HealthCare Companion

A report submitted in partial fulfilment of the requirements

Of

Mini-Project (ISL64)

In

Sixth Semester

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CERTIFICATE

This is to certify that the project work entitled **"HealthCare Companion"** is a bonafide work carried out by **Amarthya Ravi** bearing **USN: 1MS17IS017, Amit Vasudev** bearing **USN: 1MS17IS018, Ashay Fernandes** bearing **USN: 1MS17IS028** and **Anirudh Dutt** bearing **USN: 1MS17IS024** in partial fulfilment of requirements of Mini-Project (ISL64) of Sixth Semester B.E. It is certified that all corrections/suggestions indicated for internal assessment has been incorporated in the report. The project has been approved as it satisfies the academic requirements in respect of project work prescribed by the above said course.

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Abstract

HealthCare Companion is a mobile application for people who wish to manage and monitor their health. It can also be used to gain information and insight about the various health schemes offered by the Government of India and to learn about a few major disease outbreaks. Users can register with their own email address and can store personal information. Users can also calculate their Body Mass Index (BMI). Using the Google Maps API, directions and routes to various blood banks in the case of blood donation have been implemented. This app is designed for specific hospitals. The receptionist of the hospital will have access to all the stored information. Patients can book appointments with doctors based on their requirements, view the profiles of various doctors and can provide feedback. Patients can also choose the appointment slots. A User Interface for the doctor side has also been implemented to help them monitor their appointments for the day. The doctor can view all the details in the same way as it is displayed to the patients, in case of any incorrect information, the doctor has the privileges to change all the related details except the availability of the doctor, for which the doctor has no access. In order to gain access, doctors have to raise a request and only if permission is granted by the hospital, the doctors can make changes.

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Chapter 1

1. Introduction

1.1. Motivation

The standards of healthcare are not up to the mark in many states. The general mass of people does not follow the necessary precautions and often end up with new problems because of ignorance. Many don't have an idea about the various schemes available for medical help, hence they don't take care of the problems. Healthcare and sanitation are two major problems of India. All the communities will benefit with an organised planner/ manager which helps the people keep track of their health and provides information about government schemes and diseases.

This project was made to provide easy HealthCare and to enable people to book appointments with doctors online so that crowding in the hospitals or clinics can be reduced. With the added feature of a map interface built from the google maps API, people can get directions to blood banks and hospitals quickly in cases of emergencies.

1.2. Scope

The HealthCare Companion app has been designed for the convenience of hospitals. It is used to provide an efficient data and patient management system to relieve the particular hospital's staff of various problems. The app can be used by patients to book appointments with doctors in that hospital. The hospital's receptionist will have access to all the stored data. This provides a very smooth patient information management system as the possibility of losing records can be eliminated. Directions and routing to blood banks using maps have been implemented for the patient's convenience.

A separate application has been developed for the doctor side. Doctors have access to the appointments made under their names. The doctors can update any incorrect information except their availability. Special permission is to be obtained by the hospital if a doctor wants to change their availability. This is done in order to keep the major control in the hands of the hospital. No registration is required for the doctor side app.

Future expansions and improvements can be made on the app. The patient's medical history can be stored, multiple hospitals can be integrated into a single framework, the hospital and doctor side interface can be created to expand into their domains. Online purchase and delivery of drugs and medicines is another important future scope. Prescription printing, doctor-patient communication and many more functionalities can be implemented. The blood bank mapping interface can be modelled around every user who is using their live location.

1.3. Objectives

HealthCare Companion is an application which helps reduce the troubles and difficulties experienced by people when they want healthcare or when they want to get in touch with doctors. Some of the accomplishments of the application are:

i. Appointment Booking – Patients will have easy access to the available doctors for booking appointments. The need to physically visit the hospital just to book an appointment is reduced if people use this application.
ii. Maps Interface – With the added features of navigation maps, people can look up hospitals, blood banks and any desired location, and can get directions to the location instantly.
iii. BMI Calculator – Patients can calculate their body mass index on the app to get an idea about whether they are underweight, normal or obese.
iv. Information Portal – Information about different major diseases and outbreaks along with their statistics have been provided so that people can be up to date on the causes and preventative measures. Information about various government health schemes has also been provided so that users are aware of the available options in case of emergencies.
v. Doctor side – The doctors have a separate application which will show them their appointments which have been booked and the details of the patients who have booked appointments with the doctors.

1.4. Proposed Model

This project is built based on the Iterative Model. The Iterative Model is an implementation of a software development life cycle that focuses on an initial, basic and specific implementation which then gains more complexity and functionality as more and more requirements emerge.

The Iterative model can be thought of as a cyclic process. Usually, the early increments of the system include the most important or most urgently required functionality. The customers can evaluate the application to check whether it meets the requirements. If the requirements are not met, then increments are to be added only at that stage. After the initial planning phase, a specific number of development stages are repeated. The completion of each cycle incrementally improves and iterates on the software. Upgrades and modifications can quickly be recognized and implemented during each iteration which allows the next iteration to be slightly better than the last.

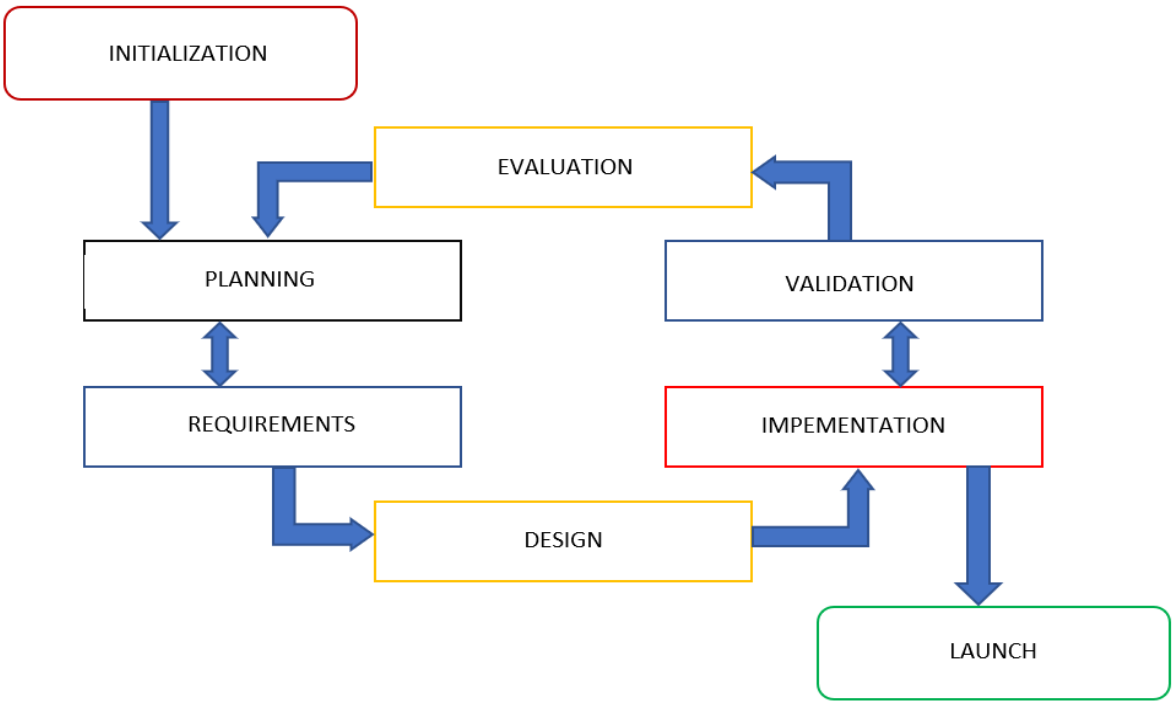

Figure 1: Iterative Model [1]

A project control list maintains the list of processes to be completed to obtain the final implementation of the project. This list can be used to determine the project's status in development. Each step consists of selecting the next process from the list, analysis the requirements to be met, adding the functionality(coding), evaluating the model after implementing the increment and updating the process list based on the evaluation result. If the evaluation is successful, the next process is selected.

1.5. Organisation of Report

In order to explain the developed system, the following sections have been covered:

1. Literature Review describes the study of the existing systems and techniques taken into account prior to development of the proposed system.
2. System Analysis and Design provides a detailed walk through of the software engineering methodology adopted to implement the model, an overview of the system and the modules incorporated into the system
3. Modelling and Implementation provides a deeper insight into the working of the model. The various modules and their interactions are depicted using relevant descriptive diagrams.
4. Testing the model to ensure bug/error free model along with the Results obtained. Discussion then provides detailed analysis on quality assurance measures.
5. Conclusion about the Results obtained after successfully running the model and Future Scope of the model is highlighted.

Chapter 2

2. Literature Review

Health is wealth. People deal with various health related issues in everyday life. Being stress-free is an important factor for good health but people are always stressed about their health or their family's health, career, profession etc. Stress is the most important contributor for ill-health. Contacting the correct doctor or hospital can be a very tedious task and is very crucial. Healthcare companion has been developed to aid people in various healthcare related ways. The initial idea for HealthCare Companion was derived from **[2]**.

After research about different health related applications and services, the most prominent service was Practo which enables patients to consult doctors very easily. Healthcare Companion is for a hospital, all the doctors in that hospital will be stored on the app and patients can book appointments, give feedback and rate the doctors based on their personal experience. The doctors will not have to worry about the appointments. They only have to operate the doctor-side app to view their schedule. The feedback system is included for the benefit of doctors and new patients who are confused about which doctor to consult. Once an appointment is booked, details of the patient along with the time slot will be registered in the database. This data is retrieved and displayed in the doctor-side app for the doctor's convenience.

The availability of blood for emergencies may be imperative in some cases. People may not be aware of the blood banks in their proximity or they may not have correct directions to the blood banks. The work of Anabhavane et al **[3]** provides a good model for the blood emergency and routing system. For HealthCare companion, **[3]** was used as the basic motivation for creating the maps interface. People who need directions to the blood bank need not switch to another Maps app like Google Maps. The inbuilt map system has a pre-loaded list of blood banks in the vicinity, directions can be obtained through Google Map routes. Returning the closest blood banks to every individual user seemed redundant. For example, if two people are 100 metres away from each other and if one blood bank is close to the first user, it will be close to the second user as well. This can be improved in future upgrades.

There are a lot of organisations and NGOs which are aimed at providing and improving the health and sanitary conditions of communities. There are many Government schemes available for those in need. People are not aware about the existence of such schemes. Healthcare contains information about a few Government schemes which may be a person's aid. The role of the Government in Public Health can be understood better from **[4]**.

Emergency number of the hospital has been provided because in an emergency, the first thing people would do in an emergency situation is to reach out to a doctor who can triage. Patients can also fill details if time permits in the rapid emergency form page.

The world has been shaken by many epidemics and pandemics. According to the World Health Organisation, there are many deadly diseases still present. The most recent pandemic, Covid-19, has permanently disrupted every aspect of life. Symptoms and preventative measures **[5]** for Covid-19 have been provided. General information about the most infamous **[6]** diseases has been provided with charts for visualisation after researching from various sources. It is very important to have knowledge about these existing dangers so useful information from reliable sources has been provided for general benefit.

Being fit is the key to being well. In modern times, everyone would have come across the word BMI or Body Mass Index which can be thought of as a fitness gauge. In the healthcare domain, fitness has never been present along with good healthcare facilities, so a BMI calculator has been integrated where people can check their scores and keep tabs on their health in a very small but effective way.

Chapter 3

3. System Analysis and Design

HealthCare Companion has been implemented using the iterative model. In the iterative model, an initial version of the project is developed and increments are added on a cyclic basis with the help of user feedback and changing requirements. Once a particular development stage has met the particular requirements, the next stage is processed and this process continues till the final model is developed.

3.1. App Work-Flow

When a user loads the app, the first screen which is displayed is the welcome screen. New users will have to register using a valid email address and a password of minimum 6 characters. If a user has an account, they can directly log in. The given email will be stored in the FireBase console. In a real time, application of this app, the hospital's receptionists will be handling the FireBase patient data. The email will be stored as the 'sender' field.

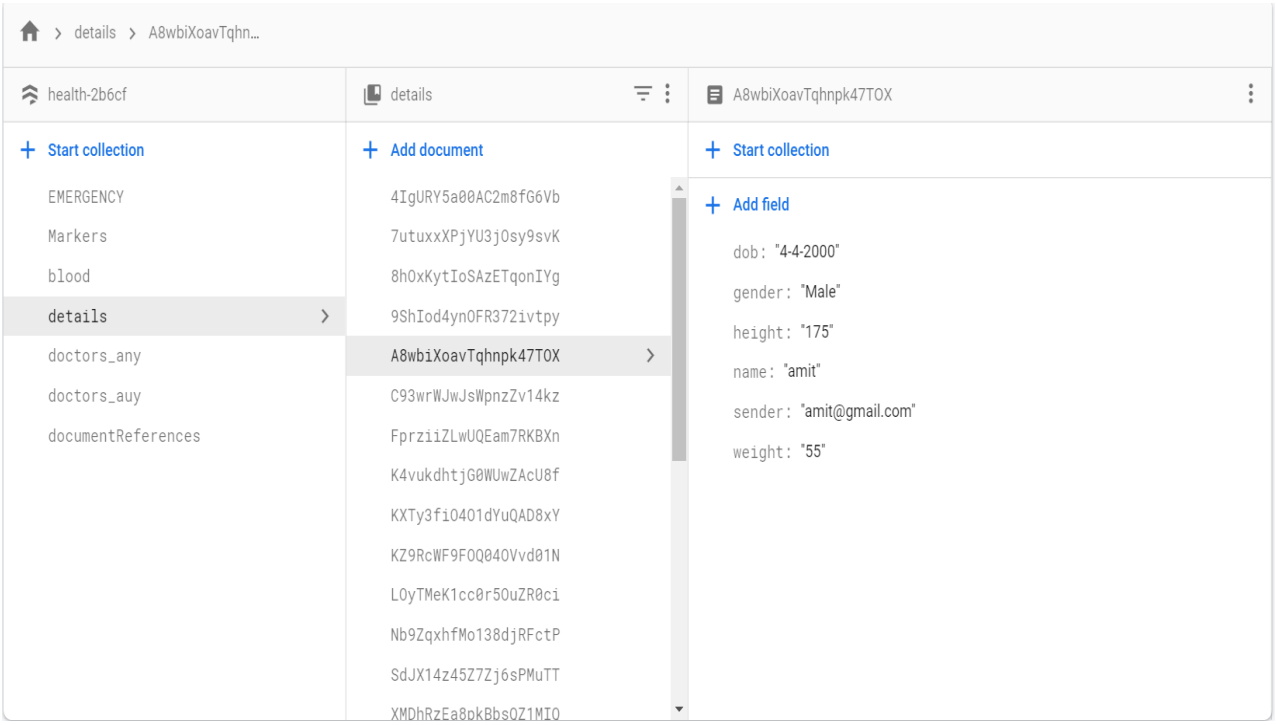

Figure 2:FireBase Console

After the user presses the register button, they will be redirected to the login screen. The user can login with correct username and password

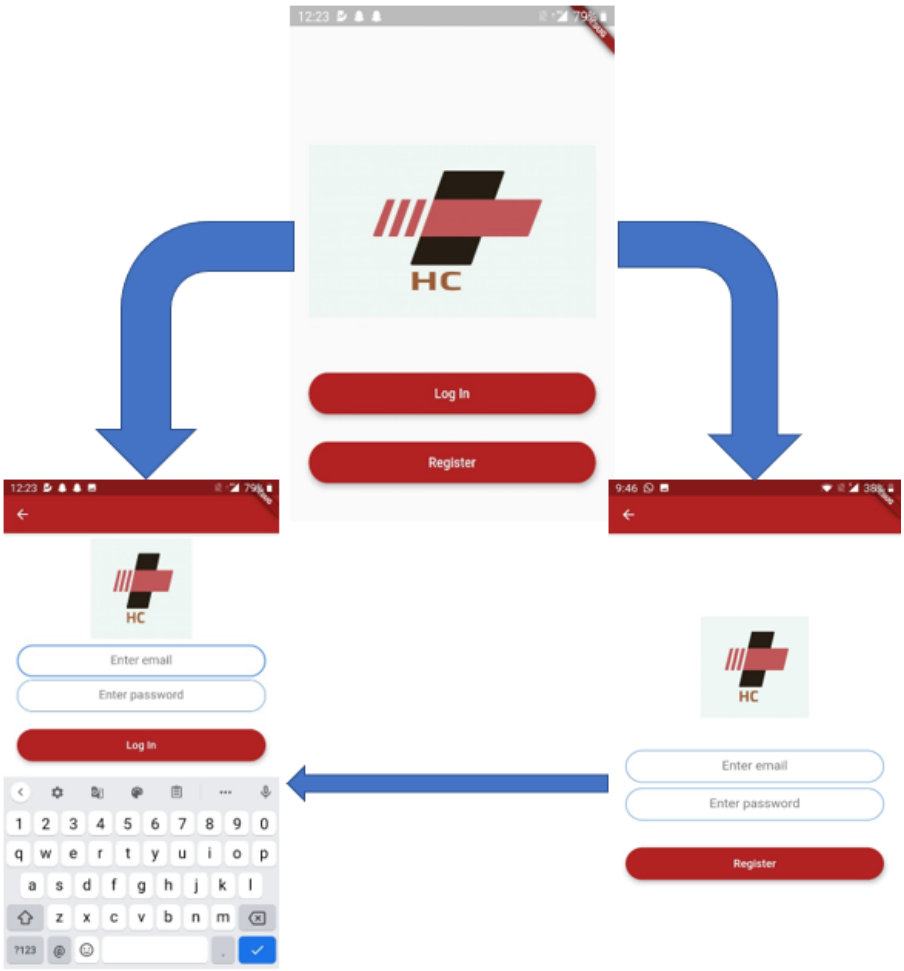

Figure 3: Login and Registration

When the user presses the login button, they will be redirected to the home screen. All the main features of the app can be accessed from the home screen. The horizontally scrollable list-view in the bottom will be edited to fit each hospital using the app. The icon on the top left when pressed shows the user details. The contact for the Emergency Room will be provided whenever the emergency button is pressed in the case of an emergency. The user must fill out a form in critical and non-critical emergencies. The form is to get the details of the person who need emergency treatment.

The main screen or home screen of HealthCare Companion is shown in the figure.

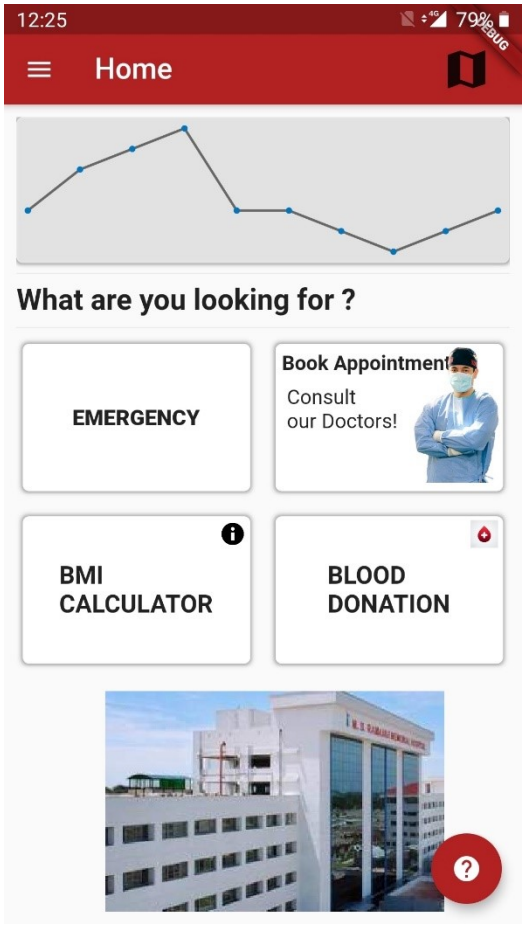

Figure 4: Home Screen

Features accessible from the home screen:

- Emergency
- User Profile and Health Schemes
- Blood Donation
- BMI Calculator
- Blood Donation Form
- Maps
- Disease Hub
- Appointment booking

Users can sign out by tapping the sign out button on the side menu.

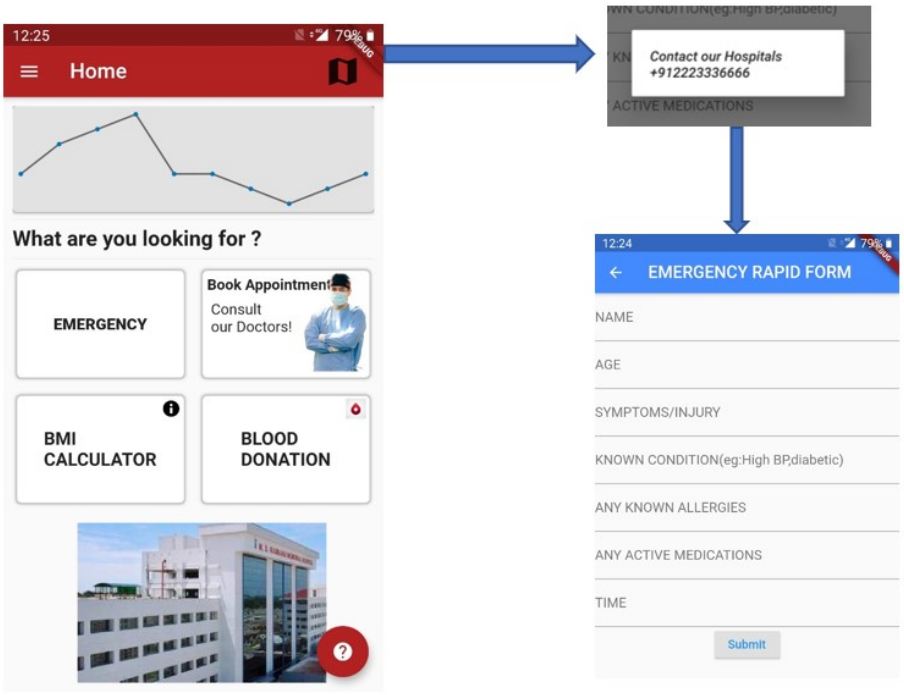

Figure 5: Emergency

The user can store and update their details by tapping the cheeseburger icon on the top left of the appbar. A disclaimer screen has been added to prevent any misconceptions for the user.

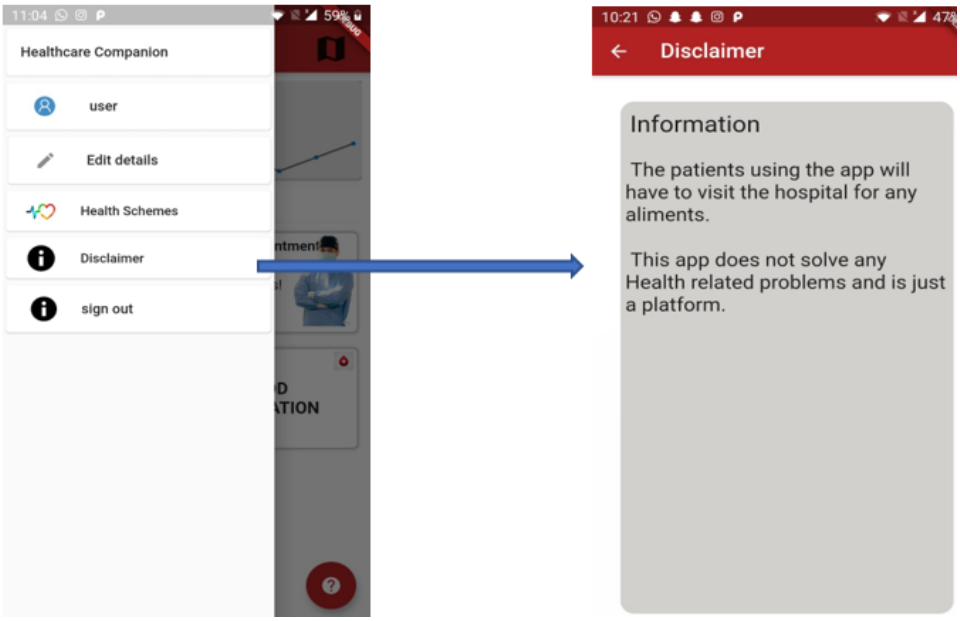

Figure 6: Side menu and disclaimer

After the user presses the register button, they will be redirected to the login screen. The user can login with correct username and password

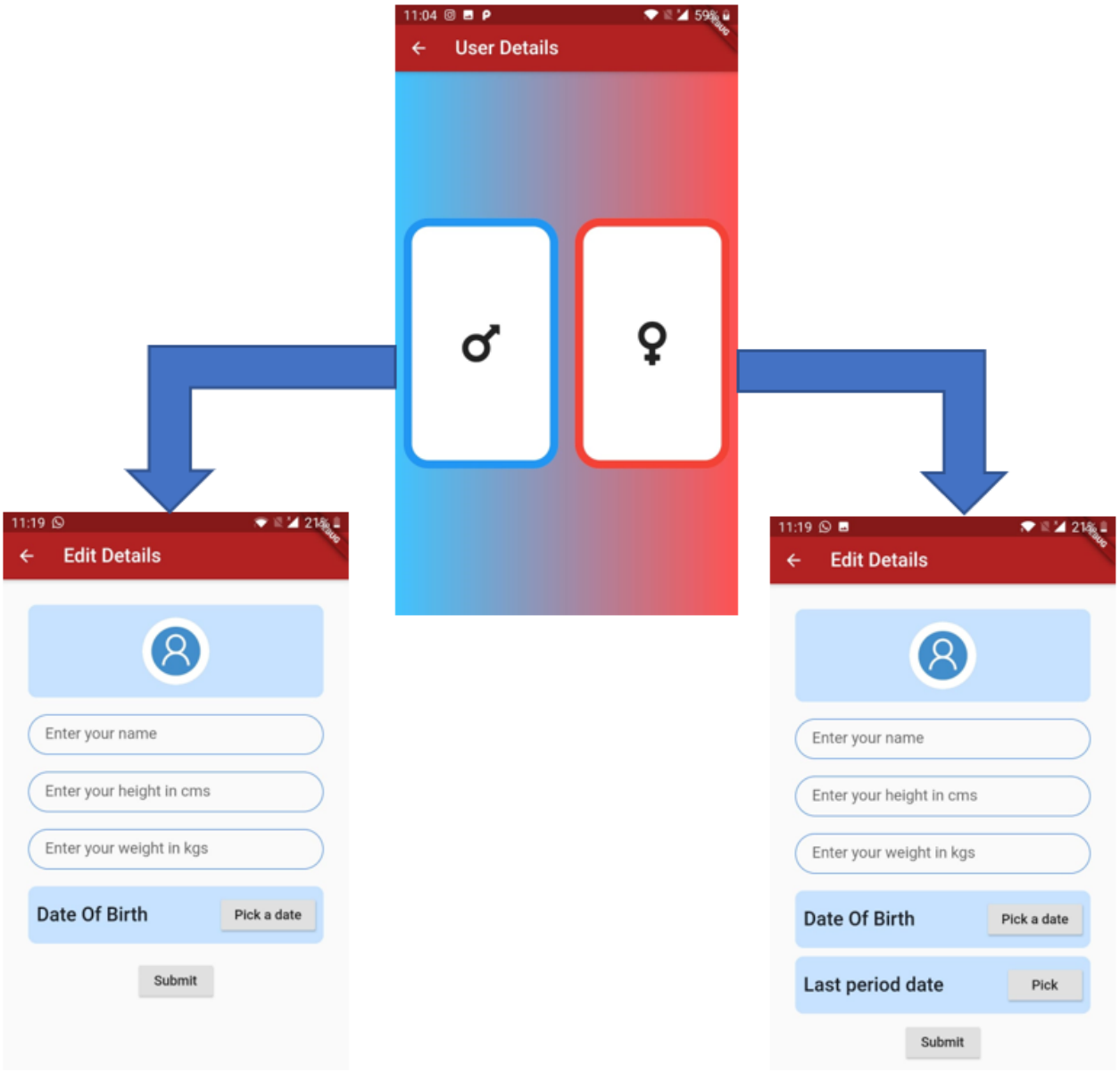

Figure 7: Gender selection and user details

Separate male and female details pages have been implemented to account for menstrual activity. The entered details will be saved to the FireBase console when the submit ‘button’ is pressed. To view the details, the ‘user’ button has to be pressed. Control will retrieve the details stored in the FireBase console for the login email address and the details will be displayed. For female users, an additional field of the last menstrual period(lmp) date will be displayed.

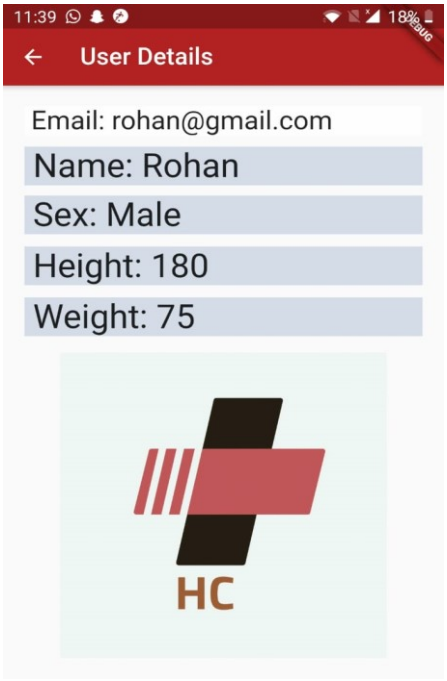

Figure 8: Stored details

Healthcare companion has information about the various health schemes provided by the government. They can be accessed by tapping the 'health schemes' button.

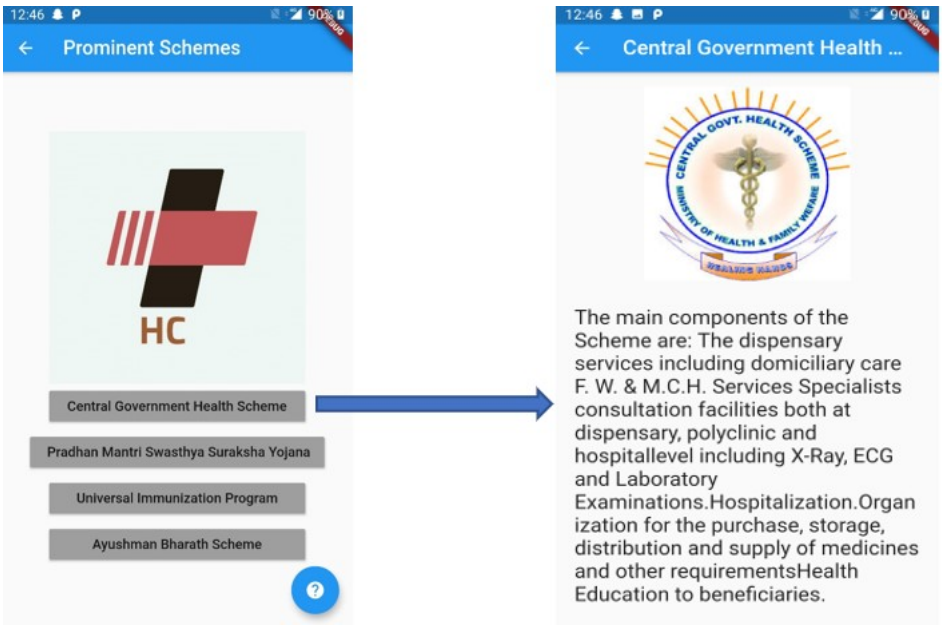

Figure 9: Health Schemes

People like to keep track of their body mass index to gauge their fitness. A BMI calculator has been implemented in HealthCare Companion.

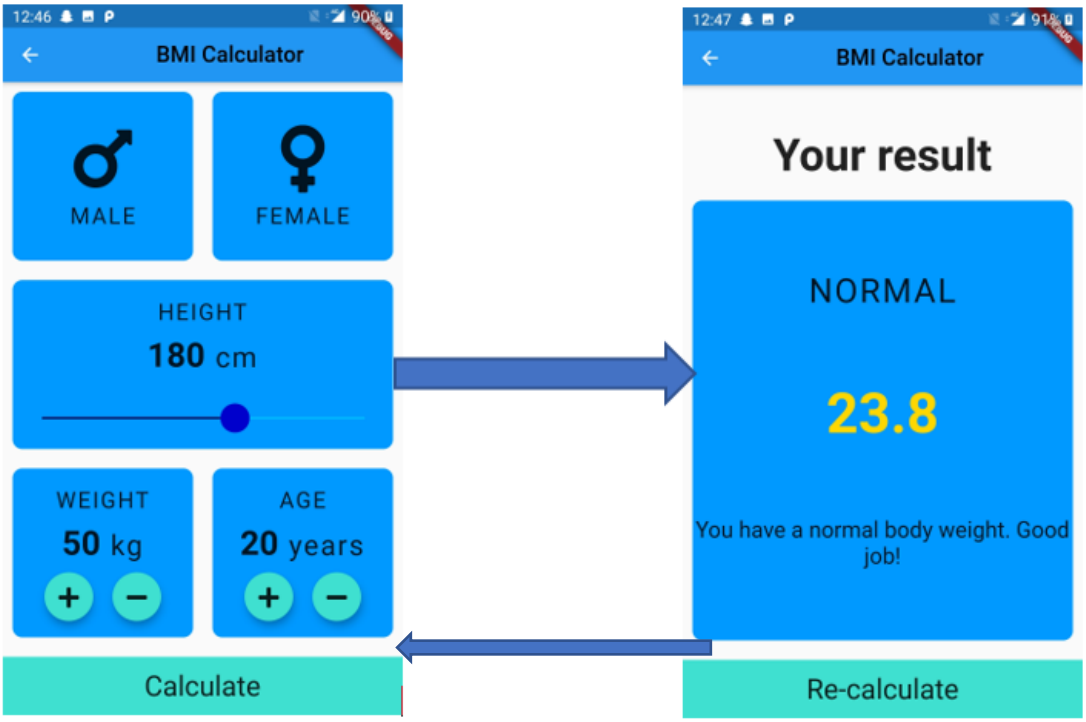

Figure 10: BMI calculator

The BMI is calculated by tapping the 'Calculate' button and can be recalculated by tapping the 'Recalculate' button. Patients can request for blood by tapping the 'blood donation' button. A form will be displayed which will have to be filled. The filled details will be sent to the hospital when there is an urgent need for blood.

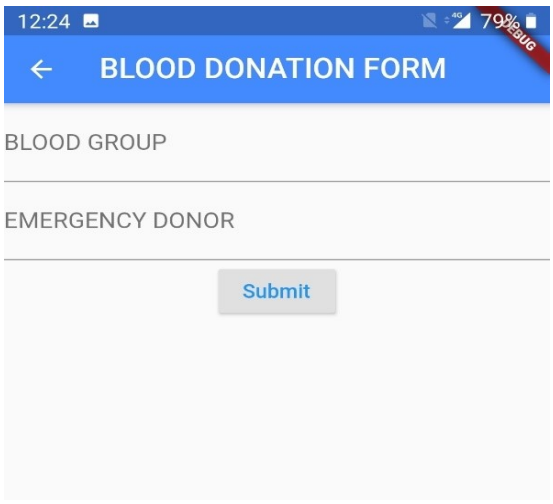

Figure 11: Blood Donation Form

A complete map interface has been implemented for directions and routing to blood banks and can be accessed by tapping the map icon. Having an in-built map routing system saves time in the case of emergencies. Patients will not have to switch to another app and type in the name of the blood banks. Using a dropdown menu, 5 blood banks are displayed. When the user selects a particular bank, a marker will be placed at that location. Users can get directions by tapping the navigate button which will open google maps for routing

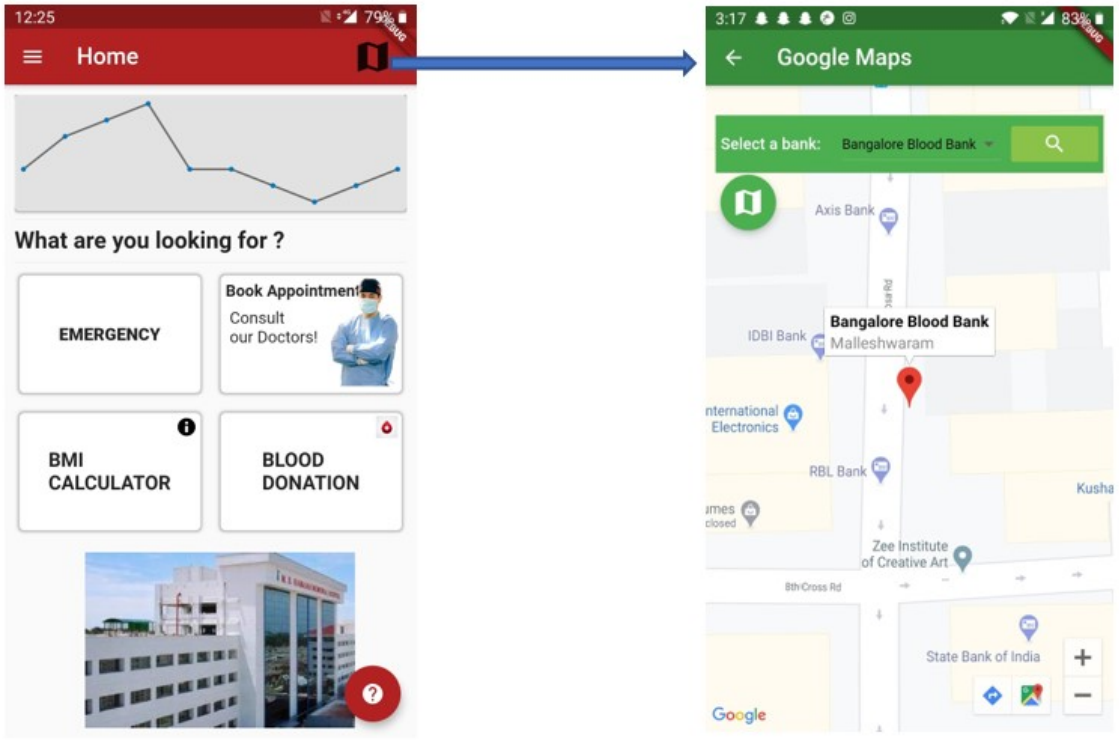

Figure 12: Maps interface

The map interface uses the co-ordinates of the blood bank to redirect to the location. More blood banks can be saved in the drop-down menu by storing the coordinates in the FireBase console. The co-ordinates are retrieved from the FireBase console when the 'search' icon is tapped after selecting the desired blood bank. A flutter widget system called Markers is used to place a marker at the retrieved co-ordinates. The blue arrow button at the bottom of the screen is used to open google maps and route to the location automatically.

There have been many deadly disease outbreaks in the past few centuries. People don't have much knowledge of these diseases nor about the viruses that cause them. HealthCare Companion has a disease hub with information about a few

major epidemics and pandemics. Graphs visualizing the death rates due to Covid-19 and for all the other diseases mentioned have been constructed.

Figure 13: Disease hub

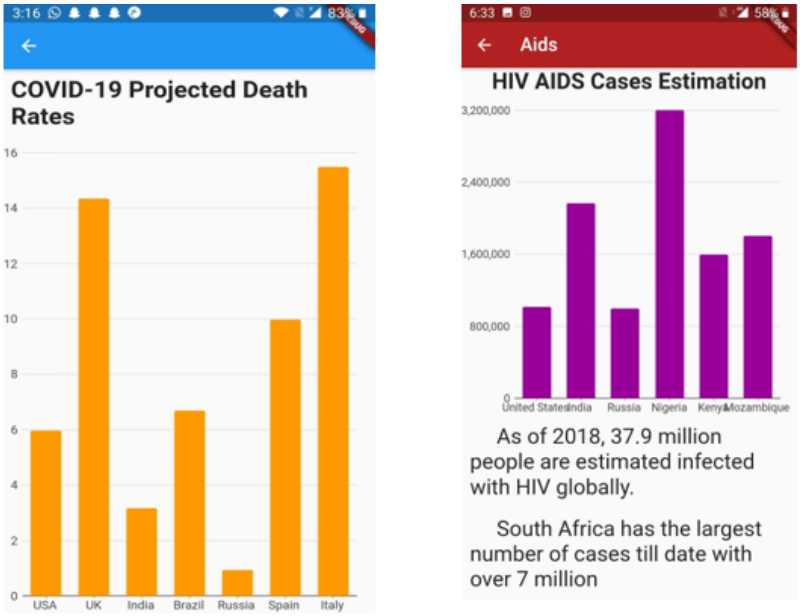

Figure 14: Disease statistics

Figure 15:Covid-19

A dedicated page for Covid-19 has been provided which contains all the information about the virus, the symptoms and preventative measures.

The main feature of HealthCare Companion is the online appointment booking system. As this app is to be deployed for an entire hospital, details about every doctor available in the hospital must be included in the database. Users can select the required specialist, choose the appointment timings and provide feedback. This system helps doctors by eliminating the pressure of organizing appointments because the time slots chosen will be updated in the doctor-side app. This system also prevents the need to physically be present at the hospital to book an appointment, which is in favour of the patient's comfort.

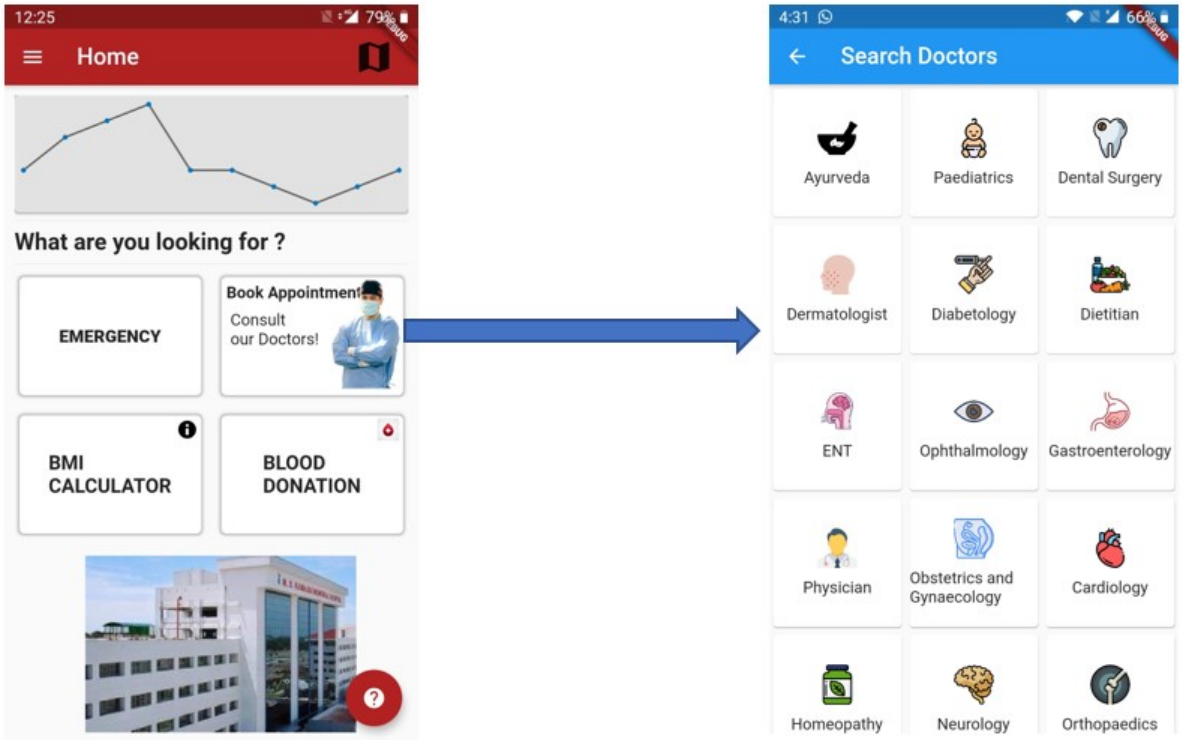

Figure 16:Specialities

When a patient books an appointment, the name of the patient, the phone number and the time slot will be sent to the FireBase manager. The doctor-side app is for the doctors to manage their appointments.

Patients can select the specialist they need to consult by tapping on the speciality. A screen showing the list of doctors available in that hospital is shown.

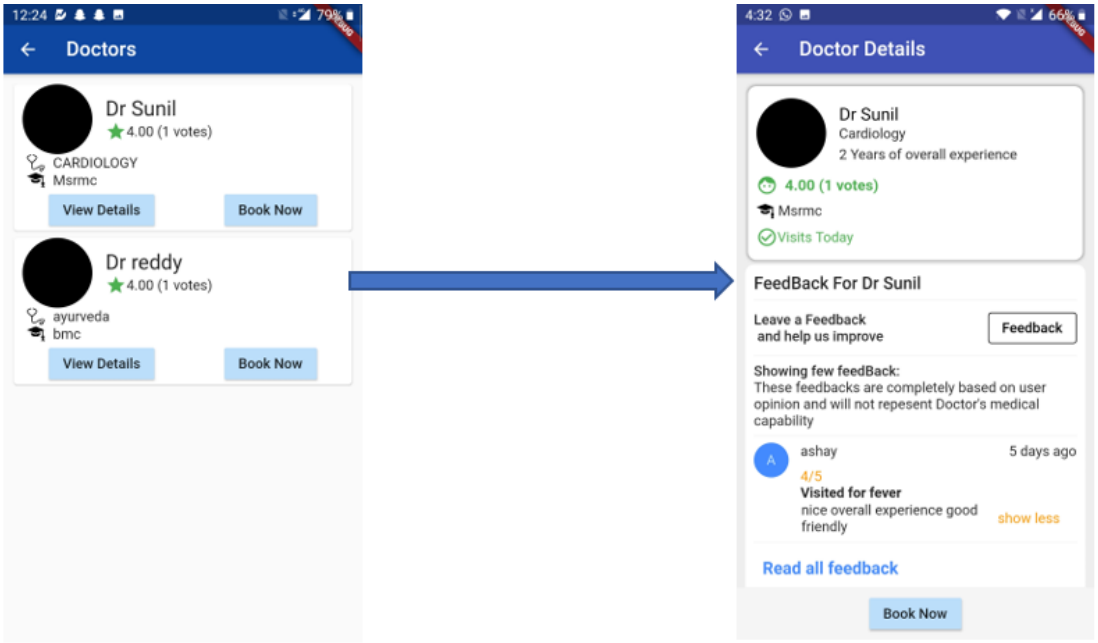

Figure 17: List of doctors and profile

Appointments can be booked by tapping the 'book now' button, available on the profile of the doctor. Users will then have to select the time slot.

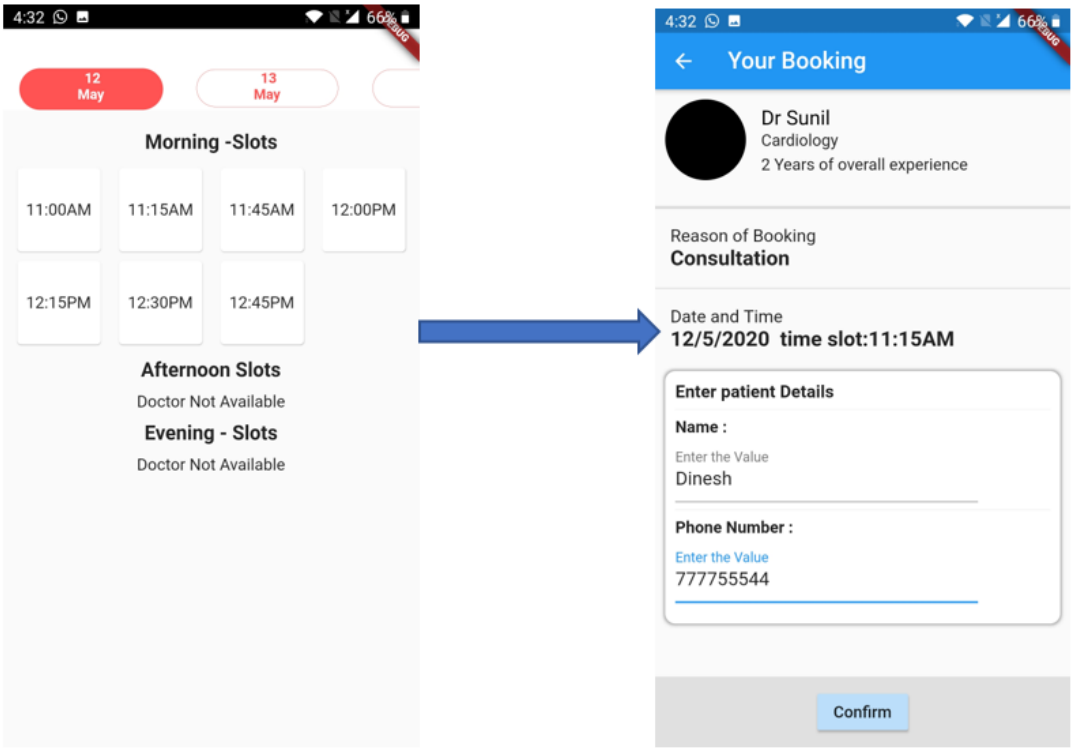

Figure 18:Appointment booking

Once the appointment has been booked, the details are sent to the FireBase manager. These details are then retrieved from FireBase to the doctor-side app.

There is a separate User Interface for doctors, where they are asked to login initially. There is no option for registration, this is done in order to avoid misuse of the application. Once a doctor joins the hospital, they will be given an email address and a password which they can use to login to the doctor-side app. There are 3 tabs in the doctor side application. In the first tab, the doctors can view their details in the same format as it is displayed to the patients. They can see the ratings they have received along with the feedbacks given by the patients. In the second tab, doctors are provided with options to update all the fields except their daily availability. In the patient side application, appointment slots for 15 consecutive days from the present day have been provided, so to maintain the integrity between the patient side application and the doctor side application, doctors cannot change their availability. If a doctor wishes to change his/her availability, they have to raise a request to get permission from hospital to make the change.

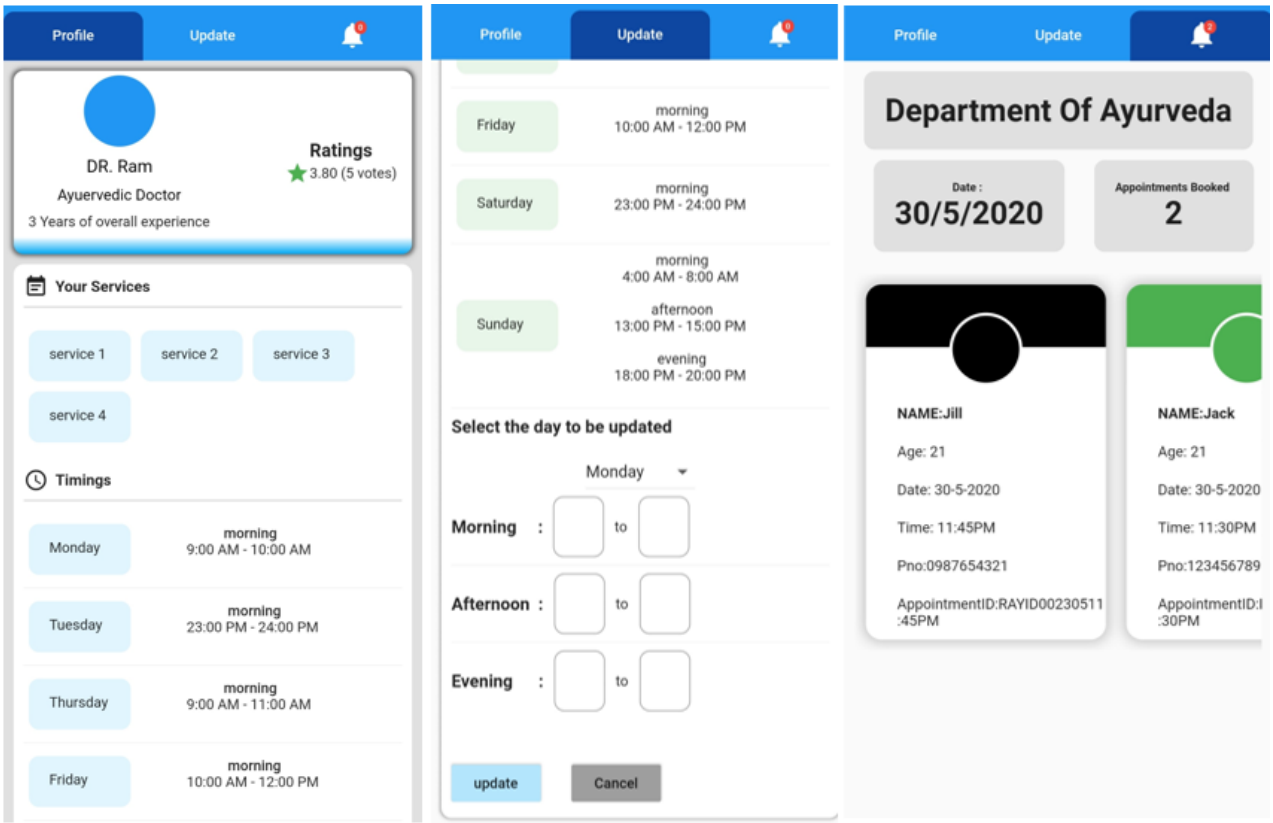

Figure 19: Doctor-side app

This request will be visible to the desk maintaining the database and once the permission to update is approved by the hospital, the doctor can update their availability and this will be reflected in both the patient side application and the doctor side application.

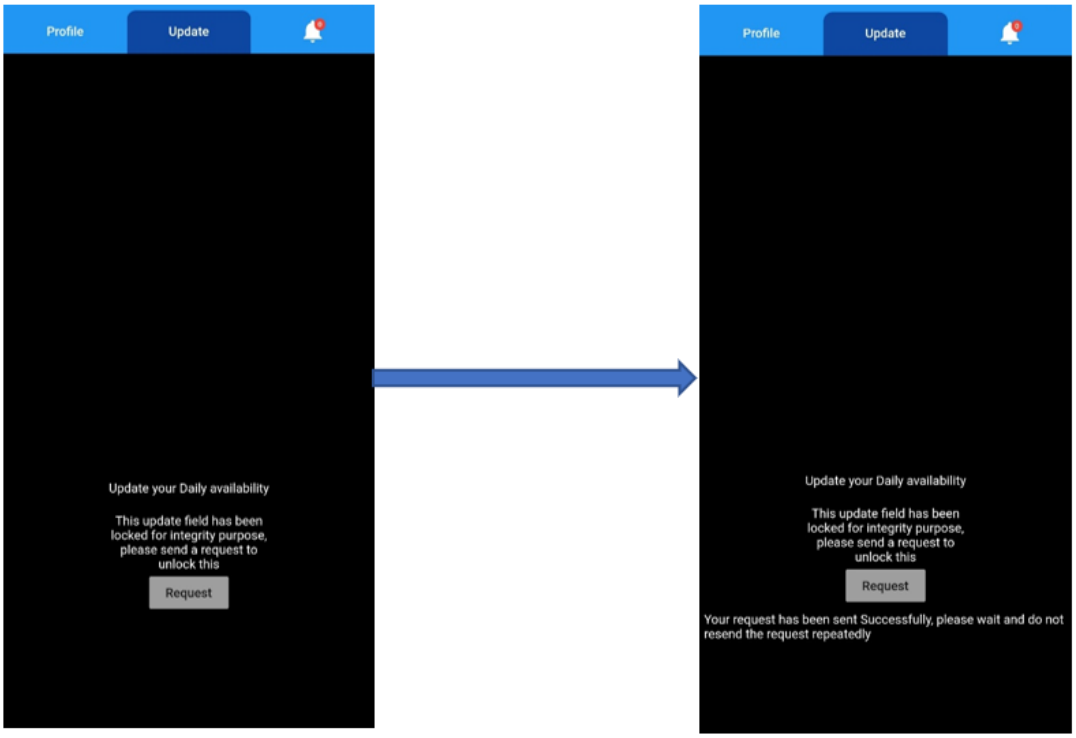

Figure 20: Update request

The third tab is to view the appointments that have been booked for that particular day. Doctors can view the details of the patients who have booked appointment like their name, phone number and time of appointment. This tab is automatically updated to reflect the changes when a new appointment is made.

Chapter 4

4. Modelling and Implementation

4.1. Use-Case Diagram

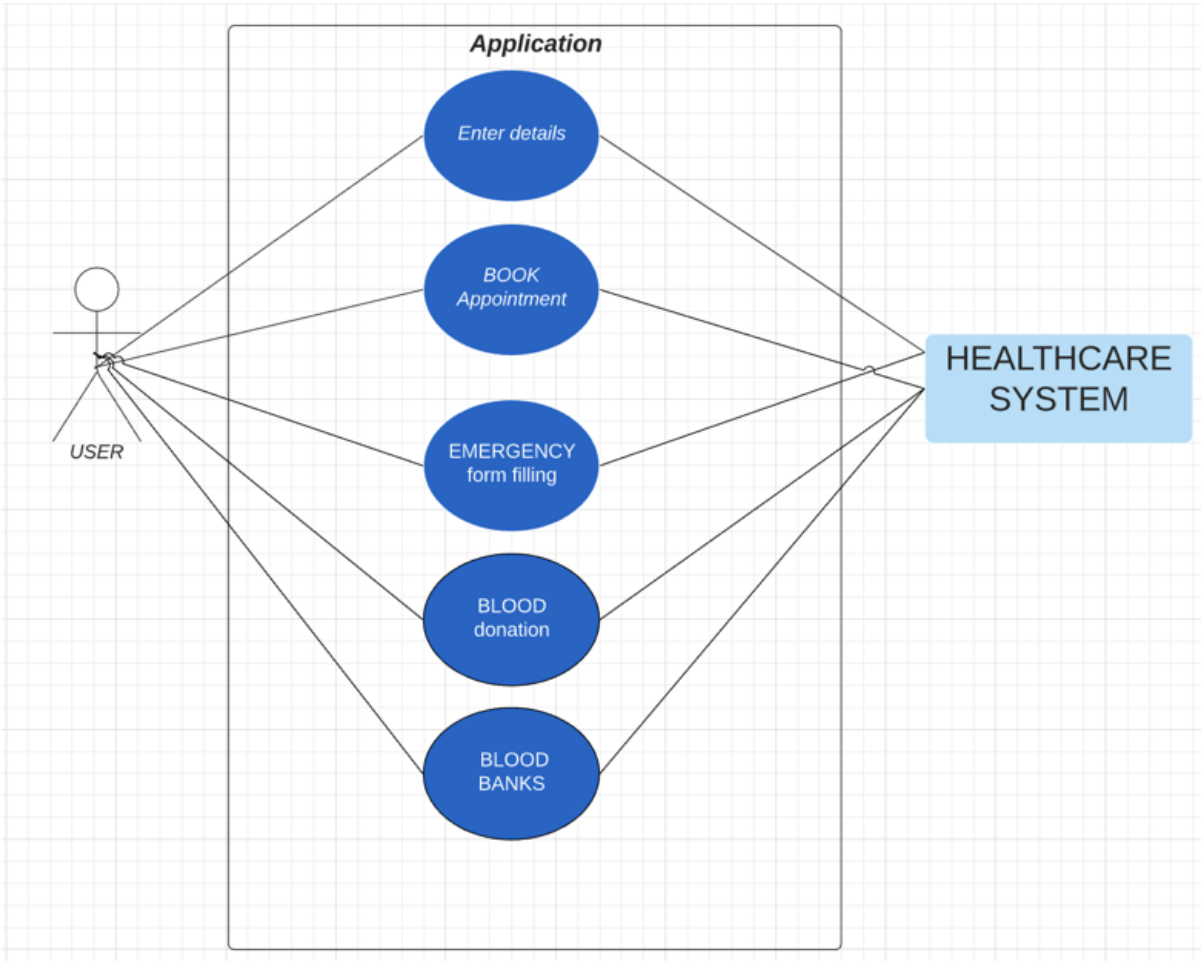

Figure 21:App topology

The HealthCare System can be thought of a database which is used to store, access and retrieve details about patients which are provided by the patients themselves. The database system used for this project is FireBase. Data is stored in the form of collections. All the nodes in the above figure are interconnected through the HealthCare System. **Figure 22:Hospital-Side Use Case** illustrates the Hospital-side use case scenario. Doctors and the receptionist can retrieve the required data from the database whenever they have to. The system eliminates the problems of appointment delays, miscommunication of information and accuracy.

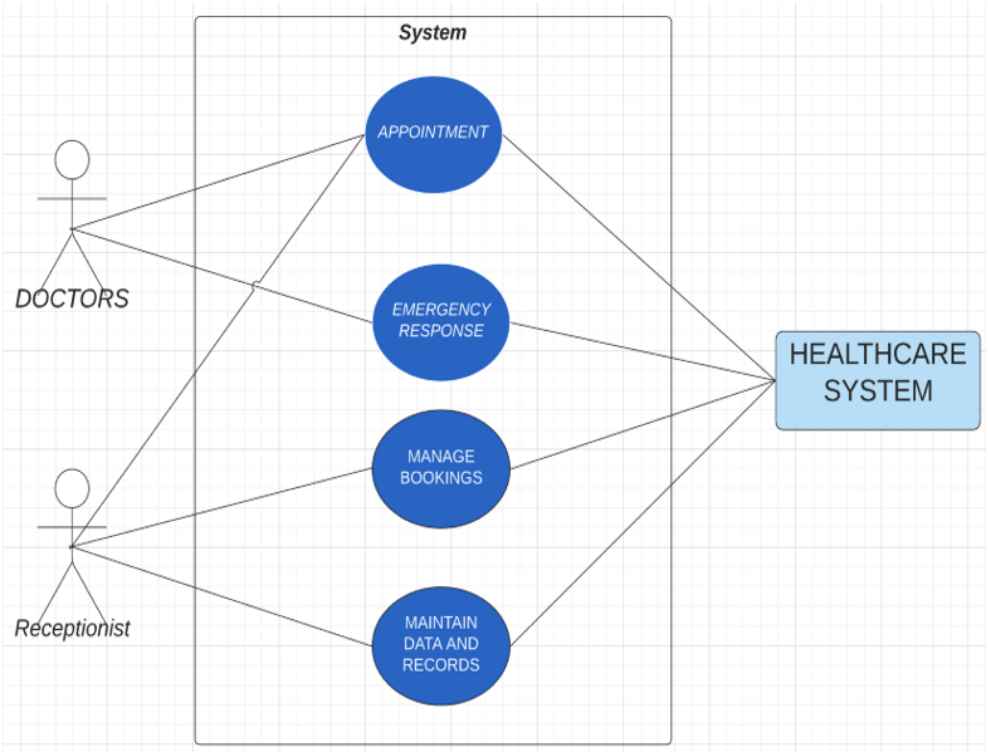

Figure 22:Hospital-Side Use Case

4.2. Class Diagram

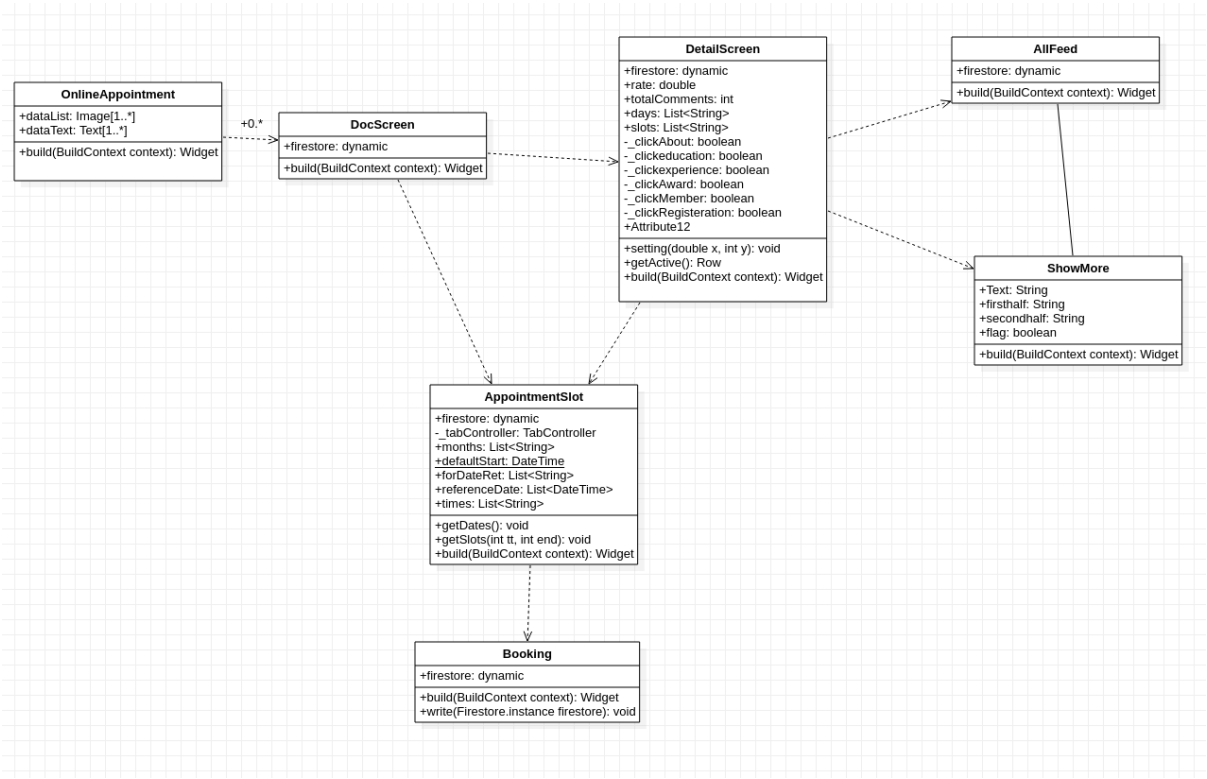

Figure 23: Hospital-side class diagram

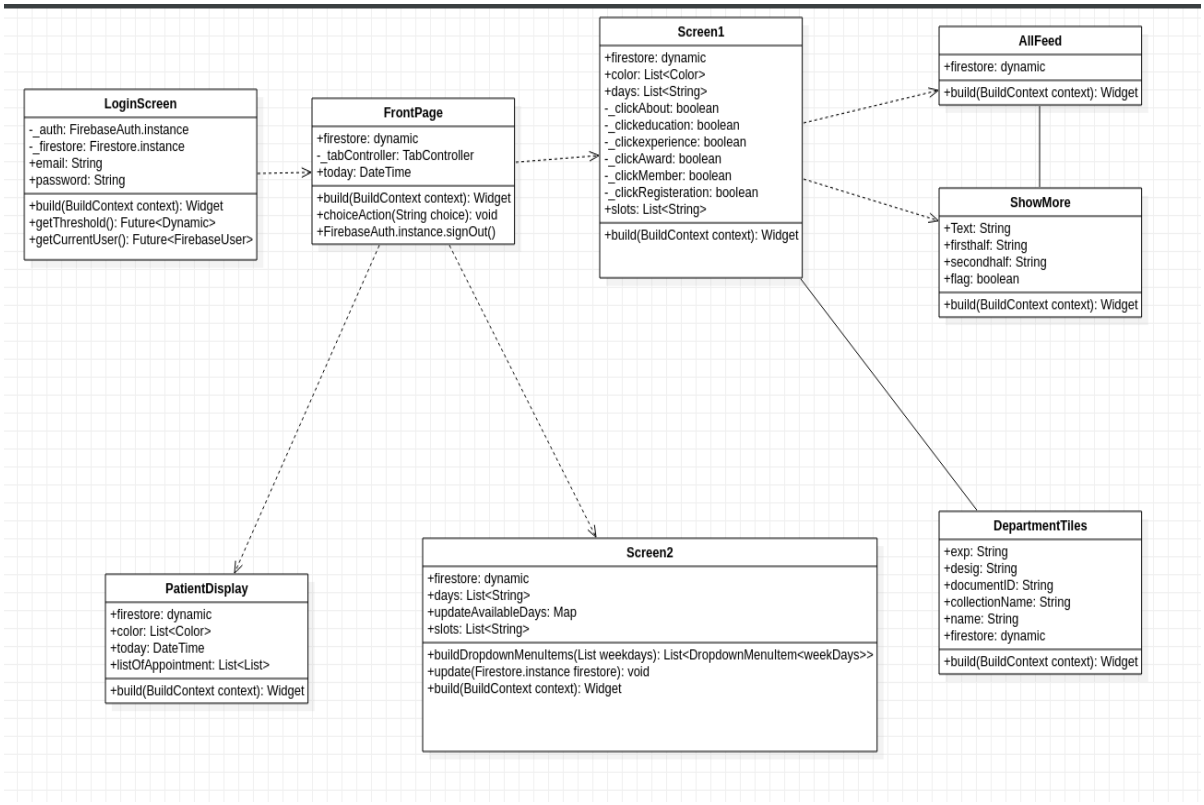

Figure 24:Doctor-side class diagram

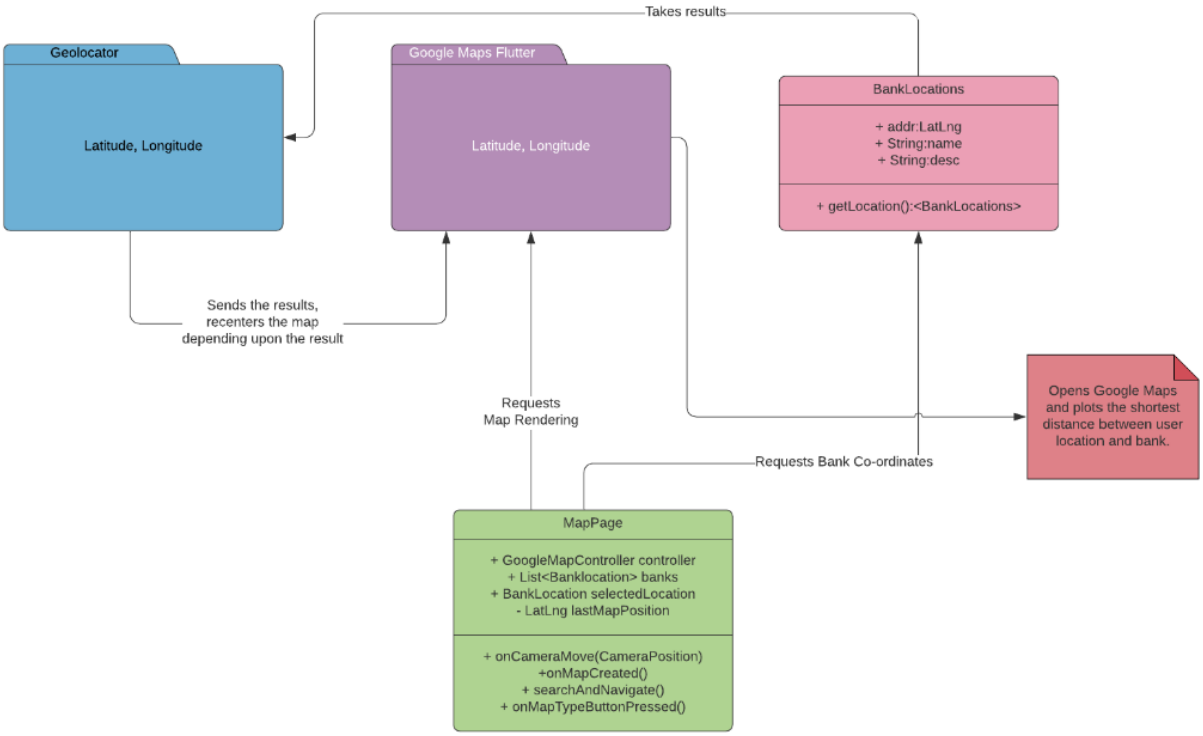

Figure 25:Maps Class Diagram

4.3. Sequence Diagram

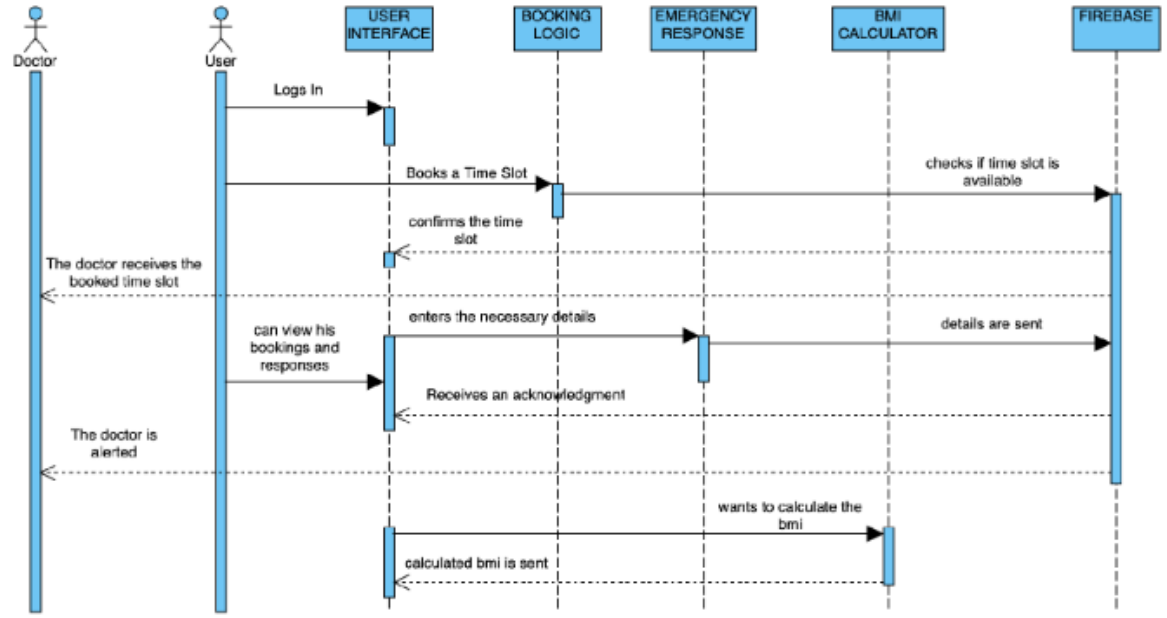

Figure 26:Sequence Diagram

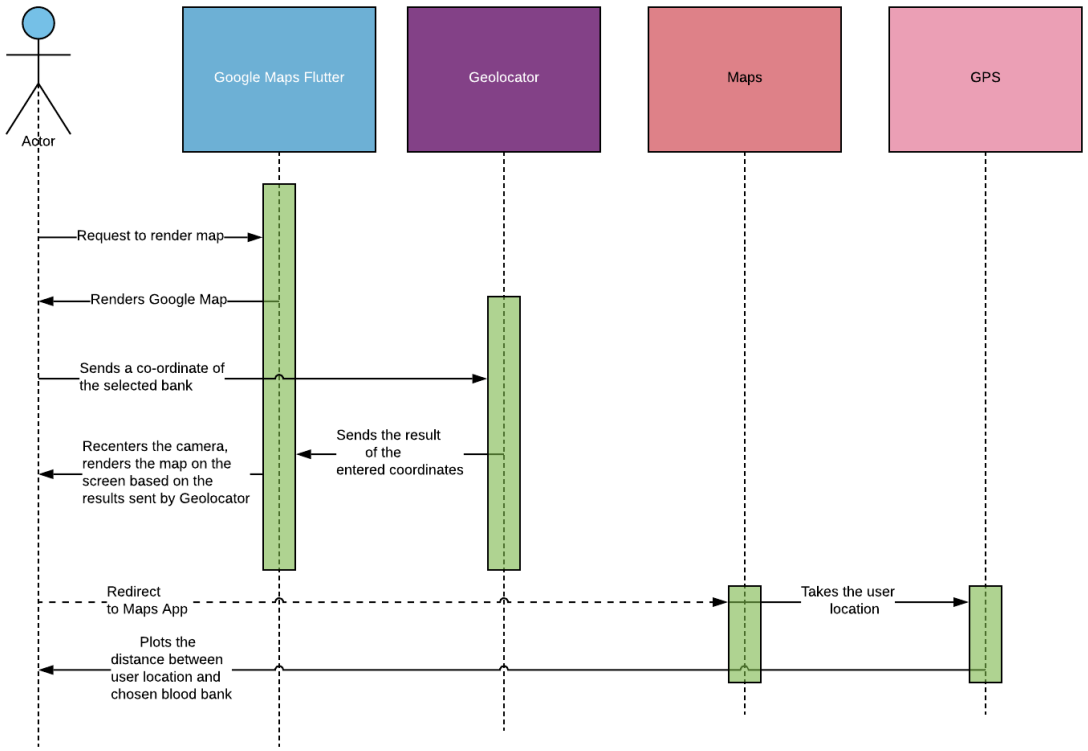

Figure 27:Maps sequence diagram

4.4. Collaboration Diagram

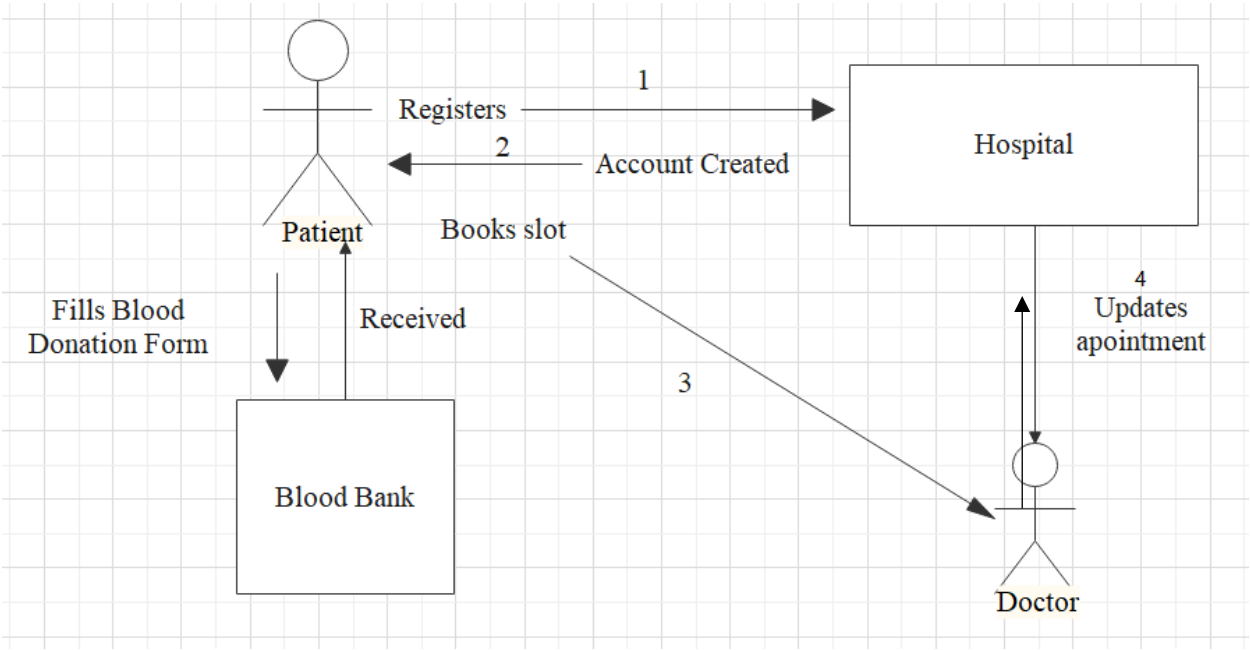

Figure 28:Collaboration diagram

Chapter 5

5. Testing, Results and Discussion

5.1. Testing

A testing environment is a setup of software and hardware systems which are used by the testing teams to execute test cases. In other words, it supports test execution with hardware, software, and networks configured. The Testbed or Test Environment is configured as per the need of the Application Under Test. In a few cases, the testbed could be the combination of the test environment and the test data it operates. The Test Environment Management deals with the maintenance and upkeep of the testbed.

List of activities by the Test environment management function:

- Maintenance of a central repository with all the updated versions of test environments.
- Test environment management as per the test team's demands.
- As per the new requirements creating new environments
- Monitoring of the environments
- Updating/deleting outdated test-environments
- Investigation of issues on the environment
- Coordination till an issue resolution.

Challenges faced when setting up the Test Environment:

i. Proper planning on resource utilization: Ineffective planning for resource utilization can affect the actual output. Also, it may lead to conflict between teams.
ii. Remote environment: It is possible that the Test environment is located geographically apart from the testing team. In such cases, the testing team has to rely on the support team for various test assets. (Software, hardware, and other issues).
iii. Elaborate set-up time: Sometimes test set-up gets very complicated like in cases of Integration Testing.
iv. Shared usage by teams: If the testing environment is used by the development and testing team simultaneously, test results may get corrupted.
v. Complex test configuration: Certain tests require complex test environment configurations. It may pose a challenge to the testing team.

Table 1:Test Case- Manage Appointments

Use case	Test case	Description	Procedure	Expected Result
UC01: Manage Appointments	TC01-1: The user tries to book an appointment.	The system checks if that particular timeslot is free.	The system manages to book successfully	The booking is registered successfully
			The system fails to book a time slot	Finds a different time slot.
	TC01-2: Time slot is removed	The system removes the particular timeslot	The timeslot is removed for further appointments	The booked time slot is removed.

Table 2:Test Case- Emergency Management

UC02: Emergency management	TC02-1: The user enters necessary details	The system holds all the emergency information	The system records all the necessary information	All the data is stored in the system
	TC02-2: The User receives confirmation	The system gives a response to the user about the details	The user enters all the necessary fields	The response is sent back to the user from the hospital
			The user does not enter all the necessary fields	The system tells the user to enter all the required fields.

Table 3:Test Case- Blood Donation

UC03: Blood Donation	TC03-1: Entering of blood details	The system stores the necessary details	The user enters the specific blood group	The blood group is stored in the blood bank database
	TC03-2: Shows the different options	Different optimum locations are shown.	The user chooses the optimum location	Maps redirect the user to the chosen location
			The user chooses a location other than the specified ones	Maps will redirect the user to the wrong location

Table 4:Test Case- User Authentication

UC04: User Authentication	TC02-1: User login	The user enters the correct email and password combination to login to the app	User enters correct credentials	Successful Login
			User enters incorrect credentials	Unsuccessful Login
	TC02-2: User logout	User logs out of the app	The user taps the 'sign out' button	Successful Logout

Table 5: Test Case- BMI Calculation

UC05: Body Mass Index	TC05-1: Calculate the BMI for women	Body mass index or BMI is calculated for a woman	Inputs of height and weight are taken and the BMI is calculated and displayed	The result is underweight. BMI<18.5
				The result is normal 18.5<BMI<24
				The result is overweight BMI>24
	TC05-2: Calculate the BMI for men	Body mass index or BMI is calculated for a man.	Inputs of height and weight are taken and the BMI is calculated and displayed	The result is underweight. BMI<18.5
				The result is normal 18.5<BMI<25
				The result is overweight BMI>25

5.2. Results

HealthCare Companion is a mobile application which aims at improving the healthcare standards of people. The application makes it easier for doctors to manage their appointments efficiently, requiring very minimum effort from the doctors. The app is built as a framework for hospitals. The receptionist of the hospital would be the database manager, keeping tab on the various appointments as well as documenting every single patient. The in-built map interface is very convenient for patients who need quick directions to blood banks. After examining the results of a number of time tests, using the inbuilt maps to search and get directions for a blood bank is faster than the conventional way of searching for a blood bank on the internet and then redirecting to a mapping application. The app however, redirects the user to google maps for navigation. Fitness is a key factor for maintaining good health. The body mass index is a good measure of a person's fitness; hence a BMI calculator has been implemented in the application. HealthCare Companion also comes with information about various pandemics and epidemics, giving knowledgeable insights to the origin and consequences of these diseases.

HealthCare Companion is just a platform for managing and booking appointments, filling out emergency forms and for getting directions to blood banks or hospitals. The patient has to be physically present at the hospital using the app to be treated.

5.3. Discussion

The digitalization of hospitals helps in improving the health and sanitation of communities, preventing the overcrowding of hospitals and can be used as a virtual platform by patients and doctors to book and view appointments. With the added features of maps and BMI calculation, the application can be used by hospitals and by individuals. Further improvements can be added to the application for extra features like an online medicine purchasing portal, a virtual chatbot so that patients can engage with the doctors and much more. Unlettered communities can gain information about the available health schemes for their benefit and can learn about the various disease outbreaks.

This app should be managed by the receptionist of the hospital which is using the app as the receptionist will have access to the database and will know the booked appointments for all the doctors.

Chapter 6

6. Conclusion and Future Work

Healthcare Companion is going to help the user have a better overall experience of the necessary healthcare services like booking appointments with necessary doctors and will also help in educating the user about the different health benefits which are available to them and information about some deadly diseases. The app allows the user to keep a tab on their body mass index so as to help people maintain their fitness levels. Users can easily find blood in the time of an emergency by using their location and the in-built map system, and help save a person's life in the time of need. The app also helps people in times of emergencies, whether it is a critical or a non-critical emergency, by helping the user save time and send the necessary information to the hospital database. All the required procedures will be performed ahead of time.

In the future, the application can be used by all the major hospitals, which provides them with easy access and maintenance of data, reducing the burden of manually using paperwork. The accuracy and precision of location and mapping services can be improved. A drug ordering portal can be implemented into the app, reducing another burden on the patient.

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