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# **PROJECT REPORT**

## **SOFTWARE ENGINEERING**

### **CSE 3002**

**Health Care Application**

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# **1. Introduction**

## **1.1 Theoretical Background**

A dull and monotonous waiting hall, the long queues, desperation to get inside the doctor's chamber, gloomy faces of ailing patients; this is the picture one would imagine maybe a decade ago while paying a visit to a hospital.

However, in the recent times, the scenario has drastically changed and most of this credit goes to the information technology industry for introducing the booming healthcare apps. We can put it like this that the healthcare apps have been the vital forerunner for transcending and reversing the condition of medical and healthcare industry.

Today's era of internet and with Smartphones reaching to every nook and corner, people living in rural and far-flung areas can also expect to get best health services. The on-demand apps help them to book appointment with doctors and buy medicines online without having to travel to the hospital.

The patients are the ones who receive the most benefits of the healthcare apps whether it is scheduling a quick appointment with the doctor, finding an appropriate specialist with hands on experience, viewing the medical test reports from labs online, and many other services. Hence healthcare applications have become an integral part of all our lives

## **1.1 Motivation**

Health care problems faced in the rural areas, and unavailability of support has led to many deaths in the recent years. Also, when a person is on a visit to a foreign place, any medical emergency might put him in false position. Hence this app has been crafted to suit and meet the needs of the people. It is user friendly, supportive as well as a regular digital nurse. This app has been developed to cater to most frequently occurring medical requirements.

## **1.3 Aim Of The Proposed Work**

The app aims at making medical facilities feasible and accessible to all users irrespective of their position. It is developed to resolve medical hindrances to people at unknown places, and to the people who don't know what to do and where to go in an emergency situation.

## **1.4 Objectives of the Proposed Work**

- To allow users to create their accounts and enter their medical data.

- To help users to keep a track of their data on a monthly basis.
- Watson Chatbot Integration, backed up by a 24hr live medical practitioner to assist the user. The user is also directed to a Slack Channel for the app, where he can directly converse with Watson.
- To provide a feature of auto detection of the users' geo-location and displays all health centres that are present in 1 km radius area around the user.

## **1.4 Report Organization**

The report will be giving us an idea of all similar applications and how this particular application stands out from the rest.

Followed by this, we will make a requirements Analysis and Design for the proposed system including the requirement analysis, requirement specification and verification, and functional as well as non-functional Requirements. This will be followed by the design of the proposed system, the architectural model and also the proposed process flow model. This is followed by a highlevel design and a corresponding detailed design for the same.

The design phase is followed by implementation and testing, and finally concluded by specifying the limitations and further scope of the project.

## **2. Literature Survey**

### **2.1 Survey of the Existing Models/Work**

There are an innumerable number of healthcare applications existing in the current world, some of them oriented for mobiles and other pocket devices, the others serving users on the computer, and quite a couple of them as REST APIs which can be integrated into other applications. Some of the existing applications are listed below.

A tool like the Isabel Symptom Checker lets you gain access to a service previously used only by the medical community. It empowers patients to research and find potential causes for their symptoms, all with a few taps and swipes. According to the Economist, the average cost of someone staying the night in a hospital is \$4,300, in UK. Dr. Now is an app that allows patients to connect with their physicians over their smartphones through a video consultation. A recent MedPanel survey showed that just 15% of all doctors in the U.S. are even discussing medical apps with their patients. Whether these doctors aren't aware of the patient demand for

these apps or simply don't want to give up more control to patients is debatable.

The usability of medical apps is getting to the point where entire tests that you once had to go to your doctor to do can now be done right through your smartphone. Simple attachments are usually all that it takes to supercharge your phone into a portable laboratory of sorts. This can help save lives, as some blood tests center around life-and-death matters. Think about cases involving possibly fatal viruses like HIV, as well as routine checks for monitoring one's blood sugar. According to reports, these ingenious and convenient smartphone attachments won't be any larger than a card reader, further adding great value to the patient's UX.

Here are the most popular medical apps that users generally download:

- Weight loss (50 million)
- Exercise (26.5 million)
- Women's health (10.5 million)
- Sleep and meditation (8 million)
- Pregnancy (7.5 million)
- Tools and instruments (6 million)
- Other (18 million)

## **2.2 Summary/Gaps identified in the Survey**

The survey is has been mostly limited to apps being used in the United Kingdom and the survey results may vary widely if conducted in a different country, or in India due to shift in the stakeholders, or rather the people who would be benefited by the app.

## **3. Proposed System Requirements Analysis and Design**

### **3.1 Introduction**

The purpose of the Software Requirements Specification is to describe the specific requirements of the Health Care Project. Included with the

description of the requirements is a description of any constraints or assumptions that the project is working within.

This document also provides a description of any project dependencies that need to be explicitly expressed. It describes the overall constraints that the project is working on as well as the assumptions made while building the project and analyzing its requirements. Along with the requirements descriptions, it is also the purpose of this document to describe any performance requirements that need to be met. If there are any standards that need to be considered when developing the software are also listed.

Lastly, the purpose of this document is to communicate the system attributes of the Healthcare application. Design constraints and standard compliance are also considered in this section. It deals with the performance requirements that are implied. These system attributes include reliability, availability, scalability, maintainability, and portability.

## **3.2 Requirement Analysis**

### **3.2.1 Functional Requirements**

#### ***3.2.1.1 Product Perspective***

The Health Care application that is to be designed aims at assisting users to initially deal with their health problems and then contact nearby hospitals and make appointments for the same. We are aiming to incorporate a chatbot to put panicking users at ease. The Healthcare Application and its requirements are only pertaining to the functionality needed to implement the Healthcare Application. This software is being developed in increments, and is not being programmed to detect diseases from symptoms. An API can be integrated at a later incremental stage judging by the financial budget and time availability.

The software will be requiring permissions and access to the user's device location to track the current GPS and locate nearby hospitals. For the same purpose, hospitals have to be contacted and they need to give accent to participate in this application's search program.

#### ***3.2.1.2 Product Features***

## **Maintaining Record Of User-Health information**

The application will provide users with an interface to update their health related information such as blood pressure, pregnancy and other information, and constantly keep track of the changes that happen with a progress graph.

### Functional Requirements

- *Purpose:* Maintaining a record of health information for users and continuously track changes.
- *Input:* Constants fed by the user, based on his health information.
- *Processing:* The data entered by the user will be stored in the database, and also processed to notify irregularities in the changes
- *Output:* An output/ prediction that shows the changes trends of the user's health conditions in the form of textual output or graph plots.

### Stimulus Response:

User Actions	System Actions
(1) Fill in data as per as the form provided	
(2) Press Submit	
	(3) Detect anomalies in the data entered
	(4) Ask user for confirmation of data
(5) Confirm/Decline and re-edit	
	(6) On confirmation ask user whether he wants to view a feedback report as per as his entered fields
(7) Confirm	
	(8) Display a feedback report

## **Chatbot Implementation and General Symptom Prediction**

The software helps diagnosis ordinary ailments from symptoms with the help of an external API.

### Functional Requirements

- *Purpose:* Diagnosis of ailments with the help of an external API
- *Input:* Comma separated symptoms in the form of textual entry.
- *Processing:* The feed thus generated is sent to an external API for processing.
- *Output:* The output obtained from the API is displayed

### Stimulus Response

User Actions	System Actions
(1) Enter comma separated symptoms of the ailment	
(2) Press on Submit button	
	(3) Verify format of data
	(4) Send raw data to external API
	(5) Retrieve feedback/ output from the API
	(6) Display the output on the frontend GUI

## **Contact and Make Appointments with Nearby Hospitals**

This feature will capture the user's device location and locate hospitals around a said kilometre radius. After location of the hospitals, the user is free to make appointments in any one of these hospitals. The user can avail the contact details and directly contact the aforementioned health centres .

### Functional Requirements:

- *Purpose:* To facilitate users to make appointments to nearby hospitals in case of emergency conditions.
- *Input:* User click on locate hospitals, to generate list of nearby hospitals, then choose a hospital where the appointment should be made.
- *Processing:* The Google Geolocation API is used to track the user's location and also facilitate making appointments to the hospitals.
- *Output:* A list of nearby hospitals is provided along with their contact details.

### Stimulus Response

User Actions	System Actions
(1) Give permission to the app to track your location.	
	(2) Location of user device tracked using the Google Geolocation API
	(3) System checks for all health centres present in a 1 km radius around the user's location
	(4) Display list of all the available health centres along with their contact details, fetched from the database
(5) Choose which health centre to make an appointment at	
(6) Confirm Health Centre	
	(7) System contacts corresponding health centre

### ***3.2.1.1 User characteristics***

The HealthCare Application is using an external API, and Watson chatbot, and a rudimentary database to implement the required functionality, which has placed certain design constraints on the design of the application. The table below lists those design constraints.

USER	DESCRIPTION
Client	The client is anyone who uses the app for personal purpose, and with a motive to lead a healthy lifestyle. The clients can be users from all backgrounds. Because of this, the system should be easy to use and user-friendly and should conform to commonly understood user interface styles for wide acceptance
Hospital Manager	The hospital manager is a person from each hospital who moderates the incoming appointments made from the app and simultaneously accepts or declines them. This group is only consisted of professional people or people who have expertise in the medical field
Moderator	The moderator is a person who checks all incoming requests and outgoing requests to and from hospitals and manage records. He is also a professional and should be literate and technically competent in performing administration on computer systems

### ***3.2.2.2 Assumption & Dependencies***

The following table lists the assumptions made by the requirements that have been made in the Healthcare Application Software

<b>Assumption</b>	<b>Description</b>
Secure Channel from User to Hospitals	The defined requirements assume that there is a method for secure transfer of information between the client and the hospitals
Secure Encryption of Personal Data	Personal data that is fed into the database is encrypted with a secure algorithms to prevent unauthorized access to data

### ***3.2.2.3 Domain Requirements***

Domain requirements reflect the environment in which the system operates so, when we talk about an application domain we mean environments such as train operation, medical records, e-commerce etc.

Domain requirements are important because they often reflect fundamentals of the application domain. If these requirements are not satisfied, it may be impossible to make the system work satisfactorily. We would also require a domain name to establish the application.

### ***3.2.2.4 User Requirements and Product Specific System Requirements***

#### ***Requirements***

The following is a table of the requirements that the system SHALL meet. The list of the requirements was produced from the initial project documentation provided by the requirements experts.

ID	Origin	Shall Requirement
1	Project Description Document	The client shall be able to maintain his/her own account in the application
2	Project Description Document	The client shall be able to maintain his/her medical database, for reference and application function assistance.
3	Project Description Document	The client shall be providing its device location to the application to help it track and locate nearby hospitals
4	Project Description Document	The client shall be able to update and record his/her health information like Blood Pressure and PR.

5	Project Description Document	The client shall be able to feed in the symptoms for further medical analysis and diagnosis of ailment
6	Project Description Document	The client shall be able to speak with a chatbot
7	Project Description Document	The client shall be allowed to locate the details of the hospitals in a 1km radius
8	Project Description Document	The client shall be able to make appointments with the said hospitals in a case of an emergency
9	Project Description Document	The hospital management staff will be able to authorize the appointments.

### 3.2.2 Non Functional Requirements

In systems engineering and requirements engineering, a **non-functional requirement** (NFR) is a requirement that specifies criteria that can be used to judge the operation of a system, rather than specific behaviors. They are contrasted with functional requirements that define specific behavior or functions. The plan for implementing *functional* requirements is detailed in the system *design*.

#### Reliability

Reliability in the HealthCare software will be ensured by thorough unit, milestone, and release testing. Comprehensive test scenarios and acceptance criteria will be established to reflect the necessary level reliability required of the HealthCare Application . The all delivered source code will be thoroughly tested using the established test scenarios until the acceptance criteria are satisfied by the HealthCare Application .

#### Security

The HealthCare Application software will utilize Pa secure key encryption strategy. Every medical record entered shall be securely encrypted.

#### Maintainability

Along with the well-formed programming enforced by Python, best practice development conventions will be enforced for the construction of the HealthCare Application . These will include adequate commenting within the source code that complies with and uses the automated Python documentation standard so that source code documentation will be able to be automatically generated. Consistent variable naming conventions will be used by all the programmers. Consistent spacing will be used in the source

code by all the programmers. The design of the source code will use the principles of Object-Oriented Design and the source code will be programmed using Object-Oriented Programming. Object-Oriented Design and Object-Oriented programming will make the code easier to understand.

### **Portability**

As mentioned above, the HealthCare Application will be written in Python and gain the portability providing by that language. It is safe to say that the implementation of the HealthCare Application will be able to be ported to other system platforms that accept Python applications with little to no changes required. It is not safe to say that the HealthCare Application will execute properly on the other system platforms with little or no change. Significant changes to the HealthCare Application may be required to ensure proper execution on other system platforms.

### **3.2.3. System Requirements**

#### ***3.2.3.1 H/W Requirements(details about Application Specific Hardware)***

This project has no specific hardware requirements. It only requires a personal computer with a decent processor and a network connection to work.

#### ***3.2.3.1 S/W Requirements(details about Application Specific Software)***

The project requires a stable web browser, preferably the latest version of either Google Chrome or Mozilla Firefox, along with access to certain APIs which have already been looked into using API calls. This project also involves node modules (dependencies) which need to be installed in the computer before locally running the application.

## **4. Design of the Proposed System**

### **4.1. Introduction**

The purpose of the Software Design Specification is to describe the specific design of the Health Care Project. The specification includes an overview of the design along with software module decomposition

This document provides a detailed description of each software module's design. For each module, a user interface design and class diagram design is given. As well, a process description is described for each module. It is in the process description that the details of what logic will need to be implemented are given.

## 4.2. High level Design

### 4.2.1 Software Model

#### Incremental Process Model

The project that I have chosen will be done using incremental process model. The given project has several complicated functionalities which can be broken down and grouped in accordance with the priorities of the user. For eg, the landing page and the other static pages can be grouped together, Watson chat bot in another, and finally the functionality to view and make appointments in another model. A partial implementation of the total system is constructed first, and then gradually increased functionalities are added.

The following are the planned increments for the project:

1. *1<sup>st</sup> increment: Basic rudimentary functionality, with a functioning user interface, which are most important and also easy to be implemented.*
  - a. User login/ signup
  - b. Entering, as well as maintaining their medical records
  - c. Viewing nearby health centers
2. *2<sup>nd</sup> increment: Slightly complex functionalities*
  - a. Making appointments to the hospitals
  - b. Viewing appointments that they have made
3. *3<sup>rd</sup> increment: Functionalities to enhance user experience and interaction with the GUI*
  - a. Implementation of a Watson Chatbot for customer interaction
  - b.

#### **The other models were deemed as unsuitable for the following reasons:**

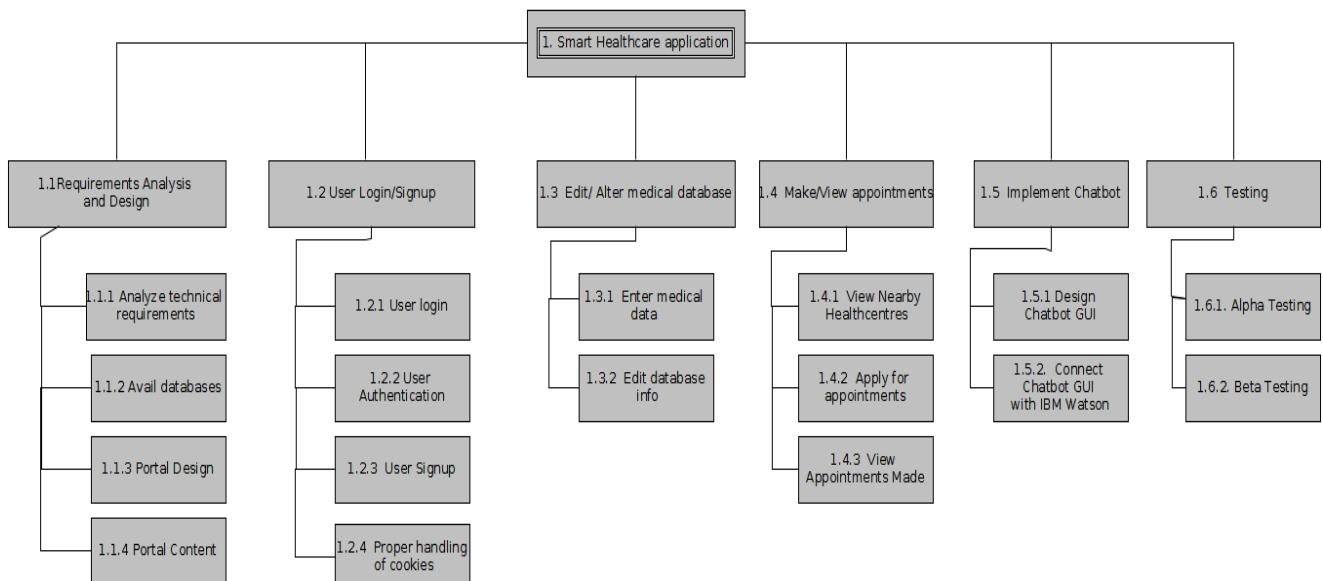
- The waterfall model was considered as unsuitable because it didn't have flexible partitioning of the work in stages, and also, given the project had some complex requirements which haven't been phased out properly
- There isn't any adequate technical advice for risk analysis. Also, it requires a high administrative overhead

- Component Based Software Engineering model wasn't suitable because of the unavailability of components
- Prototyping model was deemed unsuitable for the purpose because the requirements as well as the resources of the project are clear.

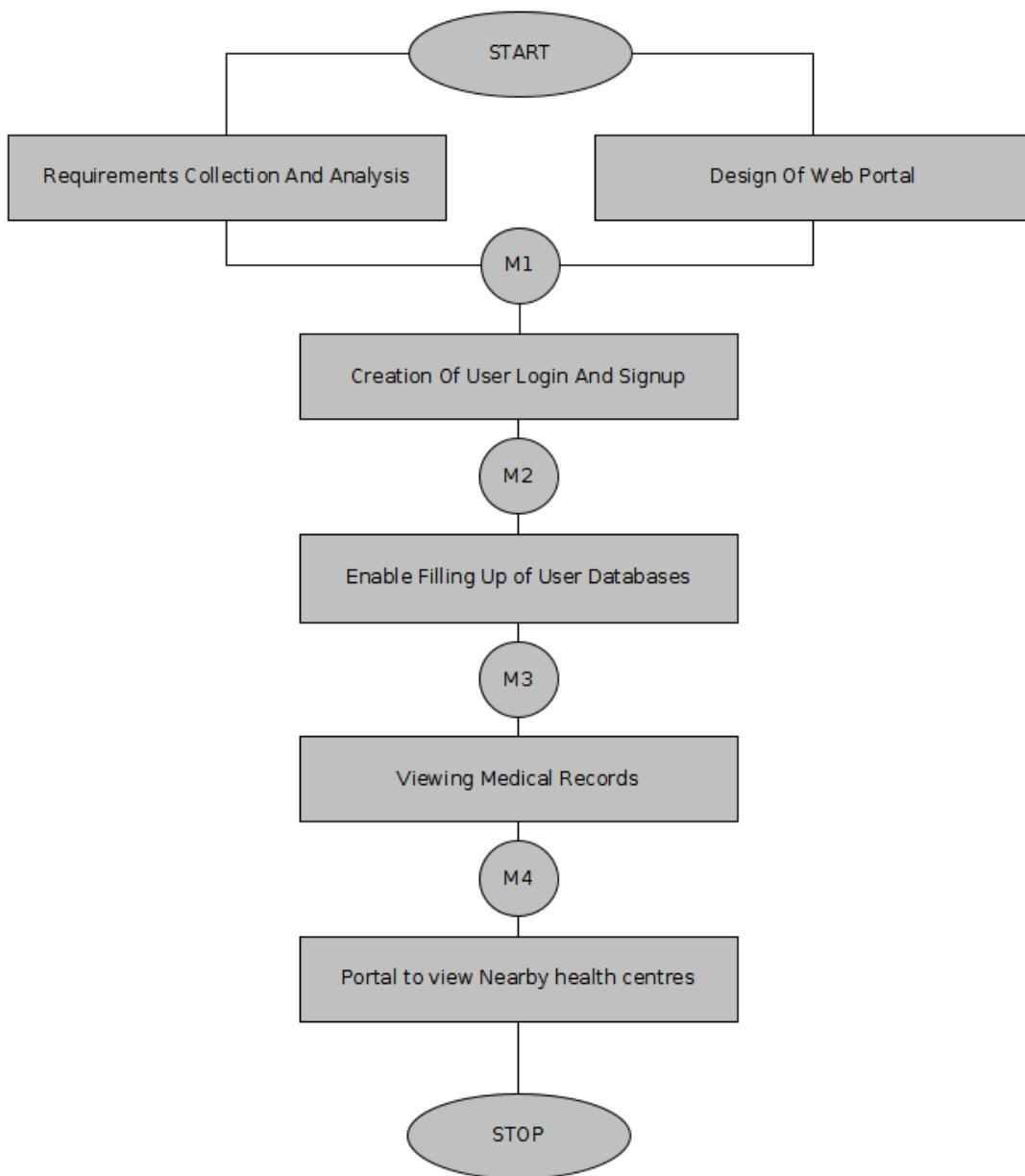
### **4.2.2 Module Decomposition**

The HealthCare application has been decomposed into the following modules:

- User Login/Signup and Data Authentication module: Allows the user to login/signup using his credentials
- Edit/Alter Medical database module: This allows the user to feed the database with details about his medical history.
- Make/View Appointments Module: This module allows to track all nearby health centres and allows the application to make appointments on the behalf of the user.
- Chatbot Module: This module involves a basic chatbot powered by IBM Watson.

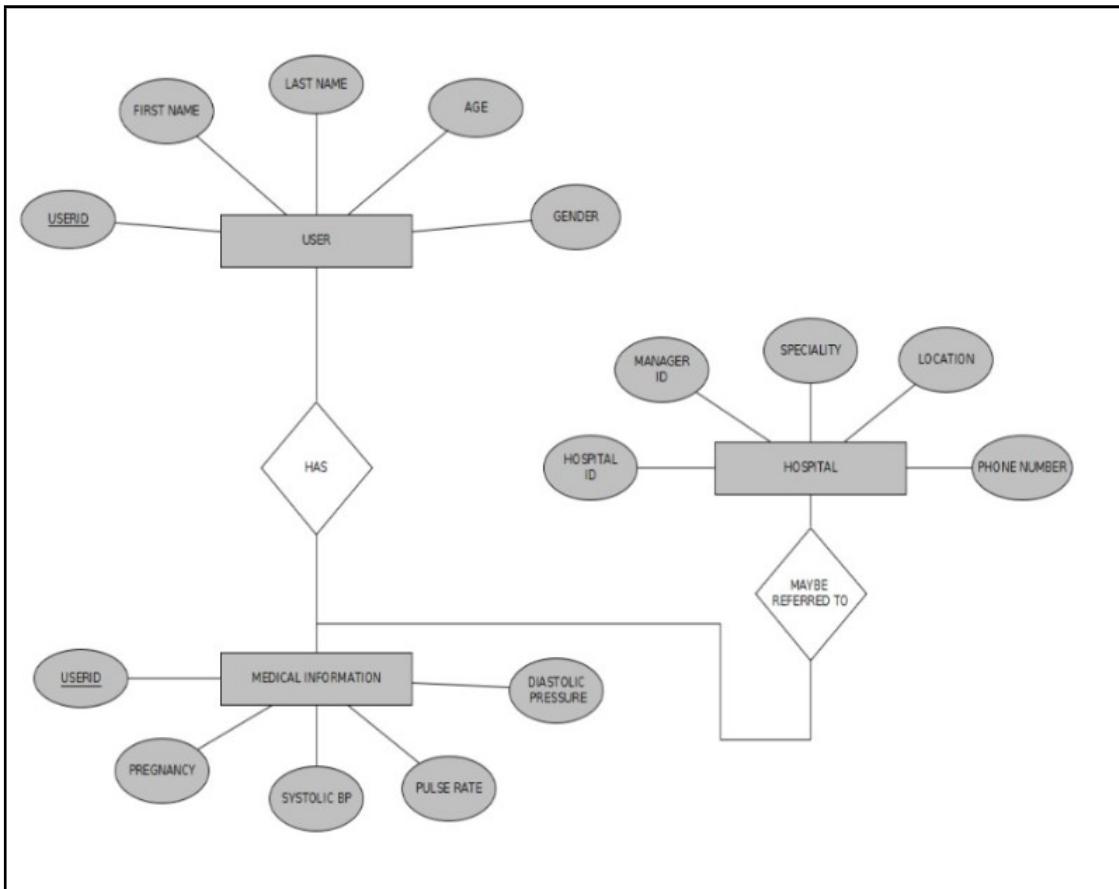


### 4.2.3 Activity Network

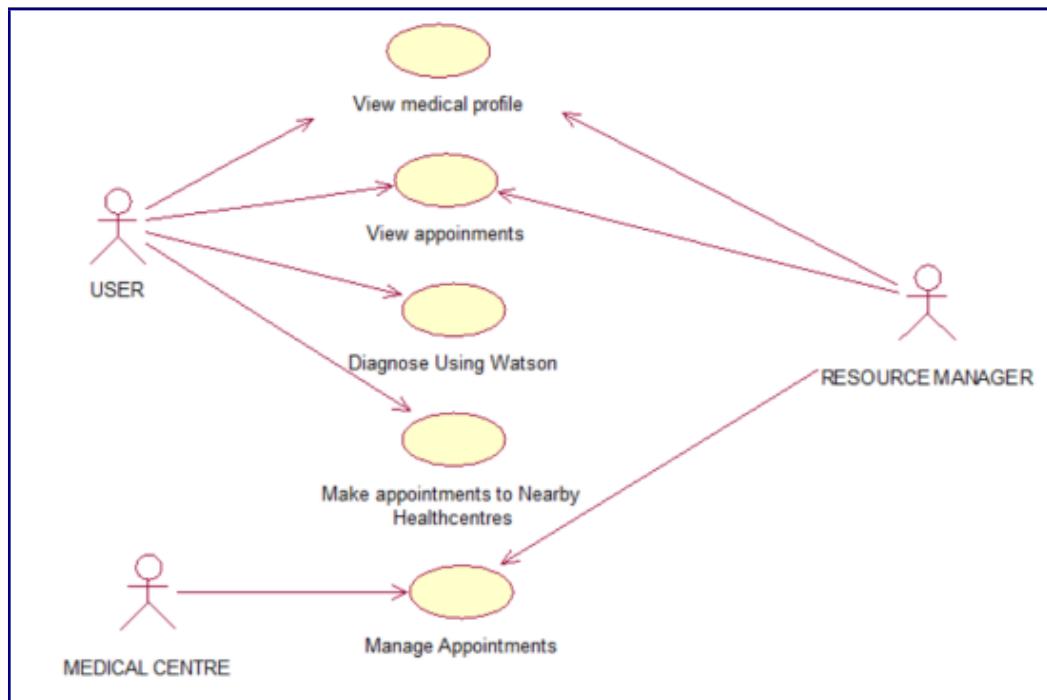


### 4.3. Detailed Design (ER Diagram/UML Diagram/ Mathematical Modeling)

#### **4.3.1. ER Diagram**



#### **4.3.2. Use-Case Diagram**

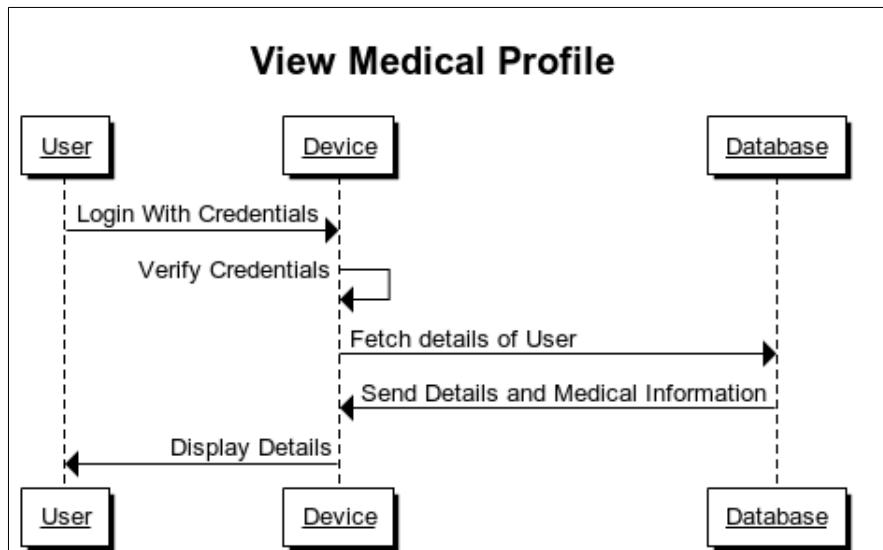


#### **4.3.2. Sequence and Collaboration Diagrams**

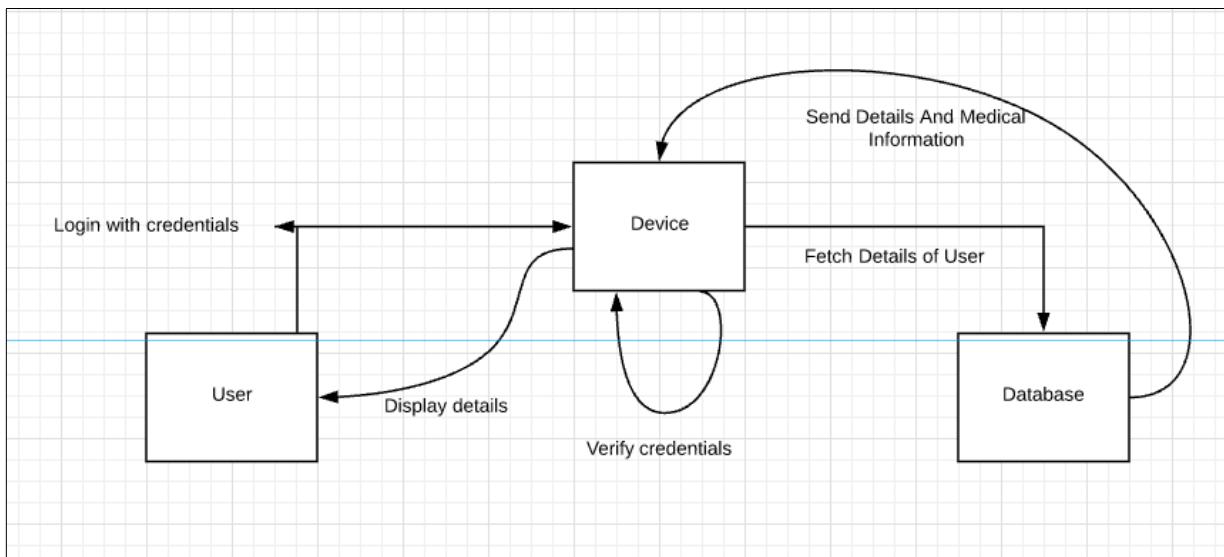
For Given Components In the Use case Diagram:

##### **View Medical Profile**

###### *Sequence Diagram*

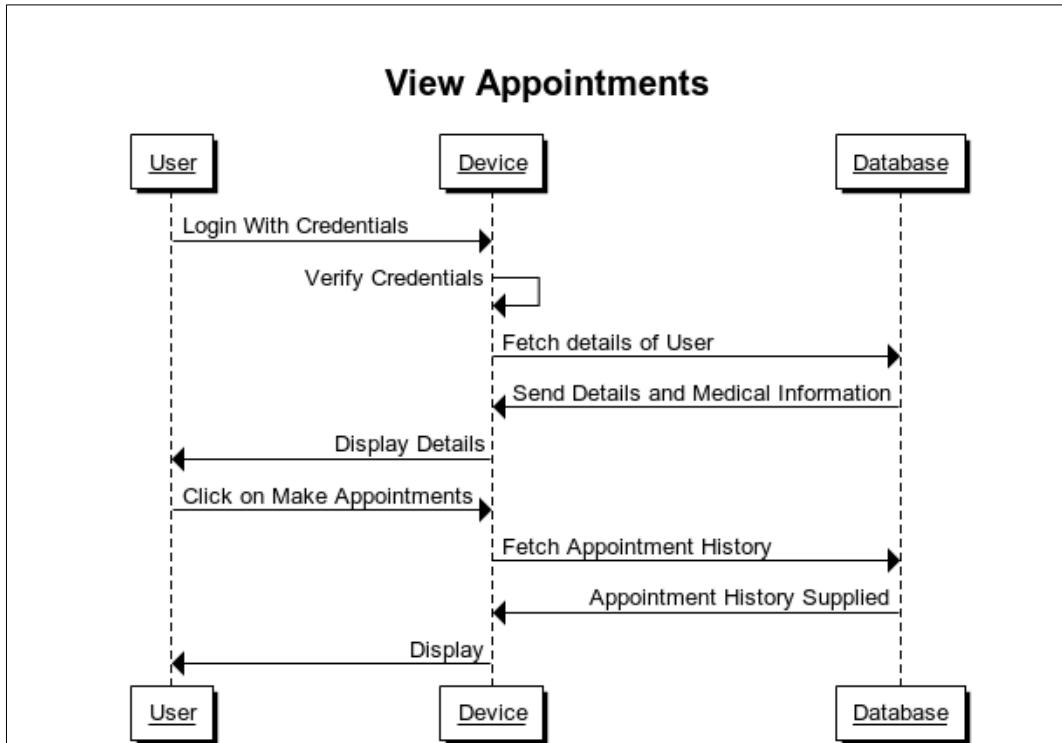


###### *Collaboration Diagram*

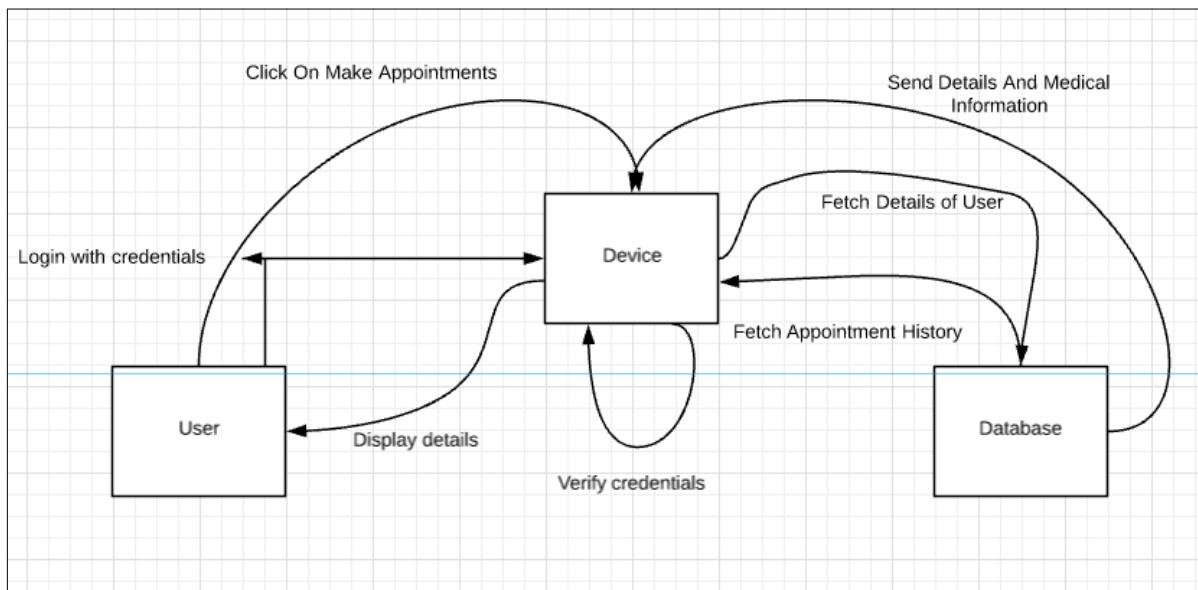


## **View Appointments**

### *Sequence Diagrams*

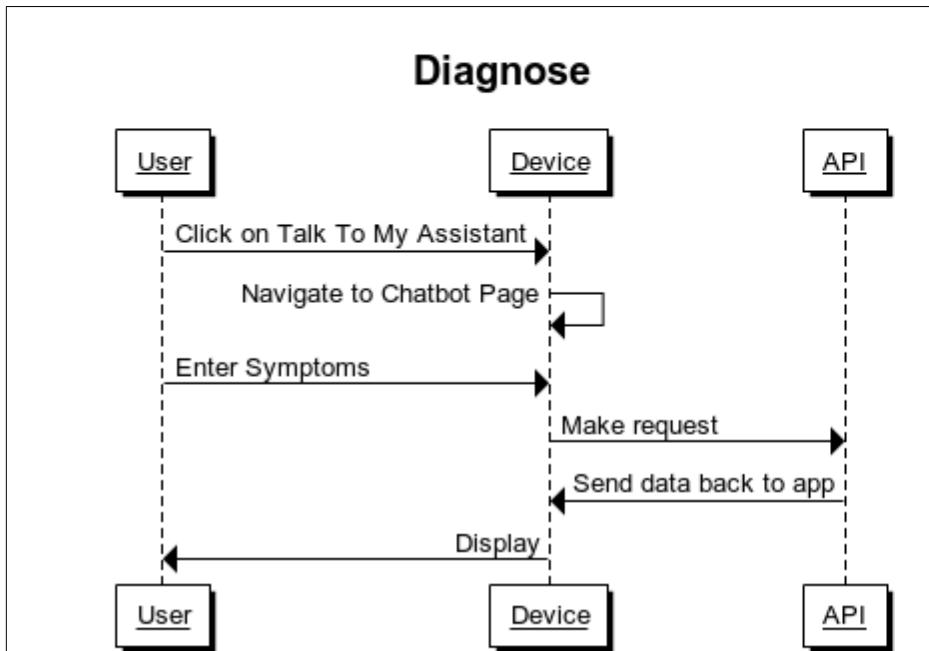


### *Collaboration Diagram*

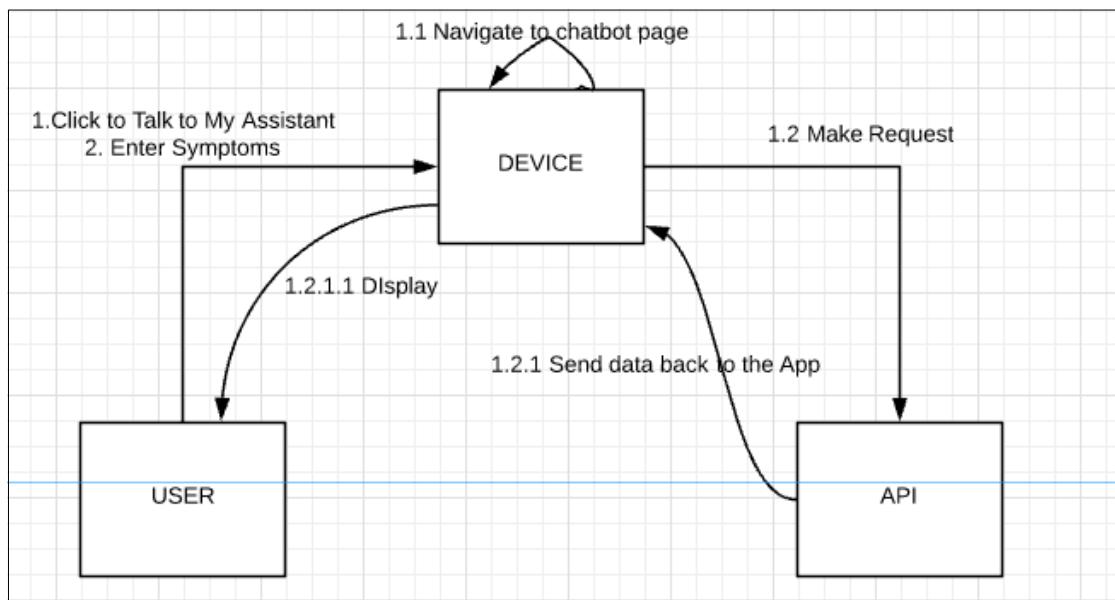


## **Diagnose Using Integrated API**

### *Sequence Diagram*

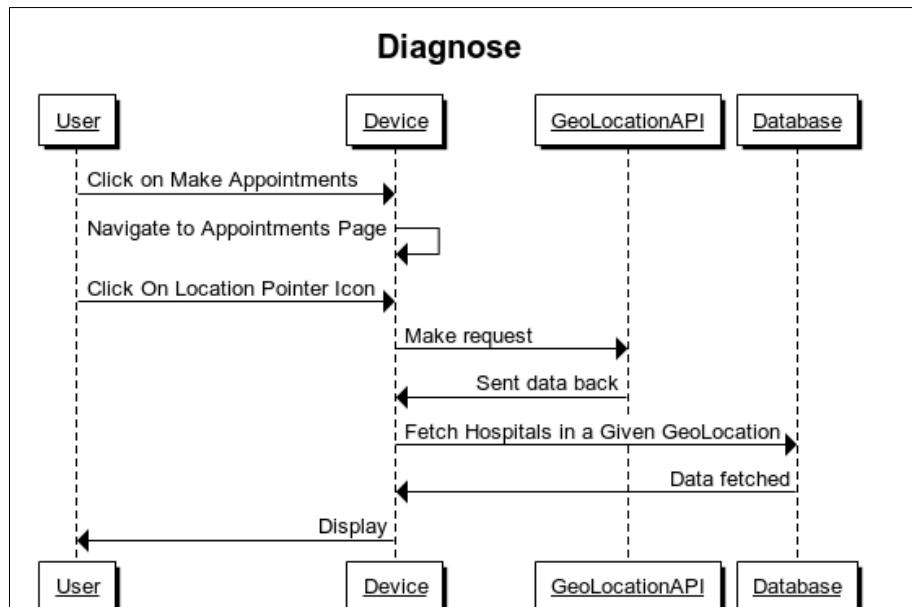


### *Collaboration Diagram*

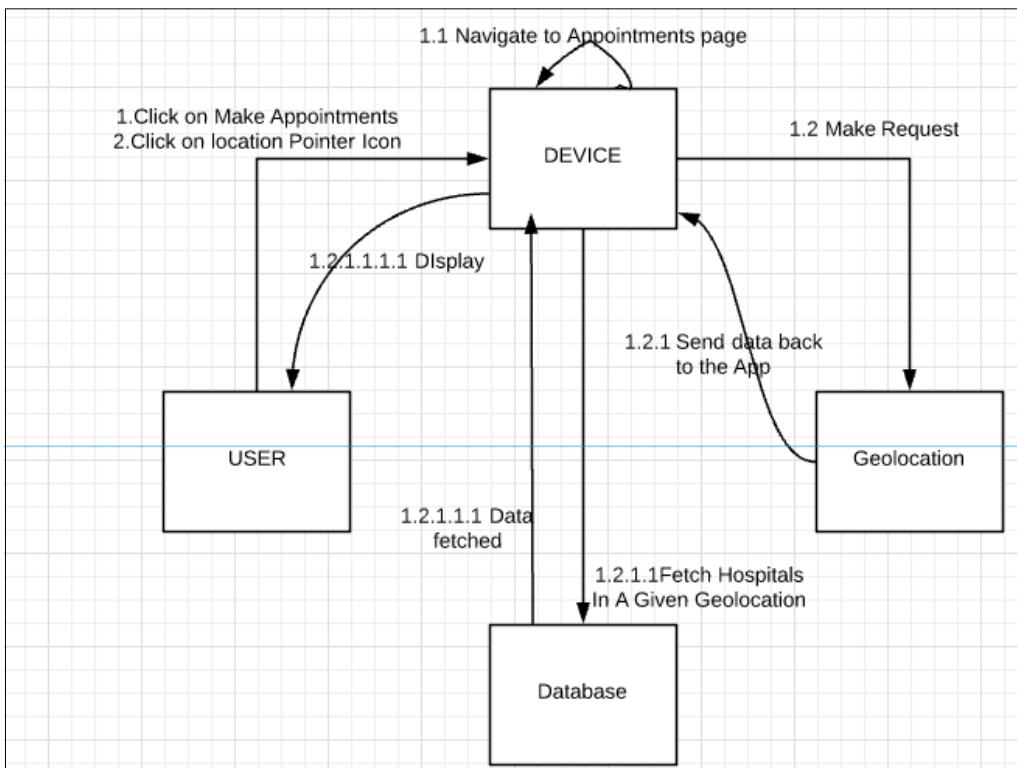


## Make appointments to nearby Health Centers

### Sequence Diagram

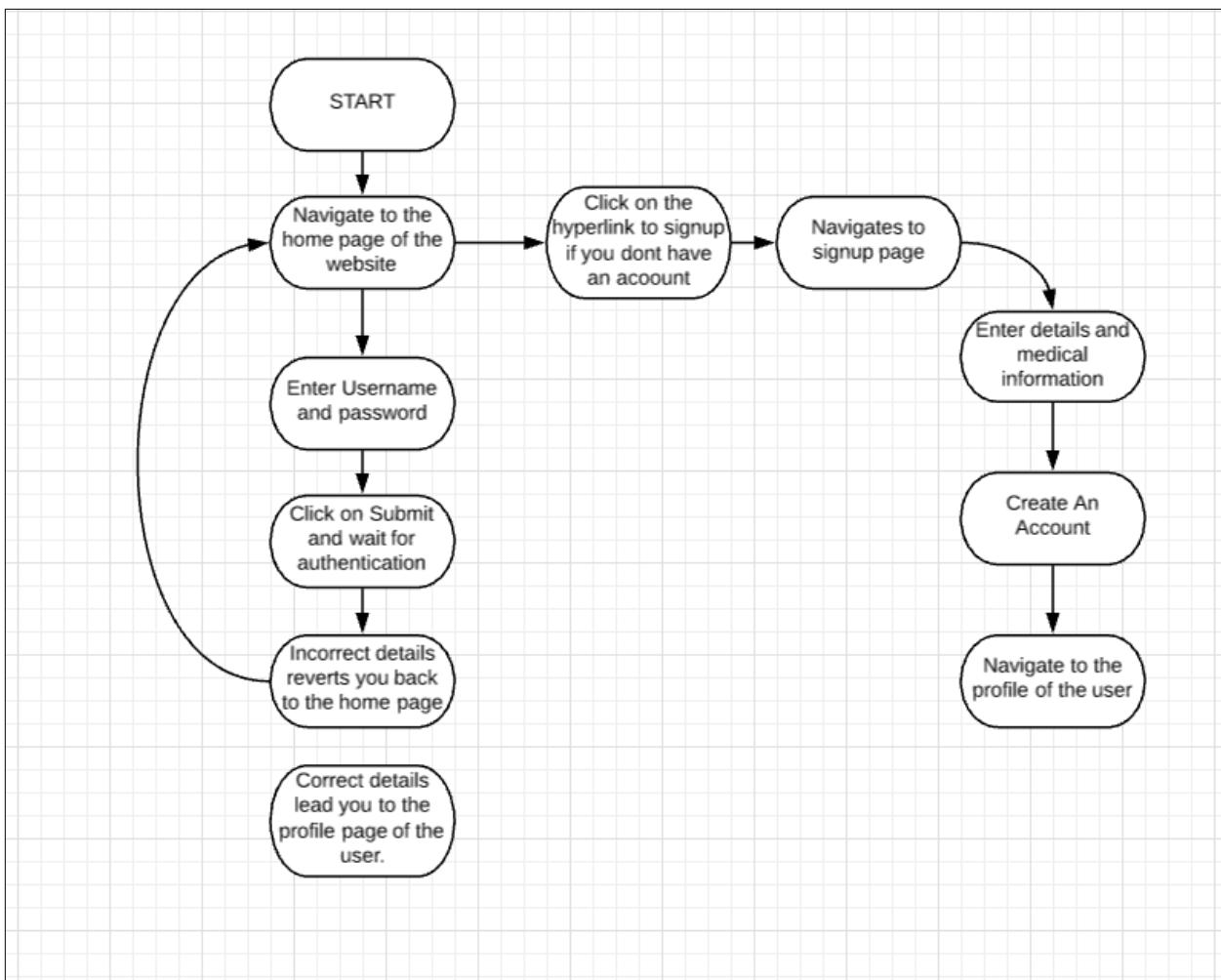


### Collaboration Diagram

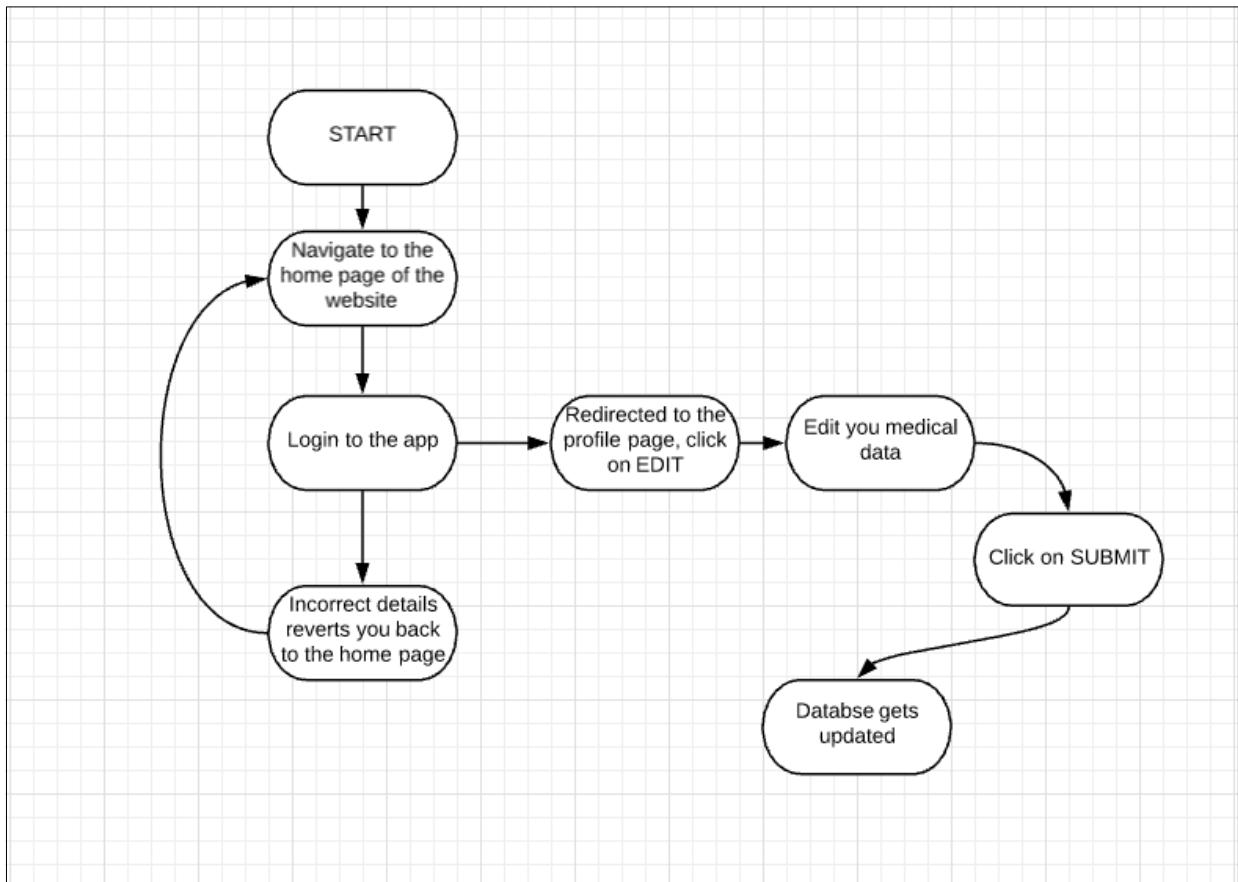


### 4.3.3. Detailed Descriptions and Activity Models For Major Operations

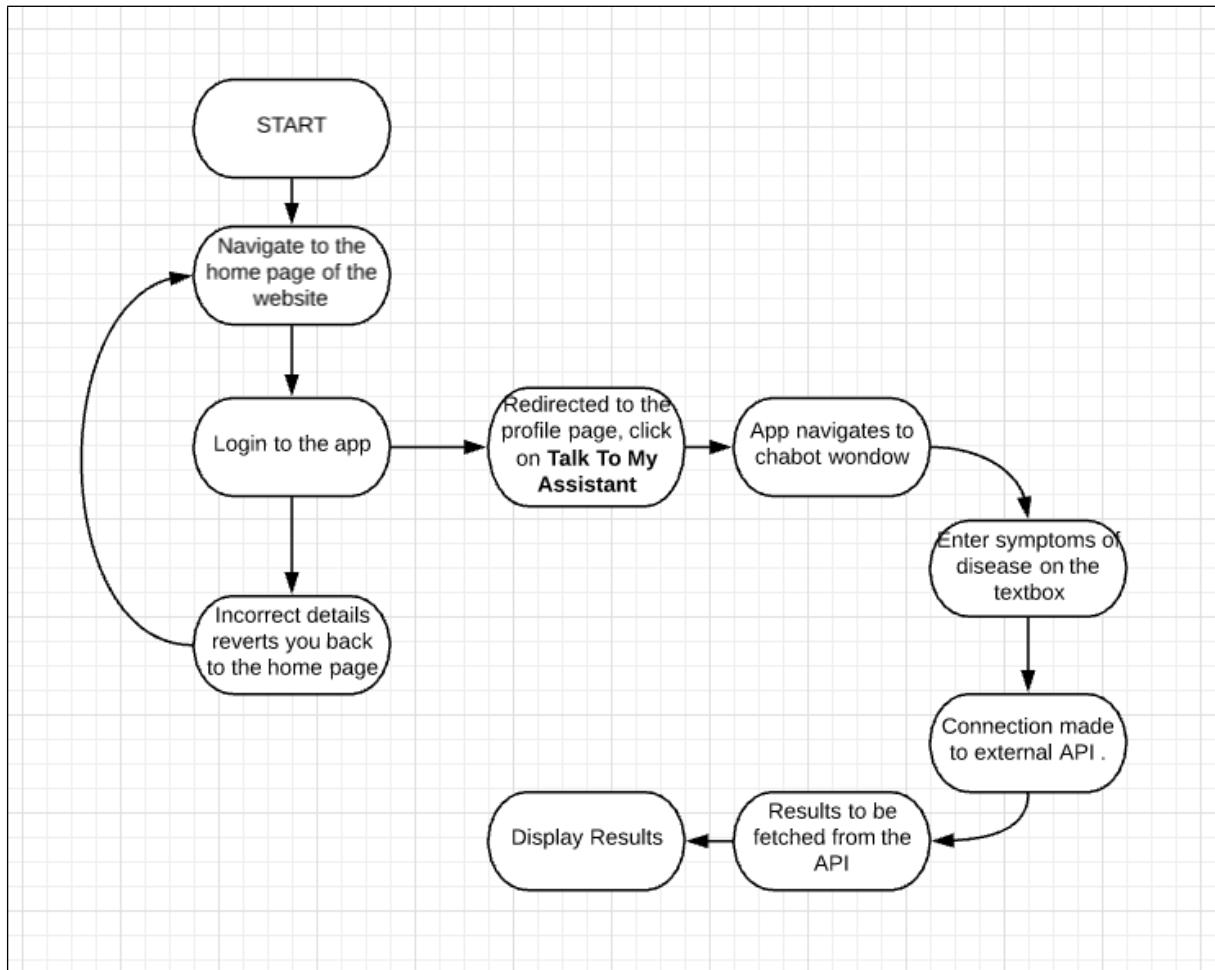
#### ***Login/ Signup:***



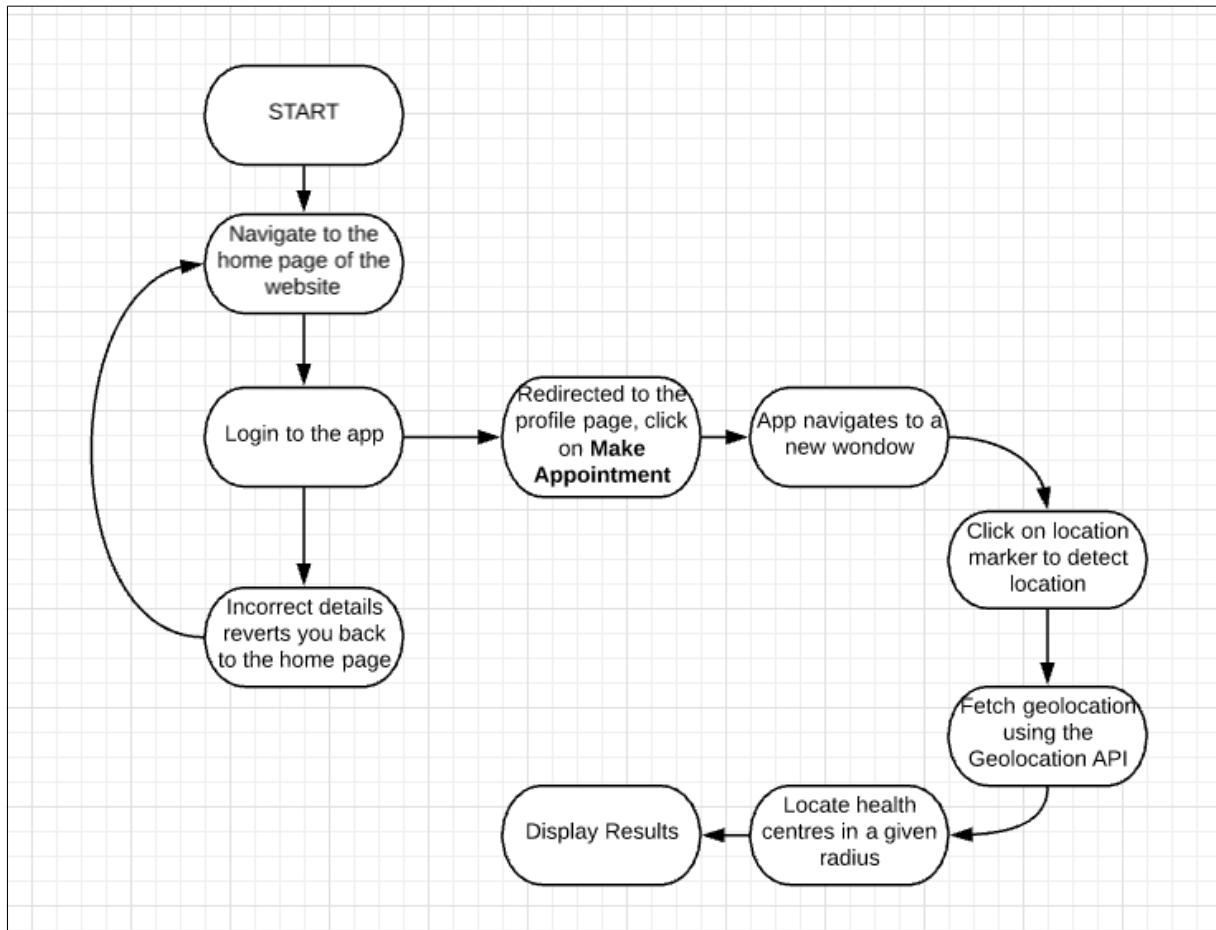
### **Edit/Alter Medical Database Entries:**



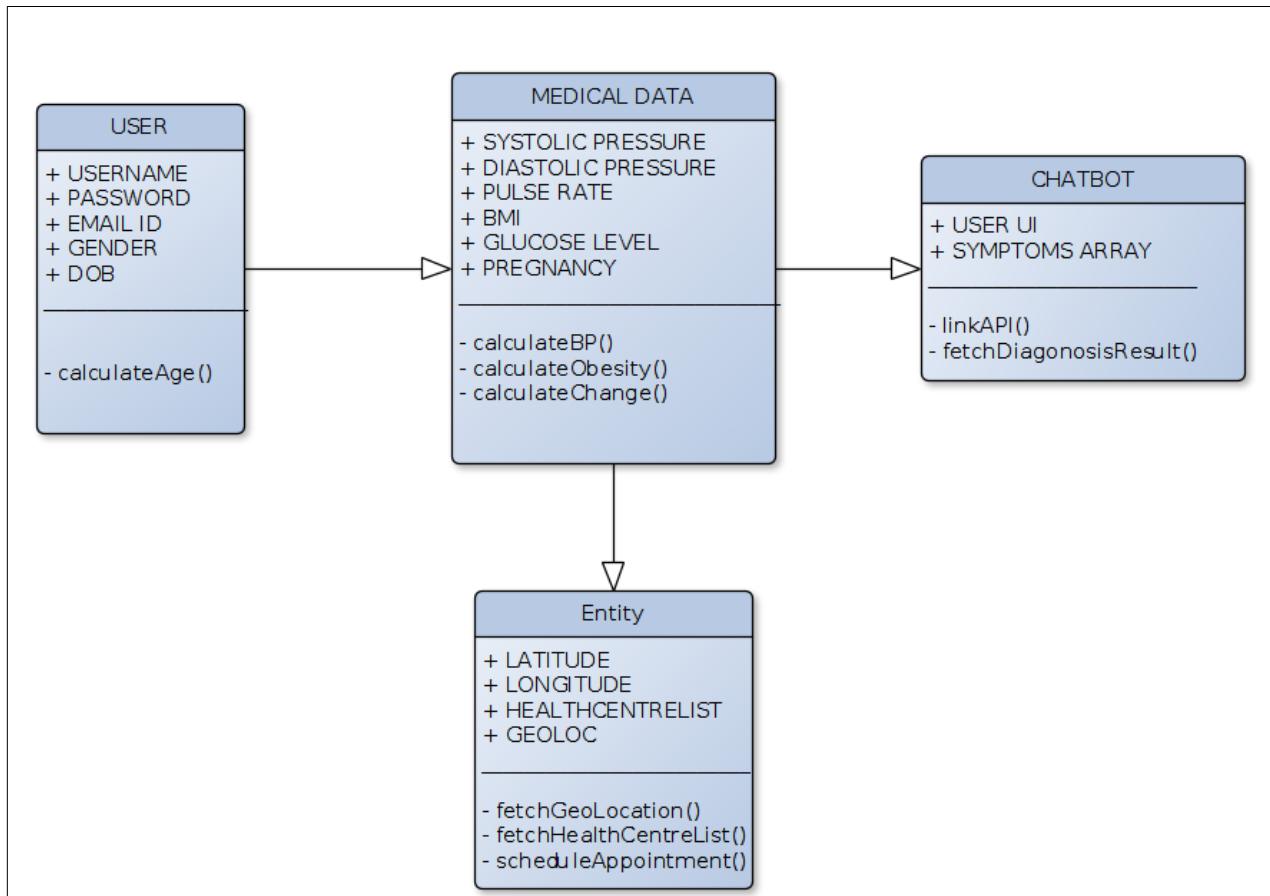
## **Disease diagnosis and Chatbot Communication:**



## ***Make Appointments***

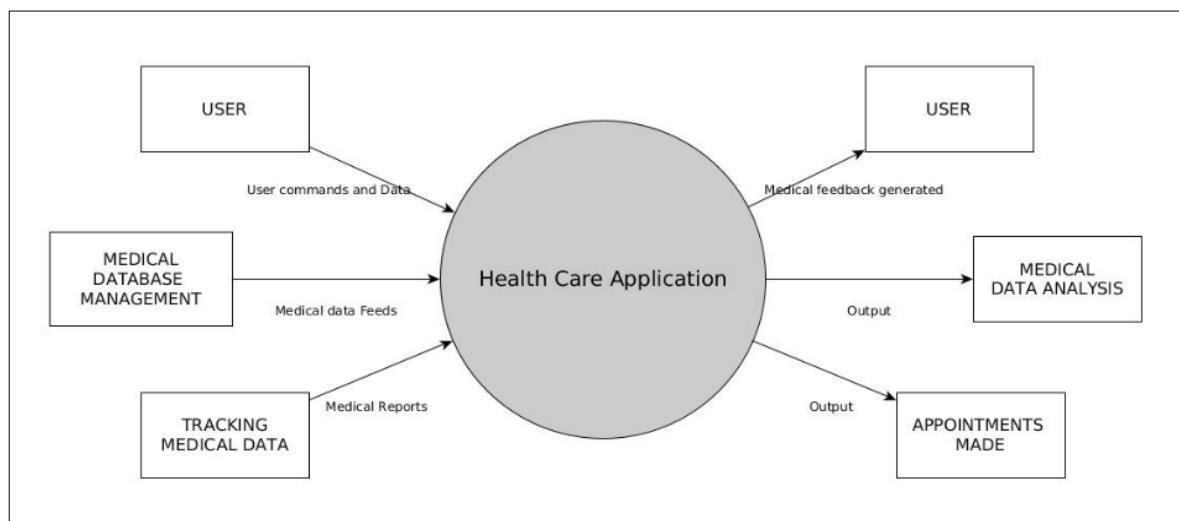


### 4.3.3. Class Diagram

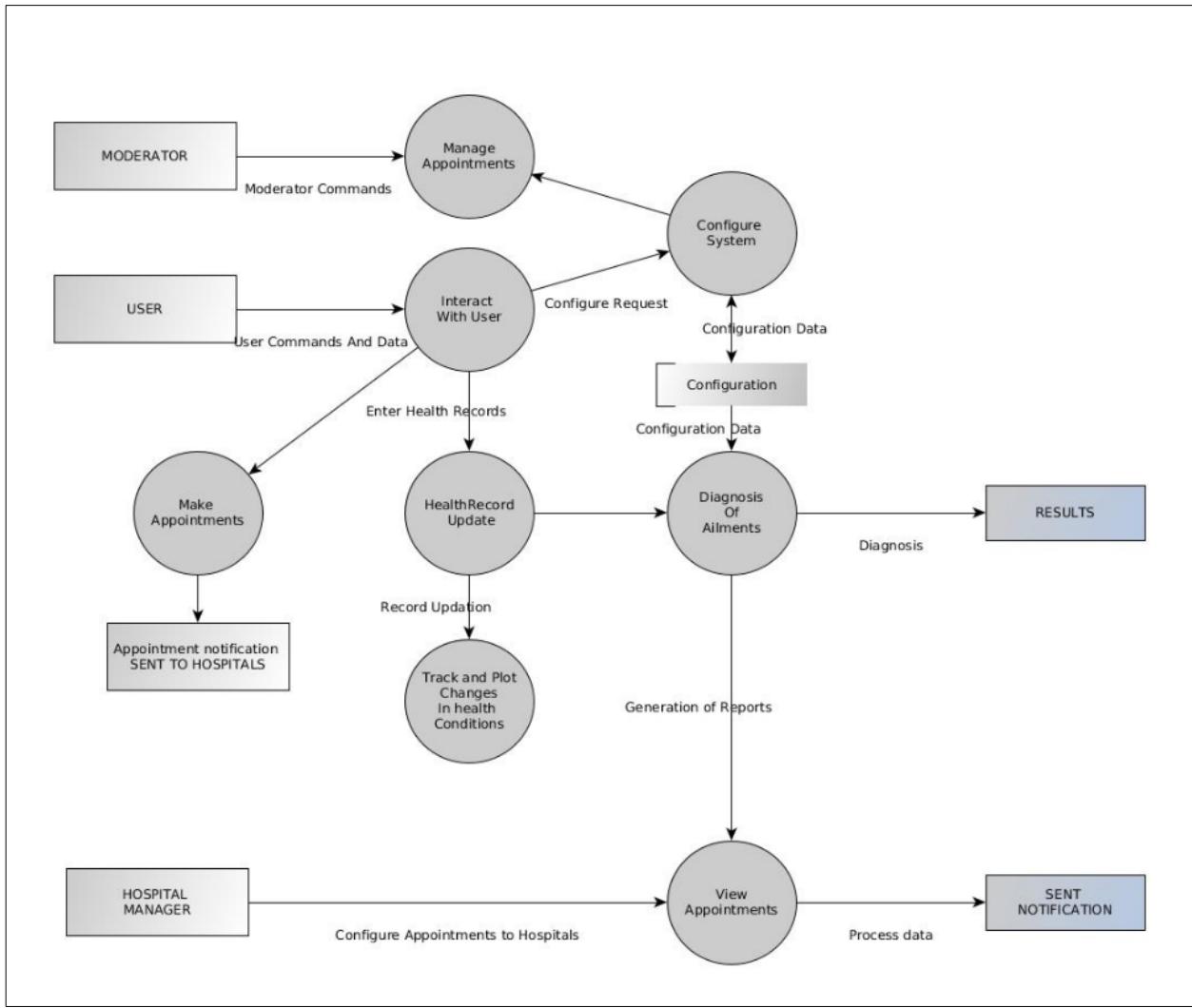


### 4.3.4. Data Flow Diagram

*Level 0 DFD*



## Level 1 DFD

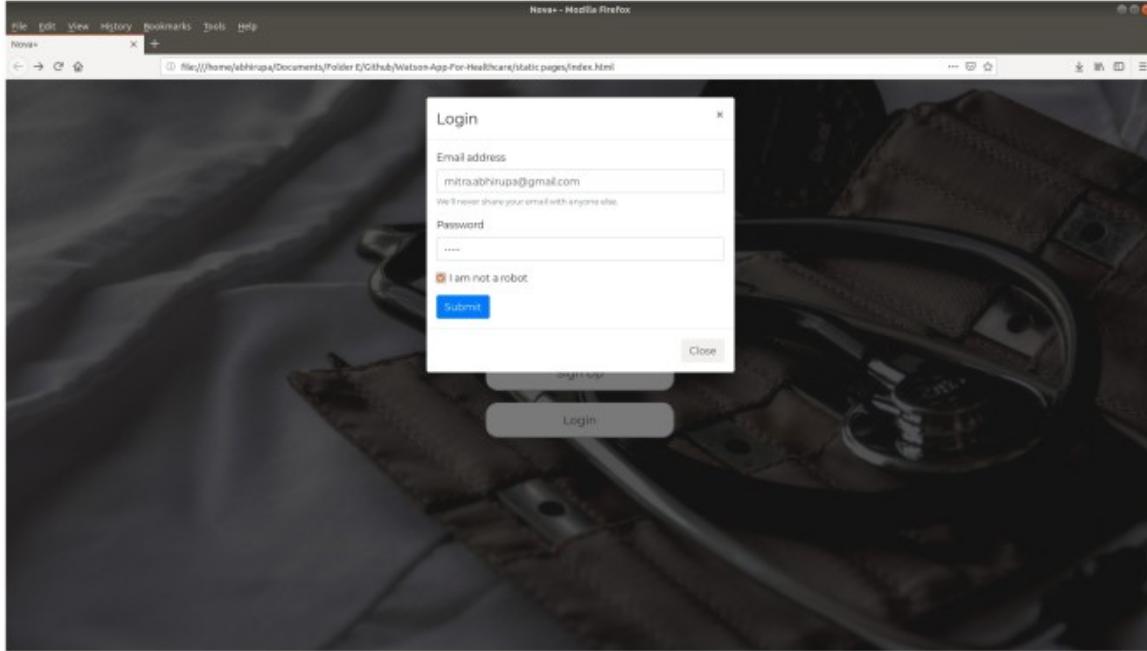


## 5. Implementation and Testing

### Test Report

Test Case ID	Test Objective	Test Data	Expected Results	Actual Results	Test Pass/Fail
1	Proper SignUp	Name:Abhirupa Password:abcde Email: <a href="mailto:mitra.abhirupa@gmail.com">mitra.abhirupa@gmail.com</a> Gender: Female Pregnancy: Systolic Pressure:82 Diastolic Pressure:102: Pulse Rate: 78 BMI:30 Glucose: <Text entry>	Should have prompted incorrect/incompleted data Entry	Took invalid data and fed it into the database	FAIL
2	Proper logging in and Authentication	Name:Abhirupa Password:abcde	Logged in	Logged in successfully	PASS
3	Proper Fetching of details on login	Systolic Pressure:82 Diastolic Pressure:102: Pulse Rate: 78 BMI:30 Glucose Rate: 5.4	Display results fetched from backend Database	Successfully Displayed Results	PASS
4	Fetching of proper location on Making Appointment	Geo Coordinates of current location: Latitude: 12.971318900000 002Longitude: 79.162052	Map of corresponding Area of katpadi	Map Being Properly Displayed	PASS
5	Fetching of details of hospitals nearby	Geo Coordinates of current location: Latitude: 12.971318900000 002Longitude: 79.162052	Details of Hospitals	Required hospital details around 1 km radius are being fetched	PASS

## **TEST ID:1**

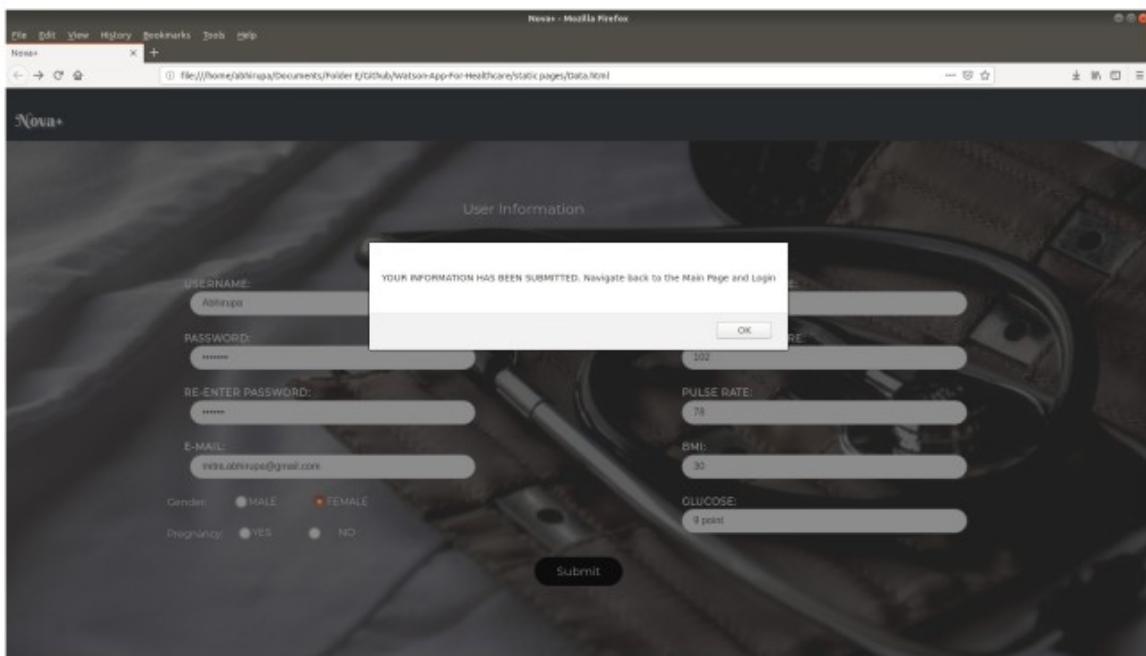


## **TEST ID 2:**

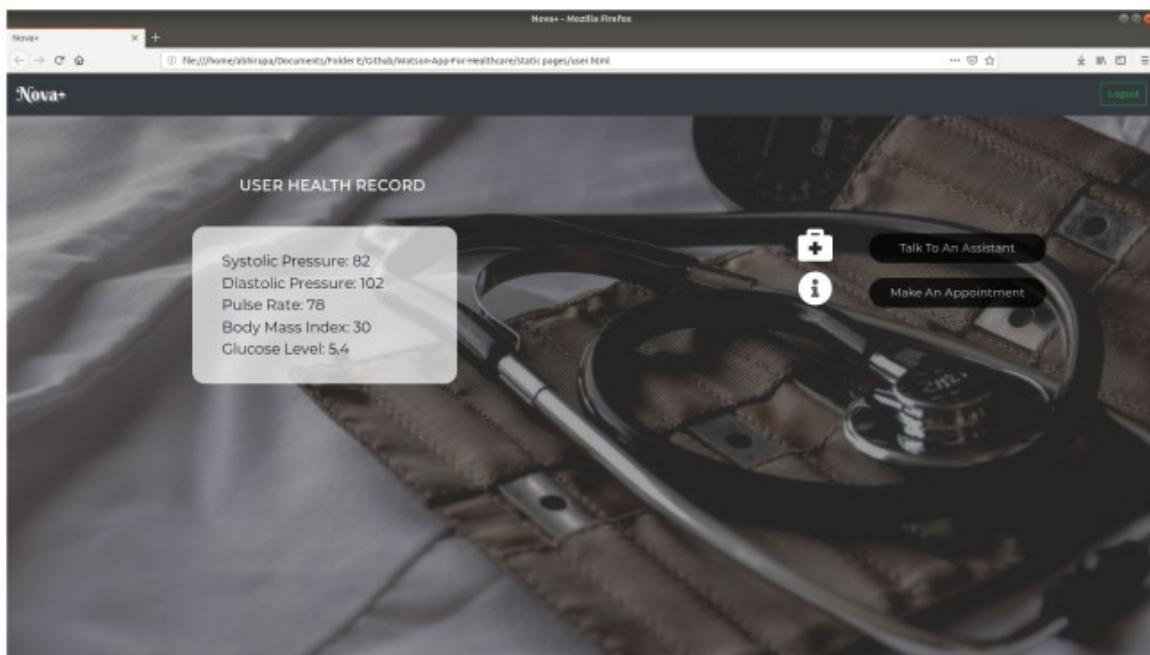
A screenshot of a Firefox browser window titled "Nova+ - Mozilla Firefox". The address bar shows the URL "file:///home/abhirupa/Documents/Folder E/Github/Watson-App-For-Healthcare/static pages/Data.html". The page has a header "Nova+" and "User Information". It features a form with various input fields and dropdown menus. The fields include:

- USERNAME: Abhirupa
- PASSWORD: \*\*\*\*\*
- RE-ENTER PASSWORD: \*\*\*\*\*
- E-MAIL: mitra.abhirupa@gmail.com
- SYSTOLIC PRESSURE: 122
- DIASTOLIC PRESSURE: 60
- PULSE RATE: 78
- BMI: 30
- GLUCOSE: 8 point
- Gender:  MALE  FEMALE
- Pregnancy:  YES  NO

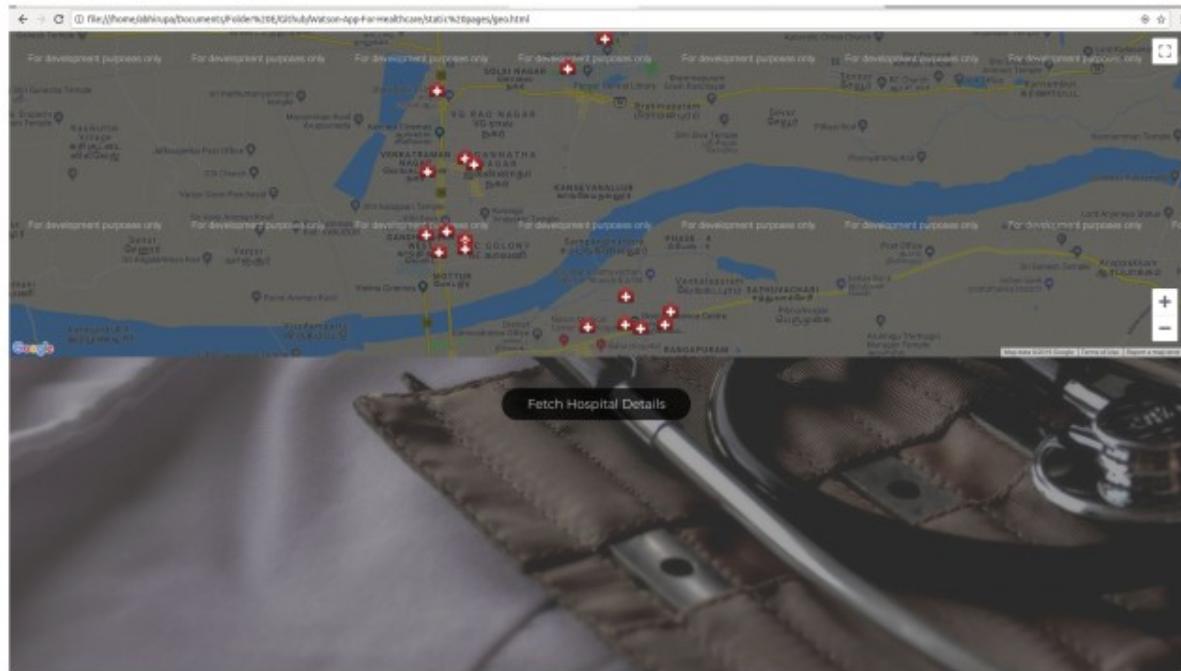
A blue "Submit" button is located at the bottom right of the form area. The background of the page is a dark image of a medical stethoscope and some papers.



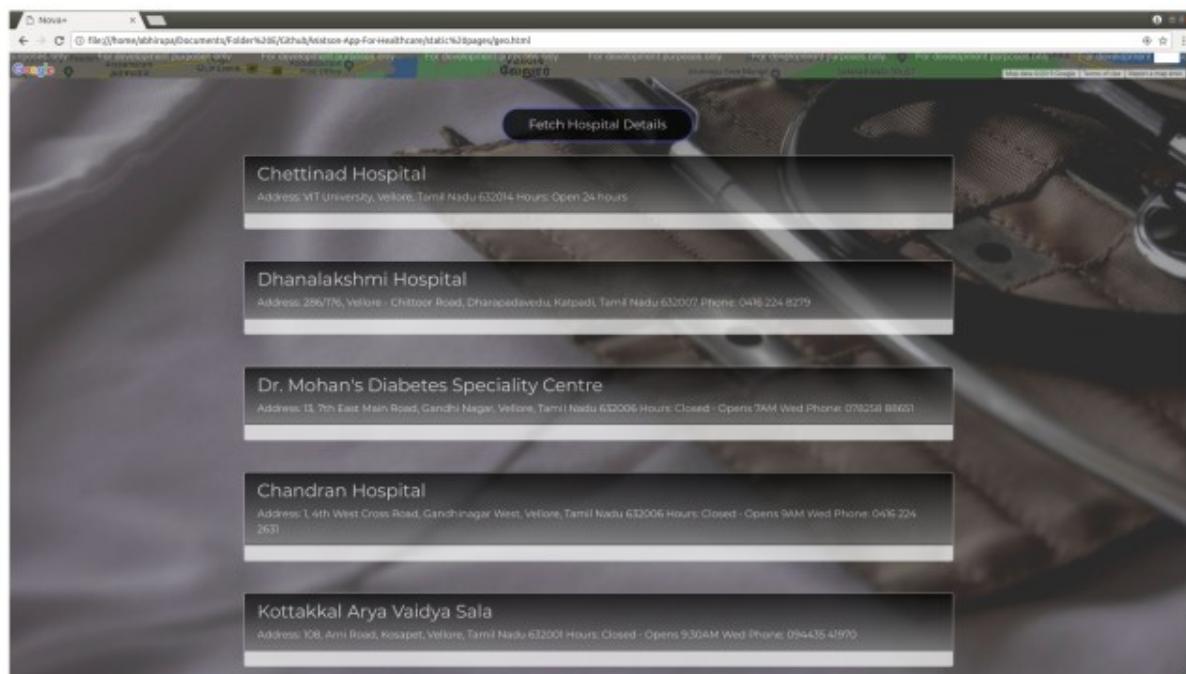
## **TEST ID 3:**



## **TEST ID 4:**



## **TEST ID 5:**



## **6. Conclusion, Limitations and Scope for future Work**

### Conclusion

The doctor and patient interaction plays the most vital role in healthcare delivery. In fact, it is a significant challenge while monitoring patients remotely. However, in this age of the advanced technology, it is not arduous to bridge that gap between a doctor and a patient.

Thence, several healthcare professionals are enthusiastic to develop a mobile application as it will help reach their patients anytime, anywhere and also improves the operating performance of their clinics. Moreover, people are also seeking quick and easy solutions for their health ailments.

Mobile applications for healthcare organizations help deliver services with quality care, improved workflow and increased patient interaction while minimizing complexity and cost to achieve the desired goals. The way the people adapt to mobile technology and looking for convenient approaches during illness has also increased the demand for mobile health apps.

### Limitations

Unsurprisingly, security is a key consideration in the new regulatory regimes, which means it may not be acceptable to use insecure methods such as SMS texting or emailing to prompt data collection. Furthermore, the burden on the patient cannot be overlooked from an ethical perspective. How often is it acceptable to ask for data collection, such as through an app that uses the alarm clock feature of the smartphone? Could illness or stress be exacerbated by a requirement to self-monitor and, if so, what degree of user involvement should be specified in the data collection process? It may be better to passively monitor rather than ask someone to self-monitor too often.

As with apps in general, users' cognitive ability, prior experience of using computer systems and the internet and preferences for modes of communication will all have an impact on results. This fact suggests that a user survey or phone audit would ideally be conducted before commencing a design.

Some other real-world user issues have arisen in our pilot studies. Healthcare app users, like all phone users, do not always keep them turned on or charged up. For a research study this could be inconvenient or result in loss of data. A research instrument may also, in time, become a product and

if an App is being used to monitor care these aspects of reliability will need to be assessed.

## Scope

There is an increasing awareness in patients about medical health, and it's giving rise to a new set of questions. Research is being done every day to reduce the minutest possible flaw in the health care system.

Web apps lack a dedicated, device-optimized user interface and thus cannot be precisely catered to fit a particular device's form factor, input methods and screen size. Thus, web apps typically deliver an "abridged" user interface. Yet, there remains plenty of scope and opportunity for healthcare applications in different fields and domains, which are yet to be explored.

## **7. References**

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