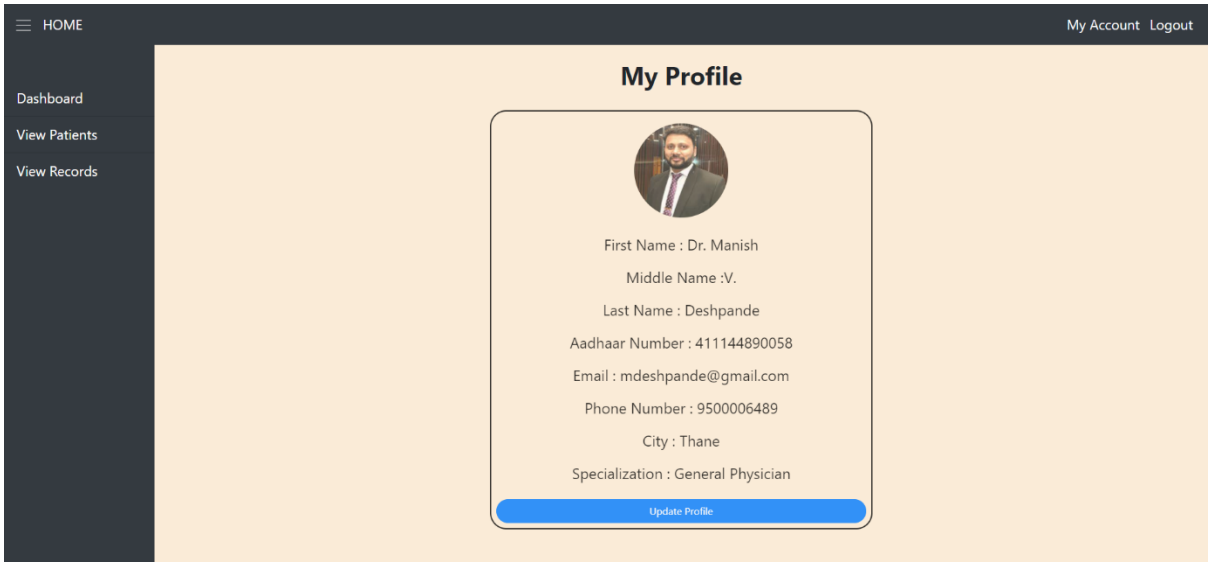

Fig. 15. My Account (Doctor)

5. Conclusion

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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