A Project Report

On

HealthStack- A Decentralized medical record storage Application

Submitted as a part of course curriculum for

Bachelor of Technology

in

Computer Science and Engineering

Under supervision of

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KIET Group of Institutions, Ghaziabad

Dr. A.P.J. Abdul Kalam Technical University, Lucknow

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DECLARATION

We hereby declare that this submission is our own work and that, to the best of our knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

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CERTIFICATE

This is to certify that Project Report entitled "**HealthStack- A Decentralized medical record storage Application** " which is submitted by **Mayank Bansal, Ritik Verma and Vedant Jain** in partial fulfillment of the requirement for the award of degree B. Tech. in Department of Computer Science & Engineering of Dr. A.P.J. Abdul Kalam Technical University, Lucknow is a record of the candidates own work carried out by them under my supervision. The matter embodied in this report is original and has not been submitted for the award of any other degree.

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ABSTRACT

This project aims to design and develop a blockchain-based web app called **HealthStack** to maintain accurate and complete medical records of patients, to help doctors to fetch previous medical history of the patients, to assist the user to find out the disease he or she is suffering from and much more. For medical services, secure data storage is one of the major concerns for people. This problem can be resolved by developing an app using blockchain technology having the features of decentralization and verifiability. Development of this app doesn't involve any kind of dependency on third-party

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LIST OF ABBREVIATIONS

NAM	Network Animator
OCR	Optical character recognition
ML	Machine Learning
TCP/IP	Transmission Control Protocol/Internet Protocol
Pdf	Packet Drop Fraction
MVP	Minimum Viable Product
NLP	Natural Language Processing

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Health Information Technology (Health IT) is a broad term that describes the technology and infrastructure used to record, analyse, and share a patient's health data. Various technologies include health record systems, including personal, paper, and electronic; personal health devices, including smart devices and applications; and finally, to share and discuss information to communities. Some of these techniques can tell if a patient needs to take a diet, and most of the time Golo's diet is what they need to do or take a gynaecological pill for gynaecology, as most men do.

Health IT helps in providing better care to patients and achieves health equity. It supports patient data recording to improve healthcare delivery and allows analysis of this information for health services and government agencies. It further improves healthcare delivery, improves patient safety, reduces medical errors, and strengthens the interaction between patients and health care providers.

It has been found that the is a need for reliable and inexpensive medical record software in low- and middle-income countries (LMIC). Health IT use in medical clinics not only improves the quality of health care, provides accurate patient records, but also enables clinicians to better understand the patient's medical history. With an extensive patient history, physicians are empowered to treat diseases and prevent excessive use of drugs that can be fatal. Without a medical record, the physician has to rely on the patient's memory, leading to a false medical history due to memory, complex drug names, and diseases that affect the patient's memory.

This motivates us to design and develop the Health Stack app. And the objective of this project is to have a secure ledger for storing sensitive medical information on a blockchain server that provides critical data analysis, such as a specific area, age, and

gender, such as a common disease, which can be used for the development of any country. This ensures that any patient's medical, treatment, medication, and vaccine records are tied to his Aadhaar card so that previous reports no longer need to be stored. Any physician and his family member can access this crucial information. Personal details & Medical history of a patient will be stored through the Blockchain to ensure Security and decentralization. Data Analysis can be employed to get the overall health condition of citizens of the country. A doctor can access his patient account after scanning his Aadhaar card through his phone and can update or add a medical prescription along with his reports. This will help other doctors and patient's family members to track the medical history of the patient.

1.2 KEY FEATURES

This application will have the following two Interfaces:

User Interface

User Interface is used by Patients. They can scan their Aadhaar card to check their medical history, search medicines according to symptoms they are having, chat with bots to ask any health-related questions, and to see prescriptions given by any doctor. Here are some of the features that are available in the user interface

1.2.1 Chat with Expert: A Chatbot build using Machine Learning Algorithm is integrated on the landing page itself. So, if the user is having any type of confusion or want to ask about the disease he is suffering from, he can ask by typing the symptoms. Along with this he will be shown the medicines and Diet he should take.

1.2.2 Scan Aadhaar Card Any user can scan an Aadhaar card of his own or any family member to check the medical history of the person, the disease he is or was suffering from, the treatment he has gone through and what drugs & vaccines he has intake.

Professional Interface

The professional interface is used by doctors. After registering on the application doctor can scan the Aadhaar of any of his patient and see his
medical history, previous treatment records, previous drugs & vaccines records and add new prescriptions or treatment record.

1.2.3 Registration to access the application as "Doctor",

a person needs to fill a registration form where he will be asked about his details, qualification, area of interest, year of experience, and license number, and some identity cards. Once these details are filled, the doctor can access his interface.

1.2.4 Scan & Add Doctor can access his patient record after scanning his Aadhaar card and then can view or add a new prescription, his treatment information, and drugs and vaccines records.

The expected impact of the project would be the creation of a stable system to illustrate to doctors and patients, how an Electronic health care system would benefit them. The system will demonstrate that by updating the paper-based systems that they are currently using, they will improve the care given to the patients by making their working environment more efficient.

CHAPTER 2

BACKGROUND

2.1 INTRODUCTION

Advances in the healthcare industry are taking place at a rapid pace to accommodate the growing number of people suffering from daily problems and chronic illnesses. Technology has helped in the way of providing patient record-keeping and providing effective ways to search and access these records. Those days are gone when the large filing cabinets and long lines of people trying to get their patient records.

2.2 MEDIUM OF DISPLAY

The Internet has been used to display data for the past three decades and the concept of web applications is nothing new. Given its wide use and ease of access. Very few advances of this kind have penetrated the medical field and very few systems end up providing vital signs that exist online, so an opportunity exists to help people in hospitals better manage patients and ultimately save lives.

2.3 RECORD CONFIDENTIALITY

Patient records and all patient information are treated as confidential. The system responsible for this data should be protected against the willful or willful misuse of this purpose. We use Blockchain technology to protect the patient data ledger. Therefore any access to data needs to be controlled and managed if it is in compliance with medical standards.

CHAPTER 3

SYSTEM DESIGNS

3.1 INTRODUCTION

This section outlines the process we have taken to gather information to design a high-quality Blockchain-based E-Health system. We will look at the building methods used and the UML models for the final design of the program.

The first step in this process involves designing a high-fidelity prototype that includes interactive displays that define what a system might look like and behave. and then iterating the prototype to build an MVP (Minimum viable product) out of it.

When designing a storage system, one must take into account the user's needs and requirements. We as computer science engineers have little idea of what physicians really need, which is why our ideas are not accurate. The only way to measure these ideas is to discuss with these health workers how best to improve our practice.
As the focus of the project is a usability priority project, the design methodology we used is an iterative development process (Iterative Model). The sequence of events for each iteration is as follows:

1. Gather user specifications & Requirement

2. Design The System

3. Implementation Phase

4. Testing and Integration

5. Deployment

6. Repeat from Step one until a viable system emerges.

This approach is also known as stepwise refinement and is very useful in project implementation, since users are heavily involved in the design of the system, and consult frequently in the design process.

As outlined in the background section, User-Centered Design principles were deemed the most effective way of creating effective software for our users: - Health Care professionals (doctors and nurses).

3.2 DESIGN OF THE PROTOTYPE

The First Iteration of our system began by designing and implementing a high fidelity prototype.

For the design of the prototype system, we took inspiration from a normal medicare website and added a chatbot at the bottom right section, and a menu to log in.

We also had some sessions to discuss with two doctors outside of working conditions to gather their thoughts on how the program should be done. In the discussion, we explained the project proposal. Their input was that they thought the project was very interesting. We took a look at what they had to say and started designing a model website.

3.3 IMPLEMENTATION OF THE PROTOTYPE

The First Iteration of our system began by designing and implementing a high fidelity prototype.

For the design of the prototype A medical system will store large quantities of data (Images, patient records, etc.) and thus needs to play a huge part in considering a solution. There are currently a number of database systems available on the market today such as Microsoft SQL Server, Oracle SQL,No SQL and MySQL database systems but in this we have used Blockchain nodes to save patient's data and NOSQL mongodb to store doctor's data.

This is a Blockchain-based web application built to enhance the healthcare industry.

3.3.1 Node JS is used as a Backend Language to retrieve and update data. It is a platform built on Chrome's JavaScript runtime for easily building fast and scalable network applications. Node.js uses an event-driven, non-blocking I/O model that makes it lightweight and efficient, perfect for data-intensive real-time applications that run across distributed devices.

3.3.2 Machine learning algorithm (Regression Model) is used to predict the diseases a patient is having by his symptoms and also suggest medicines and treatment accordingly. Regression analysis is a form of predictive modelling technique which investigates the relationship between a dependent (target) and independent variable (s) (predictor). This technique is used for forecasting, time series modelling and finding the causal effect relationship between the variables. For example, the relationship between rash driving and number of road accidents by a driver is best studied through regression. Linear Regression, Logistic Regression, Polynomial Regression, Stepwise Regression, Ridge Regression, Lasso Regression, Elastic Net Regression are different type of regressions models.

3.3.3 BlockChain is used to store and mining the data and increase the security of the database through decentralization. A blockchain, as the name implies, is a chain of digital “blocks” that contain records of transactions. Each block is connected to all the blocks before and after it. This makes it difficult to tamper with a single record because a hacker would need to change the block containing that record as well as those linked to it to avoid detection. This alone might not seem like much of a deterrence, but blockchain has some other inherent characteristics that provide additional means of security.

3.3.4 AngularJS is used to make the frontend of the application mobile responsive and interactive, and also to support Scan feature. AngularJS is a structural framework for dynamic web apps. It lets you use HTML as your template language and lets you extend HTML's syntax to express your application's components clearly and succinctly. AngularJS's data binding and dependency injection eliminate much of the code you would otherwise have to write. The impedance mismatch between dynamic applications and static documents is often solved with: a library - a collection of functions which are useful when writing web apps. Your code is in charge and it calls into the library when it sees fit. E.g., jQuery. frameworks - a particular implementation of a web application, where your code fills in the details. The framework is in charge and it calls

into your code when it needs something app specific. E.g., durandal, ember, etc. AngularJS takes another approach. It attempts to minimize the impedance mismatch between document centric HTML and what an application needs by creating new HTML constructs. AngularJS teaches the browser new syntax through a construct we call directives. Examples include:

· **Data binding, as in {{}}.**
· DOM control structures for repeating, showing and hiding DOM fragments.
· Support for forms and form validation.
· Attaching new behavior to DOM elements, such as DOM event handling.
· Grouping of HTML into reusable components.

AngularJS is what HTML would have been, had it been designed for applications. HTML is a great declarative language for static documents.

3.4 USER INTERFACE OF THE PROTOTYPE

The screenshots of the prototype system can be found in below Figures. The prototype itself outlined the capability of the website to display.

Figure. 3.4.1: Landing Page of the Application

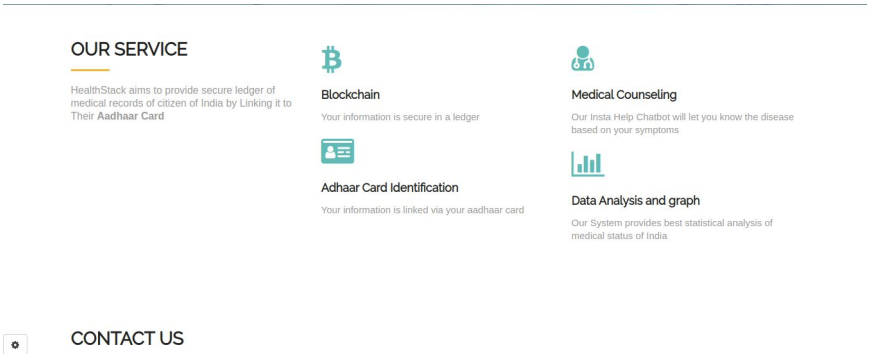

Figure: 3.4.2 Service Page of the Application

3.5 WEBSITE DESIGN

The website was designed to have the following structure:

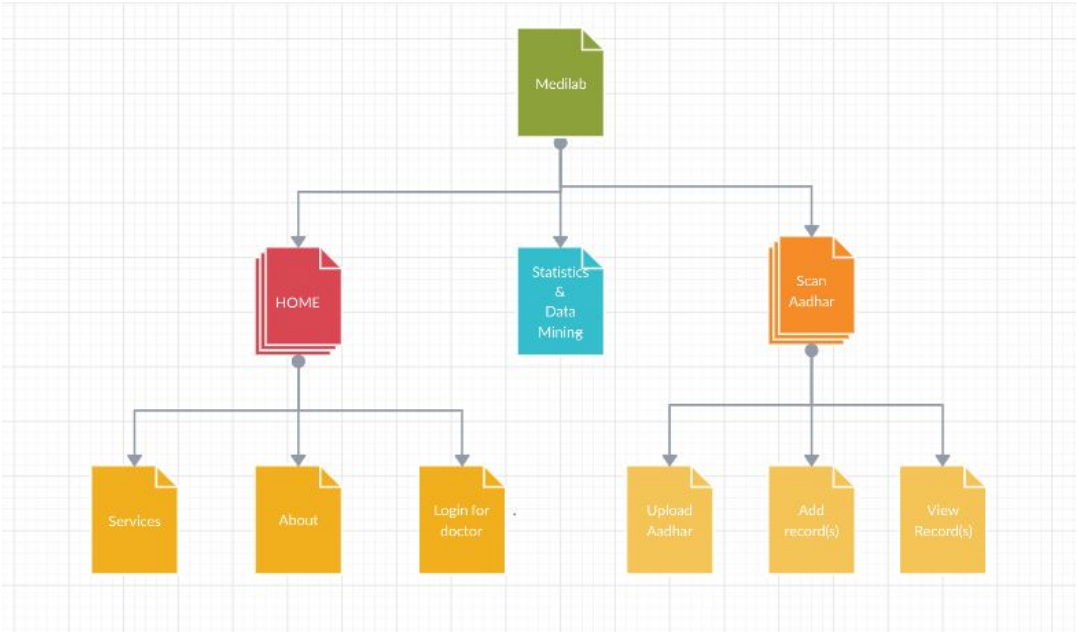

Figure. 3.5.1 Project Overview

Figure 3.5.1 .shows the idea that a prospective user of the system will choose his/her status to enter the relevant section of the website, each section is planned to have a login screen to filter out unwanted guests

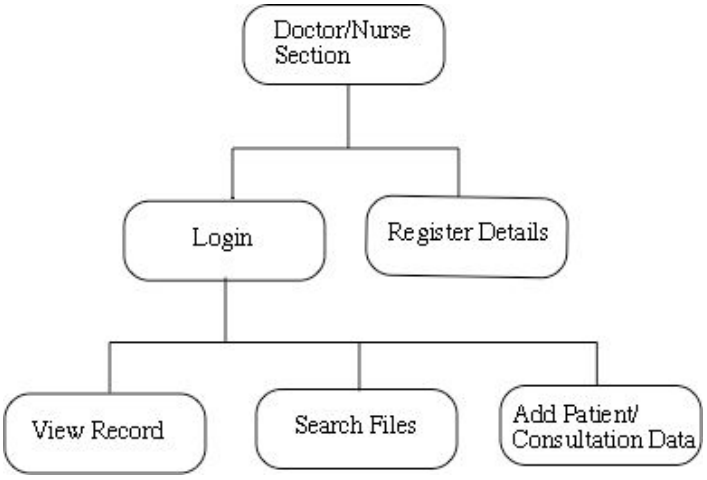

Figure . 3.5.2 Doctor Interface

Figure.3.5.2 shows the capabilities and sequence of events a healthcare worker goes through within the system where each bubble represents a new web page within the site.

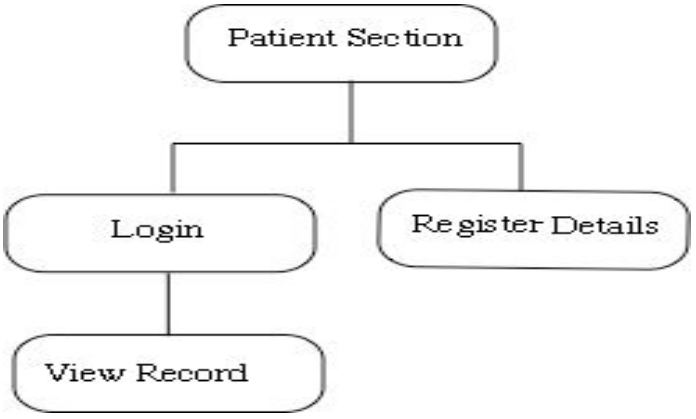

Figure. 3.5.3 Patient Interface

Figure.3.5.3 shows the capabilities a patient can use in the system, i.e. only view his/her record.

3.6 SYSTEM REQUIREMENT

3.6.1 HARDWARE REQUIREMENT

As the system is an electronic record management system, there will be some basic hardware requirements:

*A computer server with enough processing power: - Used to store all the E-Health Website files including the blockchain nodes (mining also included) where patient consultation and user data will be stored. This server will thus host the E-Health website for the healthcare workers to access.

*A Reliable ADSL router or other form of Internet connectivity: - This will be used in conjunction with the server so that the E-Health system is online at all times

3.6.2 SOFTWARE REQUIREMENTS

The software required in order to operate the E-Health record Management system is as follows:

*The Actual E-Health pages loaded onto the server: - This includes all the necessary interfaces that interact with the Health care workers and patients, as well as the back end administration system that deals with the user access controls

*Database software: - For storing the patient record, we have used Blockchain nodes keeping in mind the concept of security for this confidential data.
For storing the doctor's data , we used mongodb (mlabs)

Nodes form the infrastructure of a **blockchain**. ... They store, spread and preserve the **blockchain** data, so theoretically a **blockchain** exists on **nodes**. A full **node** is

basically a device (like a computer) that contains a full copy of the transaction history of the **blockchain**.

* Web server Software: - In order to host the Website server side software needs

to be installed. The web server directs all incoming traffic to the appropriate file by using the servers IP address.

3.7 DATABASE SECURITY

Entering in a username and a password accesses the mlab database located on the server in the encrypted form so as to prevent data leakage.
An admin user is created for a database that will handle all the operations of the database and is required to enter into the mlab server.

Public-key cryptography acts as the basic security foundation of any Blockchain network, ensuring the safety of Blockchain transactions by securely generating, using and storing the crypto keys is of paramount importance.


```
{
  "chain": [
    {
      "index": 1,
      "timestamp": 1589095419464,
      "transactions": [],
      "nonce": 100,
      "hash": "0",
      "previousBlockHash": "0"
    }
  ],
  "pendingTransactions": [
    {
      "amount": "200",
      "receiver": "553594266062",
      "age": "23",
      "symptoms": "Headache",
      "disease": "Headache",
      "treatment": "Paracetmaol",
      "location": "Delhi",
      "weight": "60",
      "url": "https://healthblock1.herokuapp.com/file-1589095580595"
    }
  ],
  "currentNodeURl": "https://healthblock1.herokuapp.com",
  "networkNodes": []
}
```


Figure. 3.7.1 Pending Transaction Response

Figure. 3.7.2 Transaction After Mining

3.8 CONCLUSION

The next step in the software development life cycle is to take all the design specifications outlined by the users and implement them in a working system. We feel confident that we have designed a system that would meet the users requirements and implementation can proceed.

CHAPTER 4

IMPLEMENTATION

4.1 INTRODUCTION

This section builds upon the preceding section's design specifications and outlines the steps we undertook to create a working system as well as illustrate the website's functions and features.

4.2 THE IMPLEMENTATION PROCESS

To begin the whole process all the necessary software needed to be installed onto our testing server. Once the Application is Deployed and configured, the tables outlined in the design chapter were created to store the data entered in by the website.

The next step was to create all the necessary AngularJS pages to be used as the website.

The website development was divided into four sections, namely

the patient access record section,

the Doctor system section,

the user registration/login section and the

admin section.

4.2.1 THE USER AUTHENTICATION SECTION

This section of the website deals with creating users that will use the system (i.e. the doctors and patients) thus web pages in this section interact with the users table created in the MYSQL database. The section also deals with verifying the users of the system so that there is a layer of security in place.

A simple login screen, was created prompting the user to choose the area of the website he/she wishes to visit.

Once the user chooses the appropriate link, he/she is redirected to the appropriate login screen.

Patients are prompted to enter their login details i.e. username and password, to access their own individual record. If they do not possess login information, they have to register their name in the system. A registration page was created, Figure 16, such that the patient enters all the required fields. The patient is stored in the system and their status is set to ‘patient’ meaning they only have access to their record and not the actual patient management system.

4.2.2 THE PATIENT RECORD ACCESS SECTION

Once a patient has logged into the system successfully, he/she can scan an aadhaar card to access his medical record and all previous vaccine, and drugs details.

Once the Aadhar card is uploaded through the UI to the server, our OCR api will come into play and will capture the Aadhar number linked with the doc uploaded.
This captured text will be the basis to fetch all records of the patient and also for all future transactions to be made in the blockchain nodes.
In nodes, the data is saved with reference to the Aadhar number of the patient.

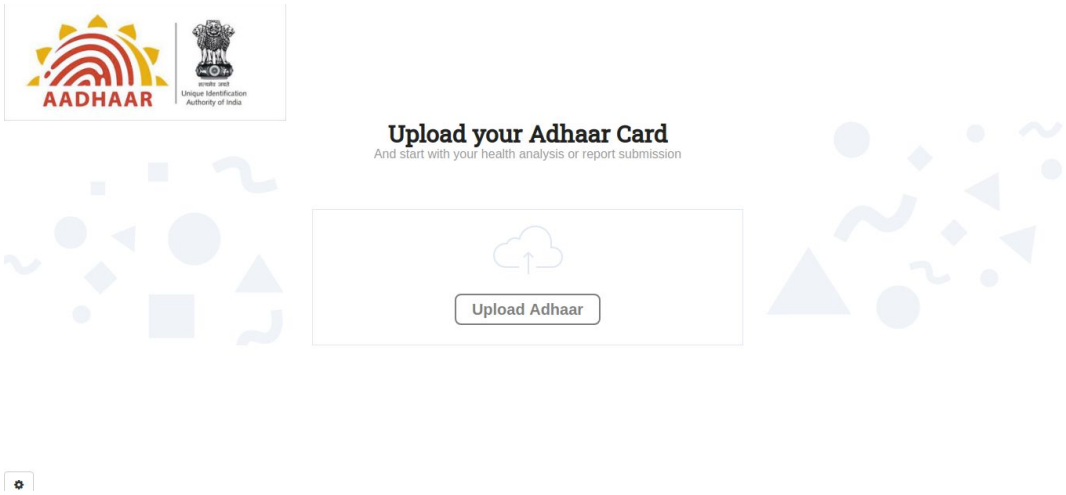

Figure. 4.2.2.1 UI of Uploading Aadhaar Card

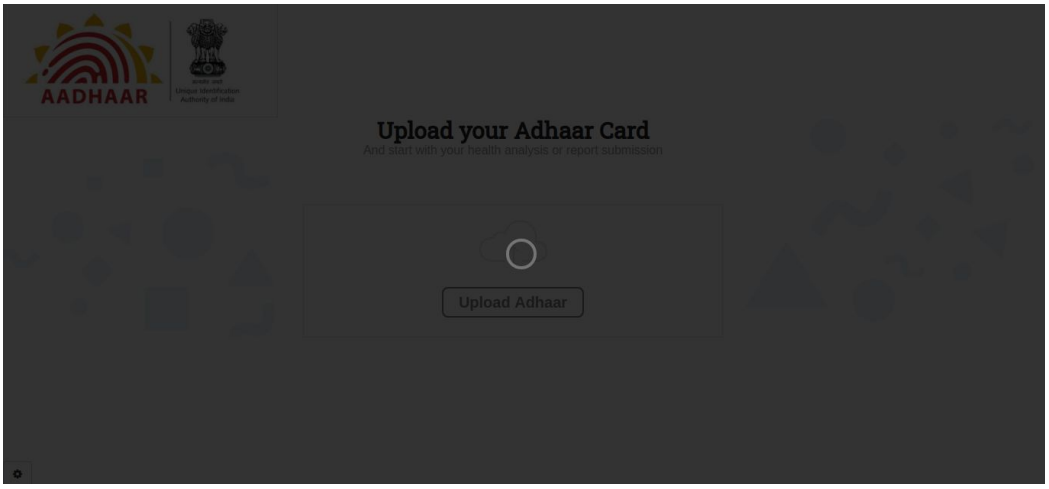

Figure.4.2.2.2 Aadhaar Card uploading

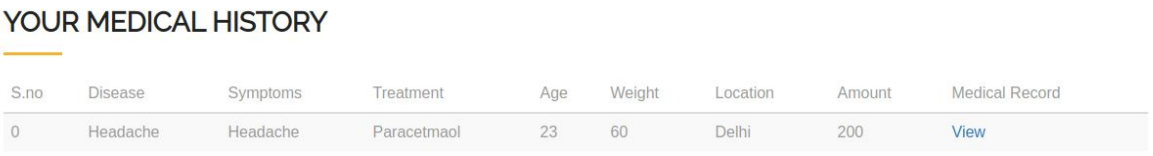

Figure. 4.2.2.3 Viewing Record

4.2.3 ADDING NEW RECORD

Only the Doctor account has access to add a new medical record of a particular patient.once a patient is logged in to the system successfully, he/she can scan an aadhaar card to access the patient medical record and all previous vaccine, and drugs details. Then he can add a new medical record that is linked with the patient's previous record.

As a doctor logs in into his/her account , a simple screen will be there having options to scan the Aadhar card of the patient.

As the scanning part is completed, all the records linked to Aadhar will be shown and an additional option to ADD RECORD will be shown asking for some basic requirements.
Once the requirements are filled by the doctor , he/she can save the details through a save button.

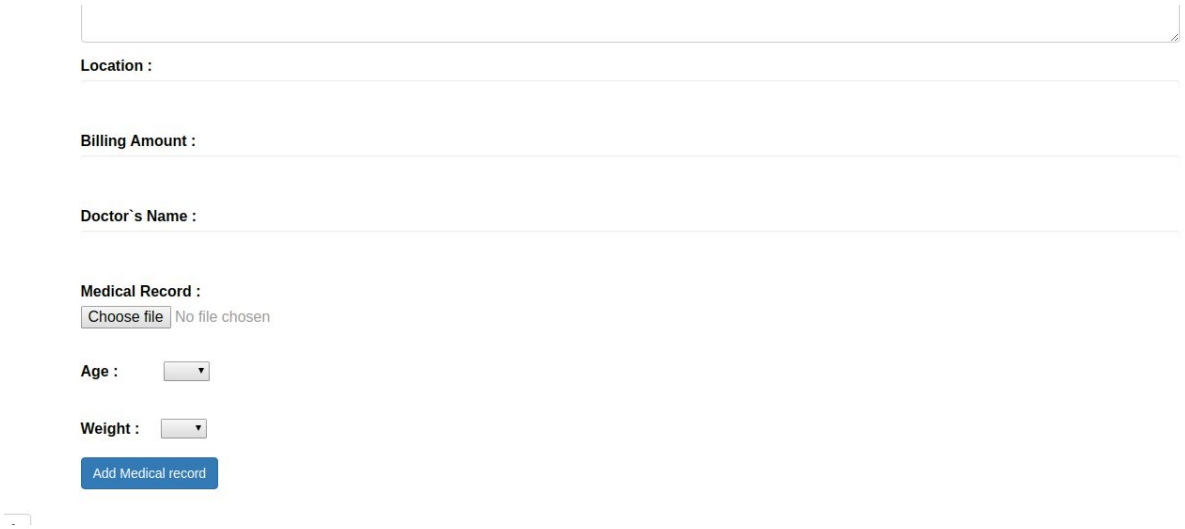

Figure .4.2.3.1 Adding New Record

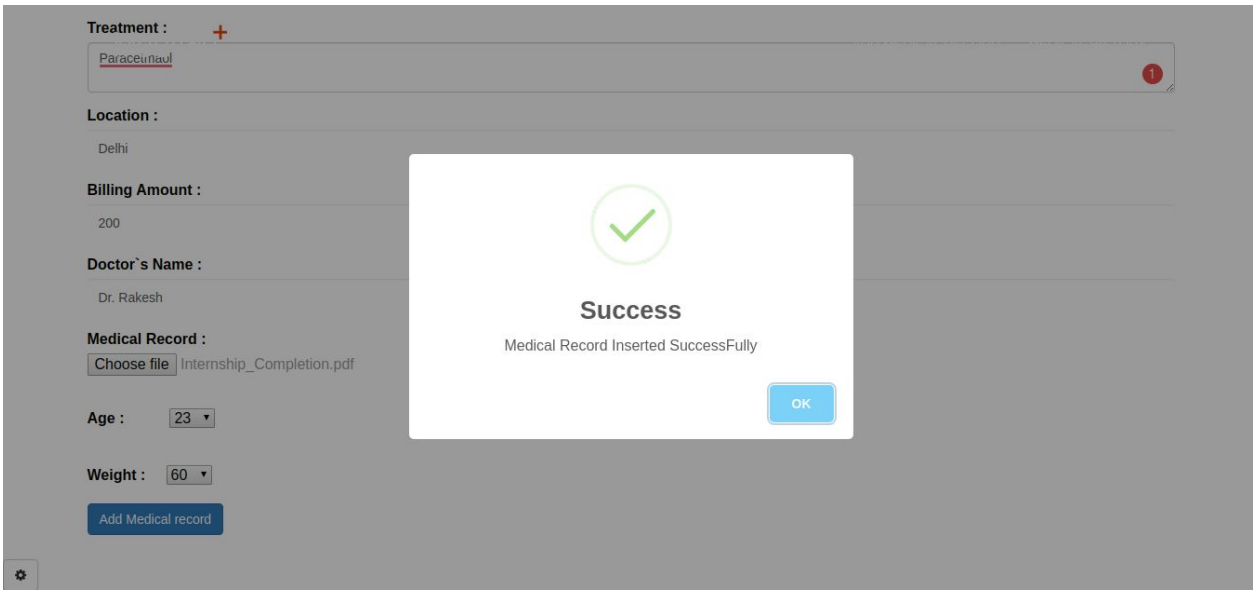

Figure. 4.2.3.2 Record Added Successfully

4.2.4 CHATBOT DEVELOPMENT

The Patient can talk to the chatbot and discuss his/her problem. The chatbot can suggest the patient according to its symptoms. The chatbot predicts the diseases according to the symptoms a patient is suffering from. The Chatbot even gives the treatment and remedies to take care of.

4.2.5 OTHER WEBSITE FUNCTIONS

Throughout the website other functionality has been implemented to make the website as user friendly as possible:

*Error screens when login has failed that link back to the previous page.

*A navigation bar within the system that stays constant throughout the session.

*A more aesthetically appealing and logical organization of the site when compared to the prototype.

* The ability to logout at any time

4.3 CONCLUSION

The implementation of our program has exceeded the criteria laid down by our design team, and we feel positive that we have solved the users' requirements for developing a useful system. The next step in the life cycle is to test our system in a variety of ways to ensure a stable environment, and to ensure that all user requirements are met.

CHAPTER 5

CONCLUSION AND FUTURE WORK

5.1 CONCLUSIONS AND FUTURE WORK

The original goal of the project was to create a system that would benefit health care workers and patients by providing a secure system to store the patients data. Personal details & medical history of a patient will be stored through a block chain to ensure security and decentralization. A doctor can access his patient account after scanning his Aadhaar card through his phone and can update or add a medical prescription along with his reports. This ensures that any patient's medical, treatment, medication, and vaccine records are tied to his Aadhaar card so that not only security and privacy can be achieved but also previous reports would be digitally available for the long-run in life. This also overcomes the problem of medical data of the patients being dispersed in various medical institutions. Thus, we can conclude that this model can create a revolutionary change in the Health-tech sector. In the near future, blockchain based medical networks can be established to associate various medical institutions. The main aims of the system were to have the ability to create, view and store patient records taking security into primary concern.

The major challenges in designing the system were working during the health workers Schedule. Most of the time they were understandably busy and we had to wait a long time before we could see them. It is also difficult to see that we have met all the requirements of one user as users often have differing views on how data should be presented and we were forced to compromise on specific aspects of the program.

5.2 SIGNIFICANCE OF THE PROJECT

The Application Developed illustrates how a web-based healthcare system would significantly help doctors to create and view patient's records and medical history. and Even Patient or his family member can view the previous medical history by just scanning an Aadhaar card. The fact that we used Open Source tools cut down the software costs tremendously and is important. Also we had used blockchain technology just to ensure the data decentralization and data security.

5.3 ACHIEVEMENTS

Health care workers and consulting staff were consulted on the design, implementation and monitoring of the priority of each module. So an effective plan is one they can enjoy using. The program achieves the goals of being able to create and manage patient records by simply scanning the Aadhar card, Show past medical history and provide a Machine Bot to communicate with the user (Patient) to collect symptoms and diseases.

The method we used was the iterative analysis, which we felt was the most effective method to use when designing our system. With each consecutive iteration, we were able to determine the user's specific needs and remove any bugs and unnecessary components to the system that might have been made during the upgrade. We believe that with our analytical process, we have developed an effective system that can be used in the Indian pharmaceutical industry today. The involvement of users was crucial in developing the plan and implementing the plan they wanted to implement and benefit from.

5.4 FUTURE WORK

While those who will be using the software recognize that the project is a success, there are still many activities that can be added to the project to improve it if there is more time to develop.

We would improve our Machine Learning Chatbot to give accurate results according to the symptoms. We will also gather the information of the medical record and diseases to know the overall health status of a particular demography.

Additional screening at the clinical environment may be possible; this will likely introduce new requirements that will require attention. A large number of patient records will also need to be added to the database to see if the system can handle large loads as there can actually be thousands of files that can be stored and maybe even more.

Future work involves the deployment of the original system within Hospitals. We will do this by first submitting the current data they have in paper form to the data. To do this we need to get permission to assure the hospital that the information will be kept confidential, which we obtained during the course of the project. The next step would be to physically enter the records by scanning the card. Of course, the money will need to be earned to achieve this and will happen by creating a business case document to present to potential plan investors.

The health care administration procedures in India is backward when compared to first world countries, and we believe that by implementing this system, we could help improve hospitals and clinics throughout the Country.

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