

Project Report

Healthcare Record Management System

SwasthaLekh and HealthTracker

A project report dedicated to the courses
Database Management Systems
and
Software Engineering

Submitted by **Team 5**

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Spring Semester 2021

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Certificate

This is to certify that this is a bonafide record of the project presented by the students whose names are given below during Fourth Semester, Spring 2021 in partial fulfilment of the requirements of the courses Database Management Systems and Software Engineering

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Date: 23 April 2021

Abstract

Good healthcare is the key to keeping the entire world healthy. The World Health Organisation (WHO) defines health management as decisions, plans, and actions that are undertaken to achieve specific health care goals within a society. The aim of healthcare management is to define a vision for the future which in-turn helps to establish targets and points of reference for the short and medium term. It also outlines priorities and the expected roles of different groups; and it builds consensus and informs people. It covers all categories of people.

Modern healthcare management systems focus on a wide variety of features pertaining to health. Already existing healthcare systems contain detailed records of an individual, but they mostly focus on the medical aspect. A quick look would show that there is an immensely important aspect that these systems don't cover. A holistic and comprehensive medical history of the individual, with all the prescriptions obtained and medicines advised. A digital medical history enables the patient to keep track of their health in the future, as well as it helps the doctors that they might be visiting in the future to understand the health condition and the medicines to be or not to be prescribed.

Our project focuses on that very characteristic of a healthcare system. We aim to build a mobile application and a web application that enables the individual to document all the prescriptions they have obtained, spanning different times and different visited health centres or hospitals, and the medicines they have been prescribed for use. More specifically, this application targets students living in hostels who make use of the institute healthcare facility to seek medical attention. These details can be documented for further use.

The significance and purpose of this project is to provide a user friendly and completely digitalized portal for documentation and management of medical data. This is a step towards reliability of crucial medical history in a digital manner. The designed applications ensure total digitization of medical data.

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Problem Definition

Existing medical record systems are individualized, every medical facility has their own database for a patient. However, in the current scenario, an individual patient does not have a "digitized" database of all their diagnoses, their prescriptions or their medications, as an individual is bound to go to different medical facilities as per their convenience. As a result, their medical history is not assembled, and rather is highly scattered which makes retrieval and use of that data extremely hectic. Adding to this problem is the fact that, in most places diagnosis and prescriptions are merely paperwork, which in turn is perishable, not a solid source of storing and very inconvenient. No modern healthcare record gives an individual a comprehensive documentation of their own data. This project focuses on that factor, from an individual point of view, and hence is its unique selling point.

The need for any patient is to have their own medical history with themselves. This would make it possible for them to understand their own condition and also help their doctor to properly analyze them based on their medical history. Recognizing this need, **this project aims to digitize handwritten prescription form and provide a mechanism for convenient search and retrieval of the medical data.** This further ensures that the temporary paperwork is turned into a digital form that is more concrete.

Another specificity of the project is the use of these applications for institute students living in hostels. Along with the utilization of the institute health centre when required, the students will be able to record their diagnosis through this application.

Introduction

2.1 Background

Many people visit the doctor office on a regular basis (sometimes multiple times per week) and have no way of accurately and efficiently keeping track of their health information, such as upcoming appointments, prescriptions, symptoms they experience away from the doctor office, notes from their doctors, and height and weight measurements.

Managing all that information can be quite a challenge because it is often written on paper and scattered across multiple documents and files. Also, information often comes from multiple doctors and clinics. Plus, there is no one, central location to store the information. For example, appointments might be scheduled on a paper calendar, but the notes from that appointment are located in a separate notebook. You might experience a symptom away from the doctor office, but you don't write it down and forget to tell your doctor at your next visit. As you can see, there are many problems with the current methods for managing one's health. Keeping track of this information is a time-consuming, manual process. As a result, this information can easily be lost, misplaced, or forgotten over time.

So, it is safe to say that managing our health information is difficult. It gets even more complex and challenging when trying to manage that information for someone else (for example, a child or grandparent).

This is where SwasthaLekh and HealthTracker comes in. HealthTracker is a web application that allows you to log and keep track of health information so that you can easily share and discuss that information with your doctor(s) during your next visit. It is one app that you can use to create and maintain a health journal for yourself or for another person. SwasthaLekh, the mobile app also documents all diagnosis and prescription related data.

No more having to carry around bulky notebooks, papers, and files to each and every doctor visit. Instead, all you need to do is bring your tablet to the doctor office, open up the app, and all the relevant information is there for the doctor to see.

Objectives:

- Computerizing basic medical details of patient
- Digitization of prescriptions to be uploaded to the cloud
- Recording illness and medicine prescribed
- Convenient viewing of the medical history
- Web application also allows keeping track of symptoms, health log and appointments

2.2 Research and survey

A quick survey in the neighbourhood hospitals and health centres is quite a revelation. There is no medical facility which provides an individual to track all the locations where they have taken past consultation from. There is no provision of tracking a digital framework of the medical history. An innovation is required in this aspect. Even from a student point of view, the medical consultations held during the time spent in universities are often not recorded. As a combination of these factors, this project develops an application to cover these aspects.

Majority of the developed countries have already adopted electronic medical records. The corporate hospitals in India have in fact started using medical records to capture patient's data. However, these records are only specific to particular hospitals, remain with the hospitals and are only used for reference when the same patient visits again.

2.3 Motivation

The motivation behind this projects lies in the fact that despite India being one of the better healthcare countries, there is a lot of pitfalls in digitizing medical data. There is a certain disparity in the collection of data and recording it. Individually, this becomes even critical. People in and around us tend to lose their prescriptions, or forget doses to medicines, forget allergy to certain medication and so forth. In spite of good health care facilities, very often this lack of medical history turns severe and even fatal for many. It also generates a lot of inconvenience and struggle to maintain or recover such data. Our projects aims to provide a solution to that.

Work Done

3.1 Product Deliverables (Core Functionalities)

3.1.1 SwastLekh: Mobile App

Scan and upload module

This module enables the user to fill essential details diagnosed during the doctor's visit like the diagnosis and the medication. Further the user can upload the prescription from their mobile gallery or scan using the mobile camera.

Search and view module

This module will help the user to search their records date-wise, doctor-wise, medicine-wise and diagnosis-wise. This section will also allow the user to show the history to the doctors they further visit.

Emergency call feature

It consists of the hostel warden's phone number, health centre's phone number and ambulance calling feature, in case of medical emergencies.

3.1.2 HealthTracker: Web Application

Authentication

When the user first visits the app, they will be prompted to log in (if they have already created an account) or sign up (if they are a new user). To sign up, the user will need to provide an email address as well as create a username and password. Authentication is required because it ensures that a user's health information is protected and blocked from other users.

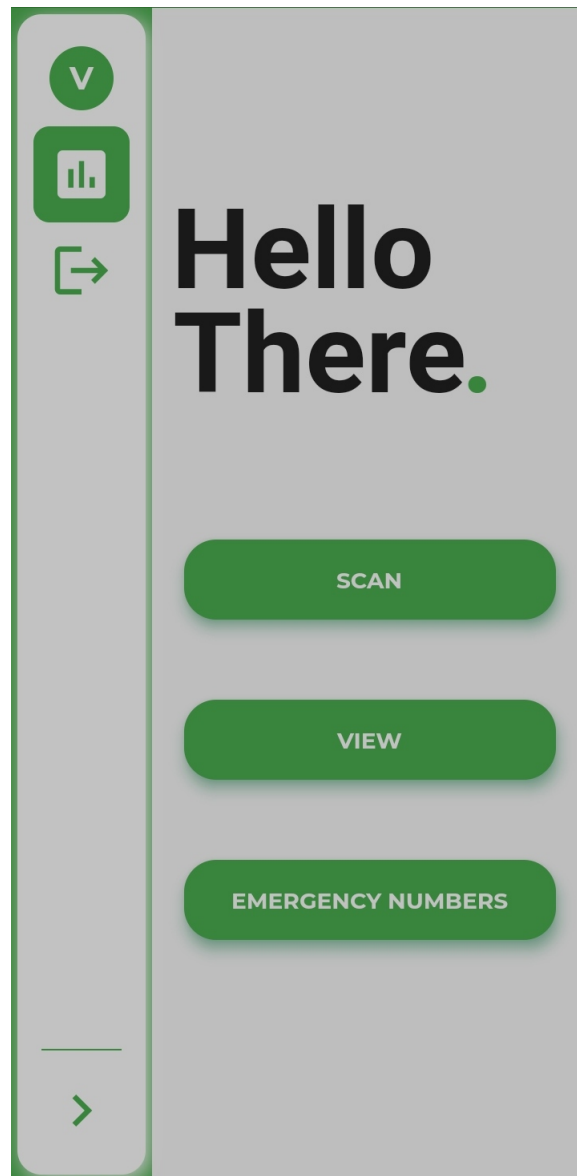


Figure 3.1: SwasthaLekh

Home

After authentication, the user are taken to the Home/Landing page. From this page, they can navigate to all the different pages with the app to keep track of their health information.

My health log

The My health log page is where the user can manually record doctor appointment information, including doctor being seen, date of visit, reason for visit, weight, height, and visit notes. The user can also track their height and weight measurements over time from the Charts page.

My symptom journal

The My symptom journal page is a log of symptoms that the user can share with their doctor at a future visit. They can record symptoms they experience away from the doctor's office, the time when the symptom occurred, and add comments to each entry. The users have a list of symptoms to choose from (for example, Dizzy, Shortness of Breath, Fainted, Swelling, Heart Fluttering, Fatigue, Other). There is a text field where they can enter more information about a symptom and list any useful information that will help them remember details of the symptom when they see their doctor at a future date.

Appointments

The Appointments page lists the upcoming appointments and related information in table format. Users can add and remove appointments from this page.

Prescriptions

The Prescriptions page is where the user can enter information about medications prescribed by a doctor, including prescription name, name of doctor who prescribed the medication, date prescribed, number of tablets, and directions for use.

Doctors and clinics

The Doctors and clinics page has contact information for each of the doctors consulted by the user, such as doctor name, email address, and office location. They can also add contact information for each clinic. After they add their doctors and clinics, the user can associate these doctors and clinics with other information, such as appointments, in the app.

Charts

The Charts page includes two line graphs. The top graph displays weight

data over time. This data is pulled from the weight measurements the user entered on the My health log page. The second graph is similar. It displays the height data over time.

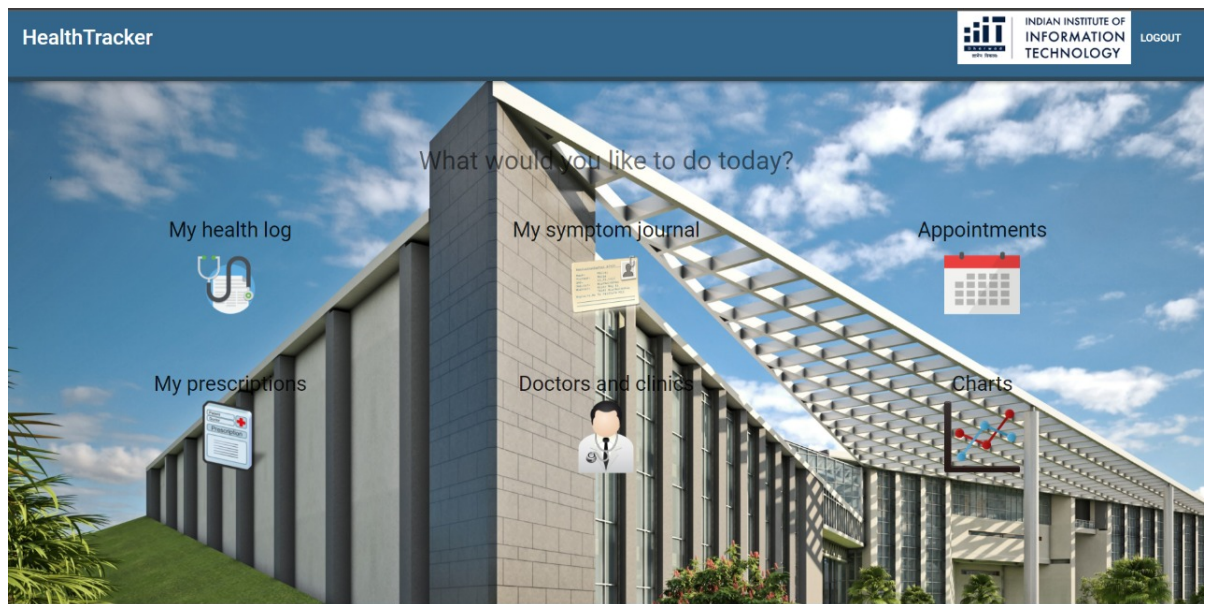


Figure 3.2: HealthTracker Home

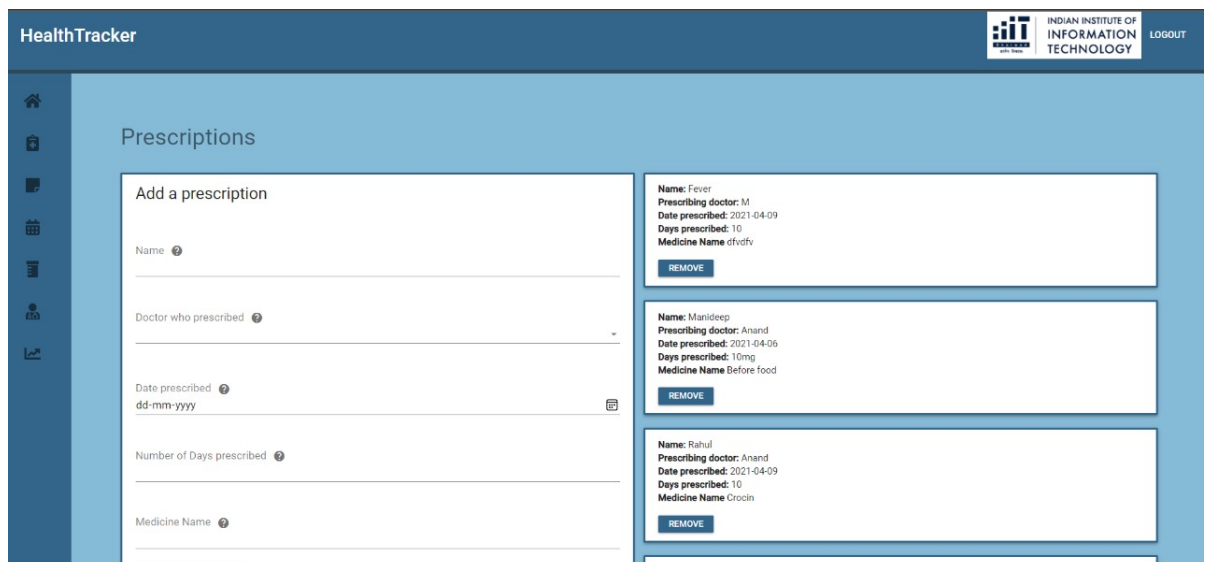


Figure 3.3: Prescriptions

3.2 Tech Stack

3.2.1 Mobile App

- **256 bit SHA encryption:** This has been used for the authentication of users. It has been used as it is much more secured than other hashing algorithms.
- **Flutter:** An open source UI SDK that has been used to build the user interface of our mobile app. It is also advantageous as it runs on many different platforms like Android, iOS etc
- **Dart:** We have used it for client development. It has been used as it is really flexible and has great tooling support. Also, Flutter is dependent on Dart
- **AWS Lambda Functions**
- **API Gateway**
- **Python:** Easy to use and has been used for server side scripting
- **DynamoDB:** This has been used for the backend. It is a NoSQL database service that supports key-value and document data structures and is offered as part of the Amazon Web Services

3.2.2 Web Application

- **React.js:** It is a JavaScript framework for creating the front end and dynamic client-side applications in HTML. It has been used as it allows to build complex interfaces through simple components and connect them to the data on the backend server
- **Express.js:** It is used for handling the server-side framework and handles the HTTP requests and responses. It works along with Node.js server
- **Node.js:** It has been used for the back-end API services
- **MongoDB:** A NoSQL database used for the backend

- On the front end side, this project is built using React, which is an open-source Javascript library developed at Facebook specifically for the task of developing user interfaces. React relies on a component-based architecture where elements of the user interface are broken into small chunks of code called components. Material UI is a CSS framework that helps with building these components. Material UI is a React component library that implements Google's material design.
- On the back end side, this project uses MongoDB, Node, Express, Mongoose ORM (Object Relational Mapper), Passport, and various third party packages. Node, MongoDB, and Mongoose are used to query and route data in the app. Express is the backend web framework used for this app. Passport is authentication middleware for Node.js (that is, the technology used to log users into the app).

Software Development

4.1 Use Case Diagram

4.1.1 Mobile App

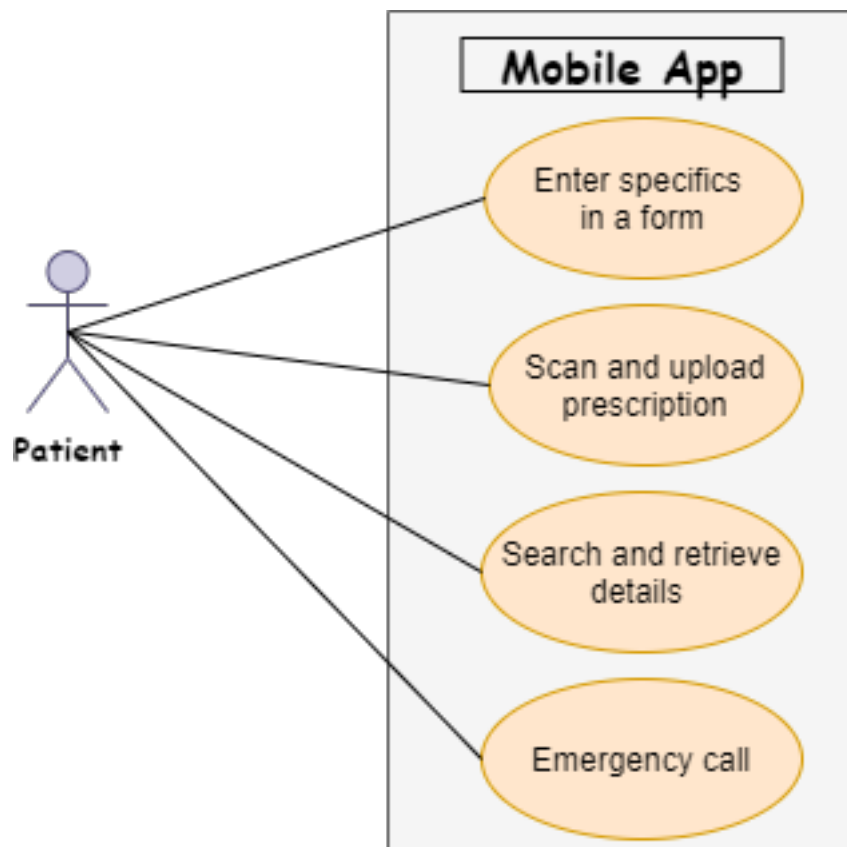


Figure 4.1: Use Case Diagram for Mobile App

The patient is the sole actor in this scenario. The patient is the direct external user of the system. The actor can interact with this app via these functionalities. The patient is allowed to enter details of the prescription in a form, scan and upload prescriptions, search and retrieve details, and also can use the emergency call feature.

4.1.2 Web Application

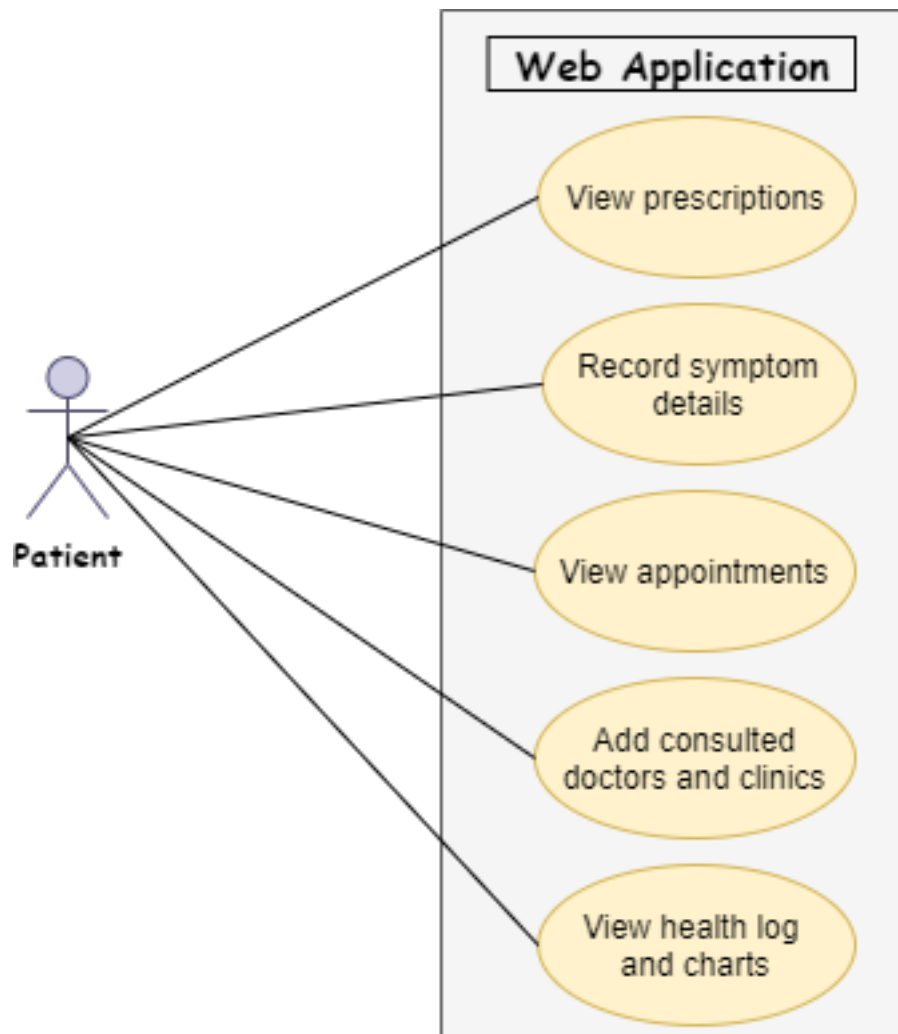


Figure 4.2: Use Case Diagram for Web Application

In the web application, the patient is the actor. They can directly interact with the application to use the given functionalities.

4.2 Sequence Diagram

4.2.1 Mobile App

Sequence diagram for scan and uploading prescriptions

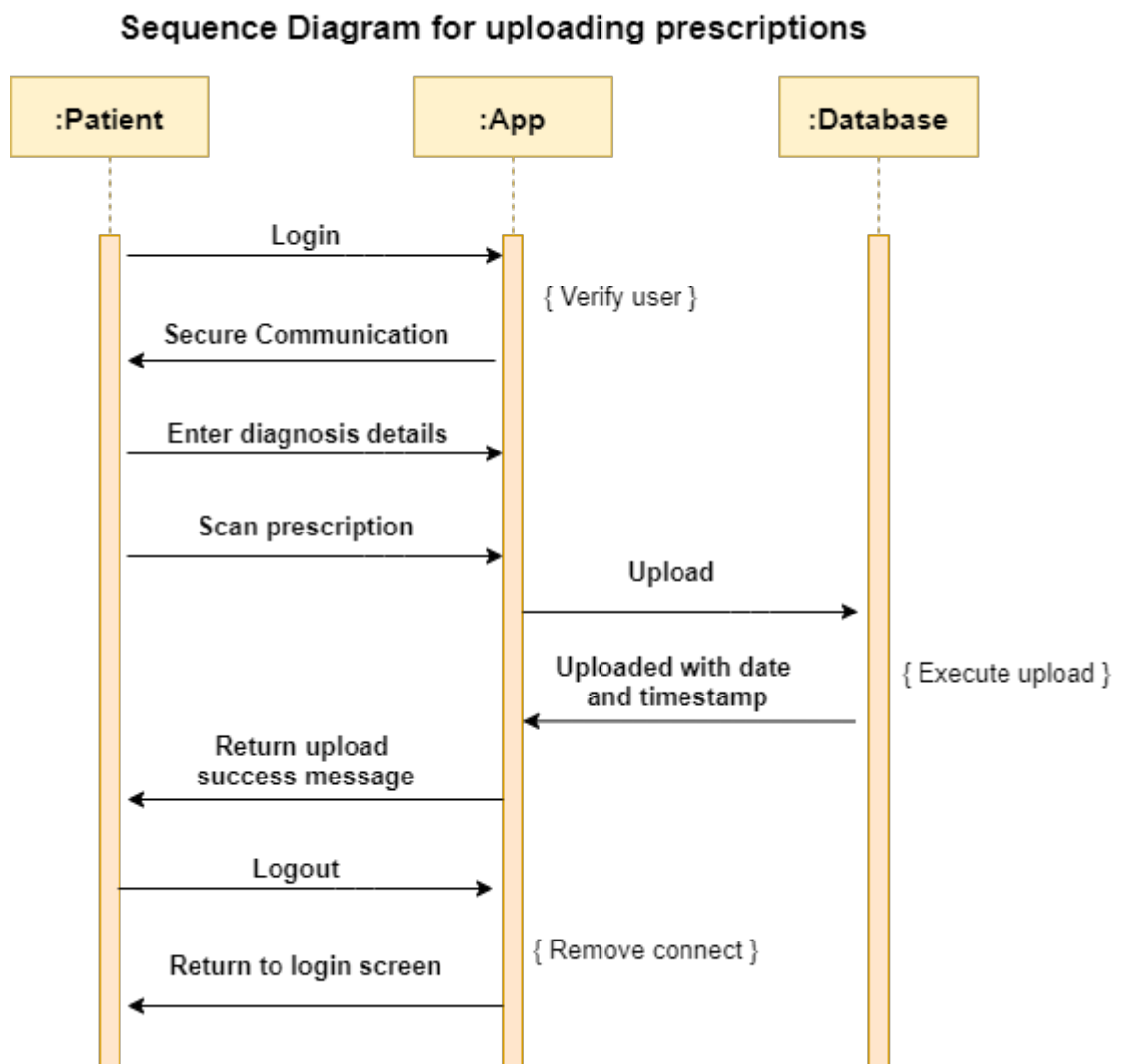
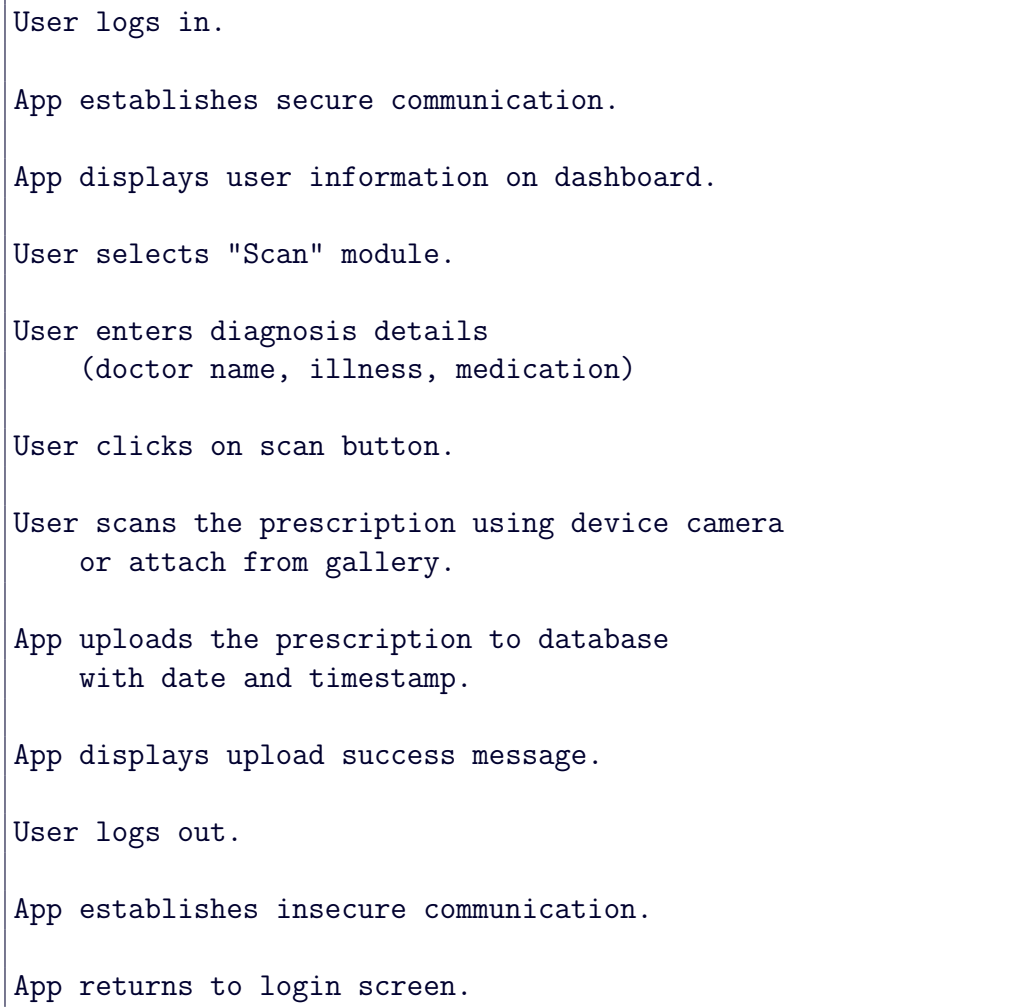


Figure 4.3: Sequence Diagram for scan and upload



A sequence diagram shows the participants in an interaction and the sequence of messages among them. **A sequence diagram shows the interaction of a system with its actors to perform all or part of a use case.** Here the scenario contains messages between objects as well as activities performed by the objects. Each message transmits information from one object to another. Particularly, the information here is exchanged between the user, app and database. The sequence diagram displays this interaction.

Sequence diagram for search and retrieval

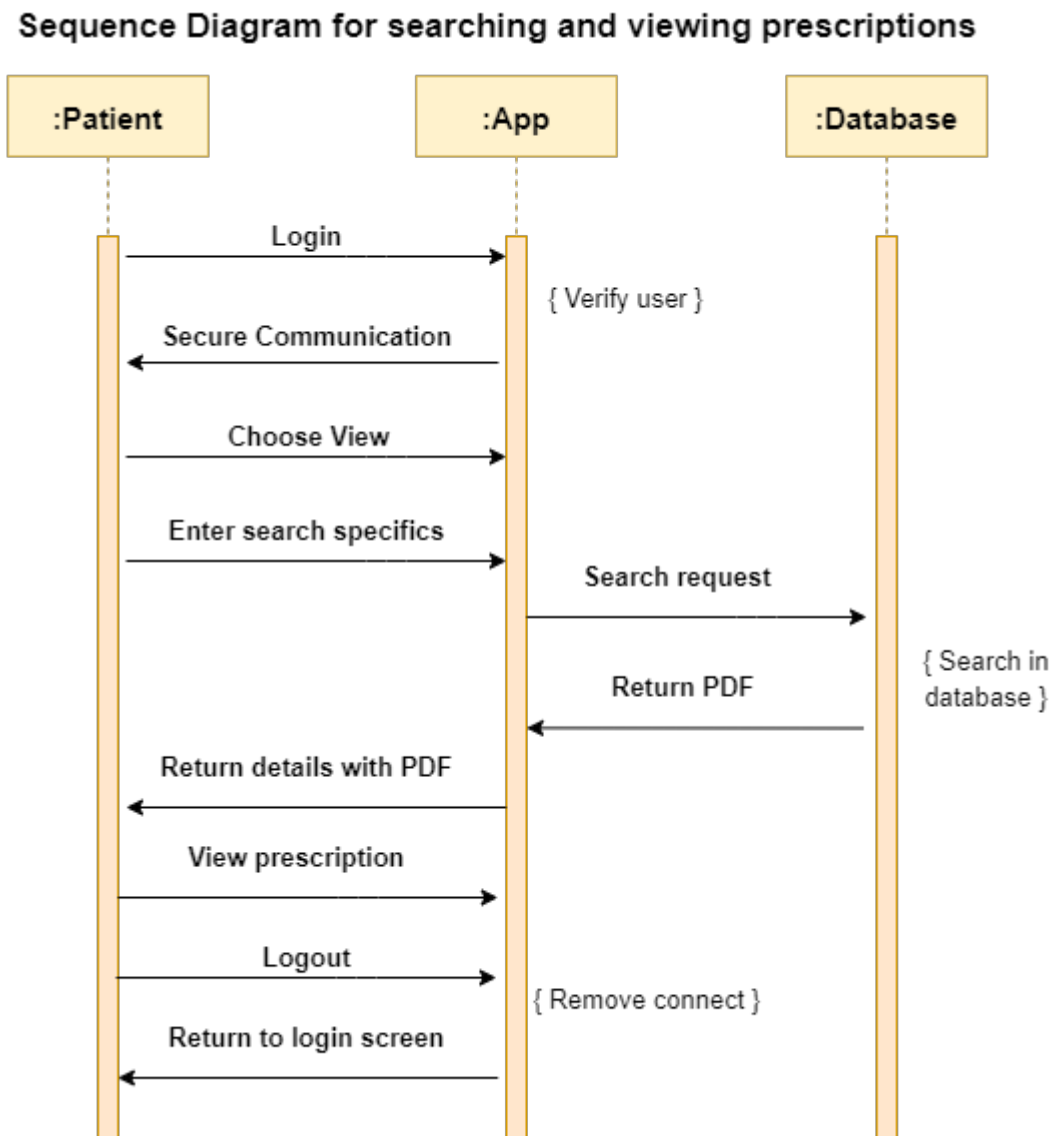


Figure 4.4: Sequence Diagram for search and retrieve

User logs in.

App establishes secure communication.

App displays user information on dashboard.

User selects "View" module.

User selects criteria for search
(date, doctor, diagnosis, medication).

User enters keywords and hits search.

App searches the database for the
data with the given keywords.

App retrieves search results.

User can view the PDF documents.

User logs out.

App establishes insecure communication.

App returns to login screen.

4.2.2 Web Application

Sequence diagram for health log and symptom journal

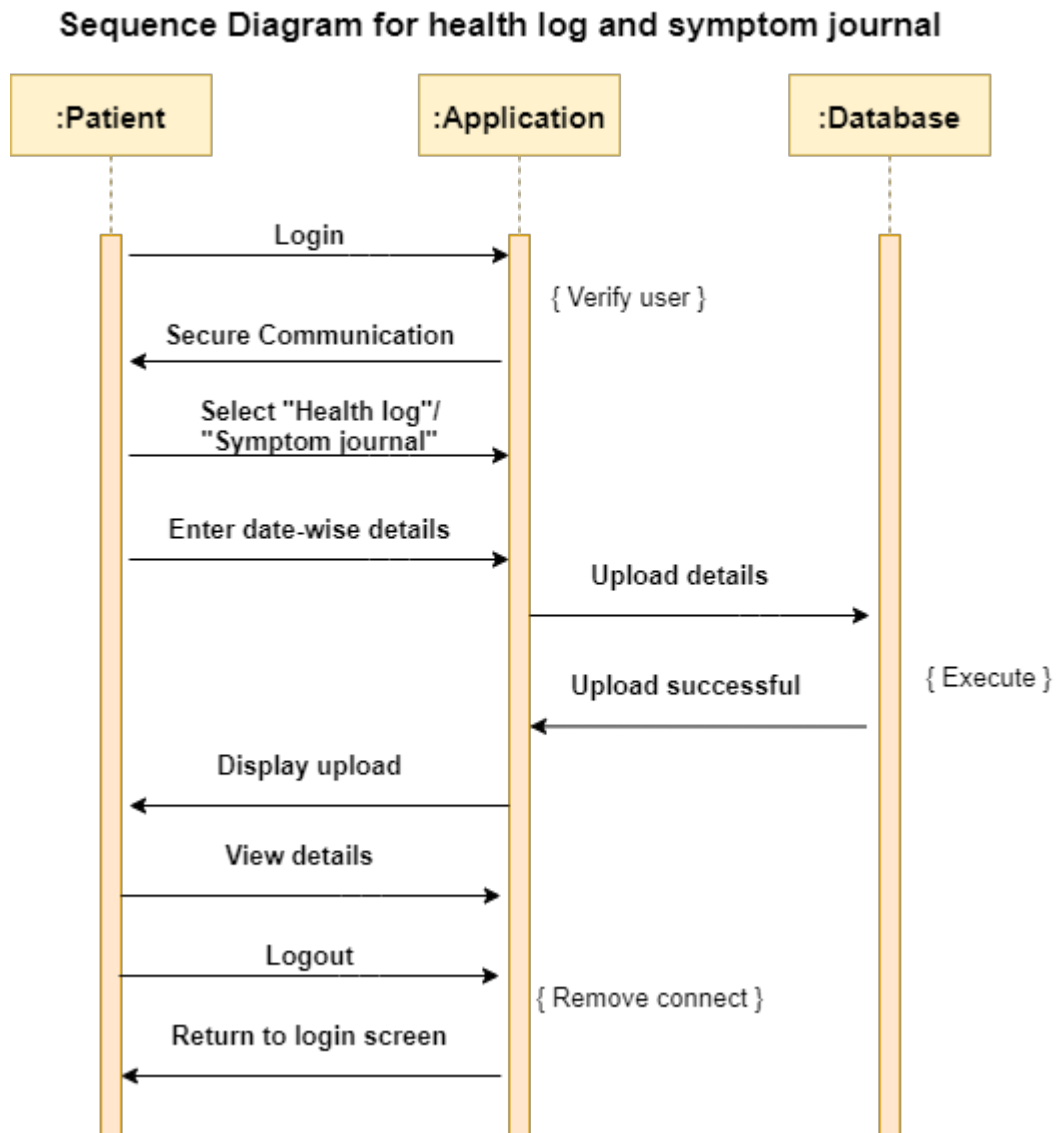


Figure 4.5: Sequence Diagram for health log and symptom journal

Sequence diagram for doctors and clinics

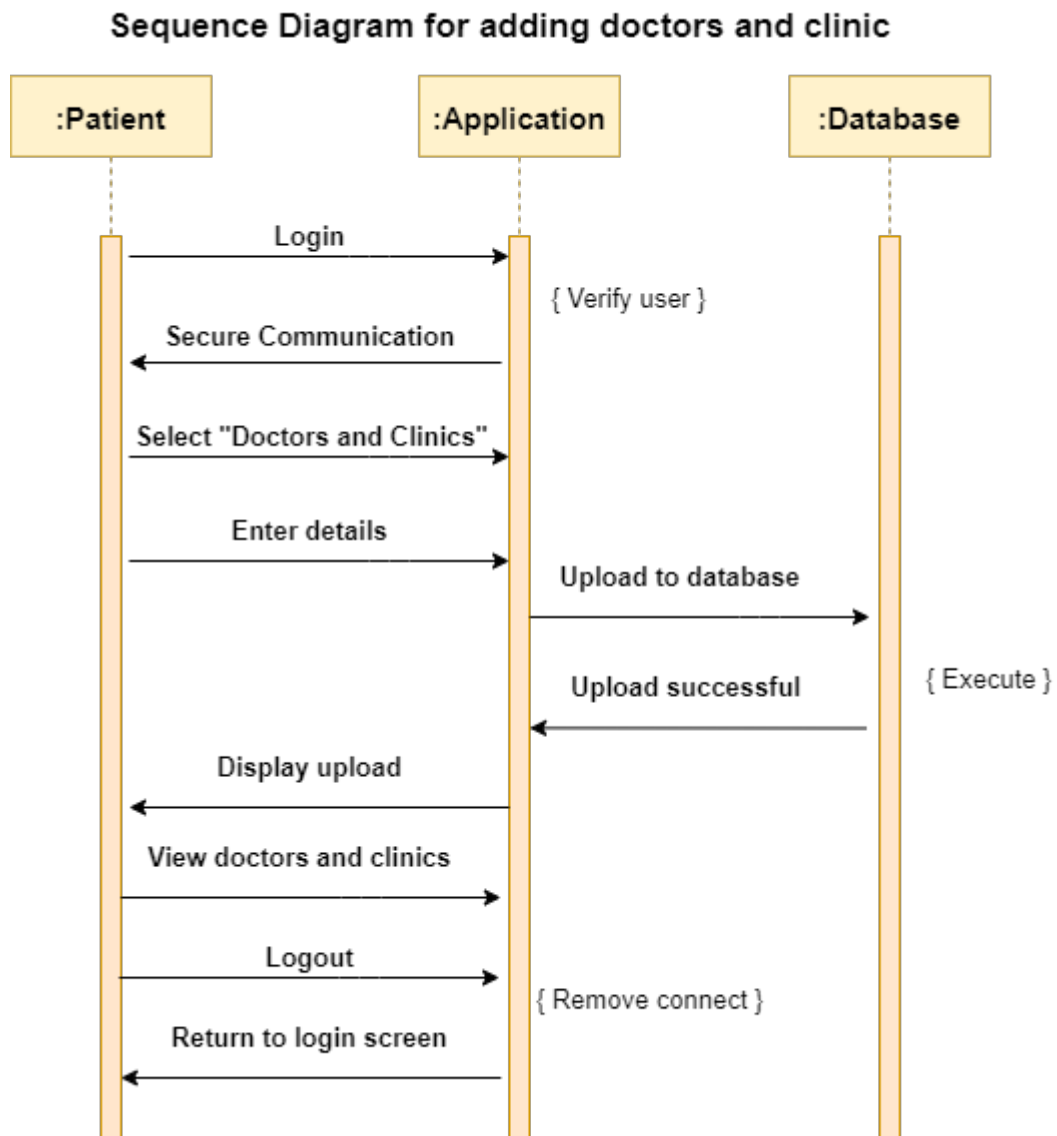


Figure 4.6: Sequence Diagram for doctors and clinics

Sequence diagram for viewing prescriptions and medical journal

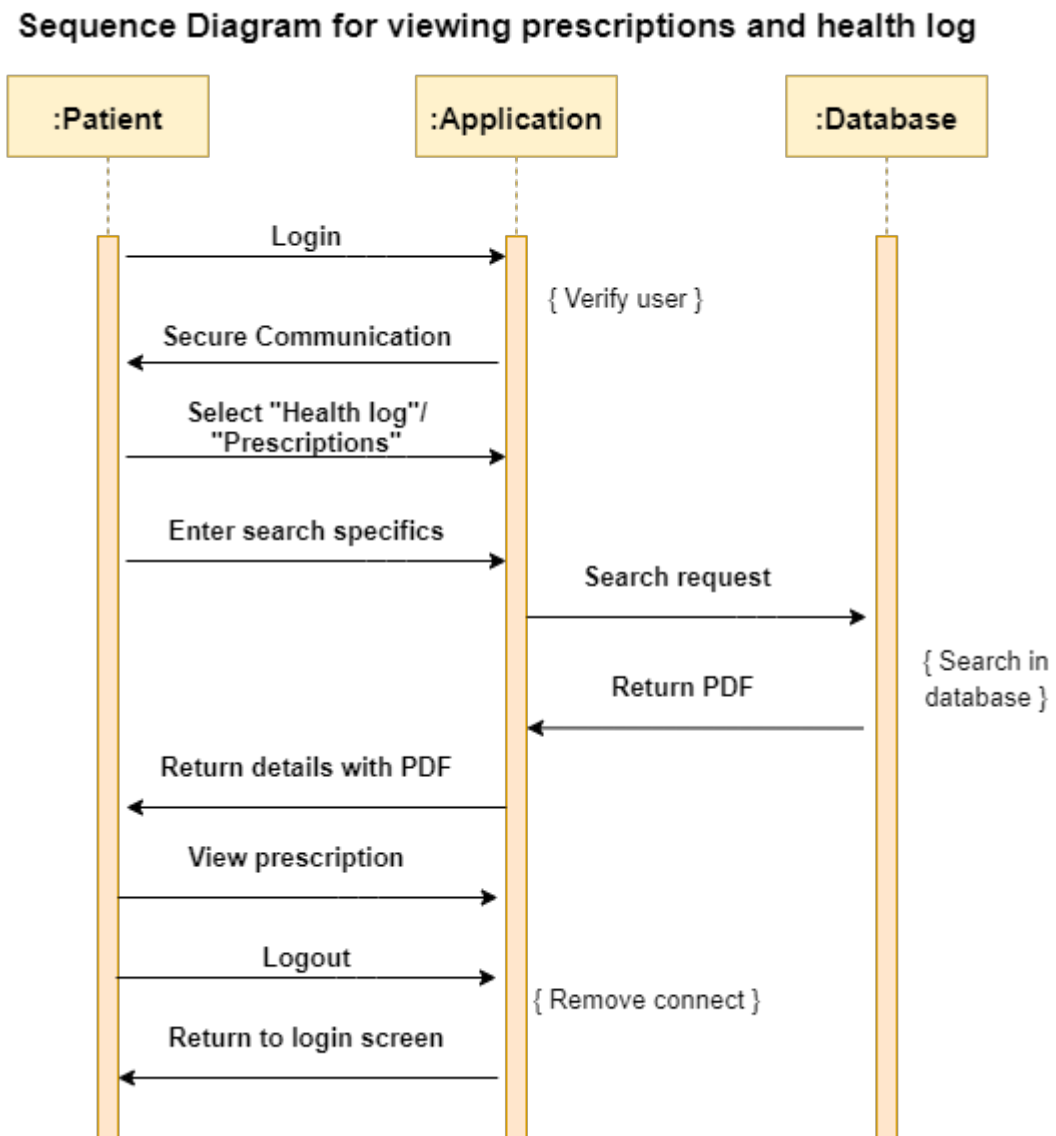


Figure 4.7: Sequence Diagram for view

Sequence diagram for appointments

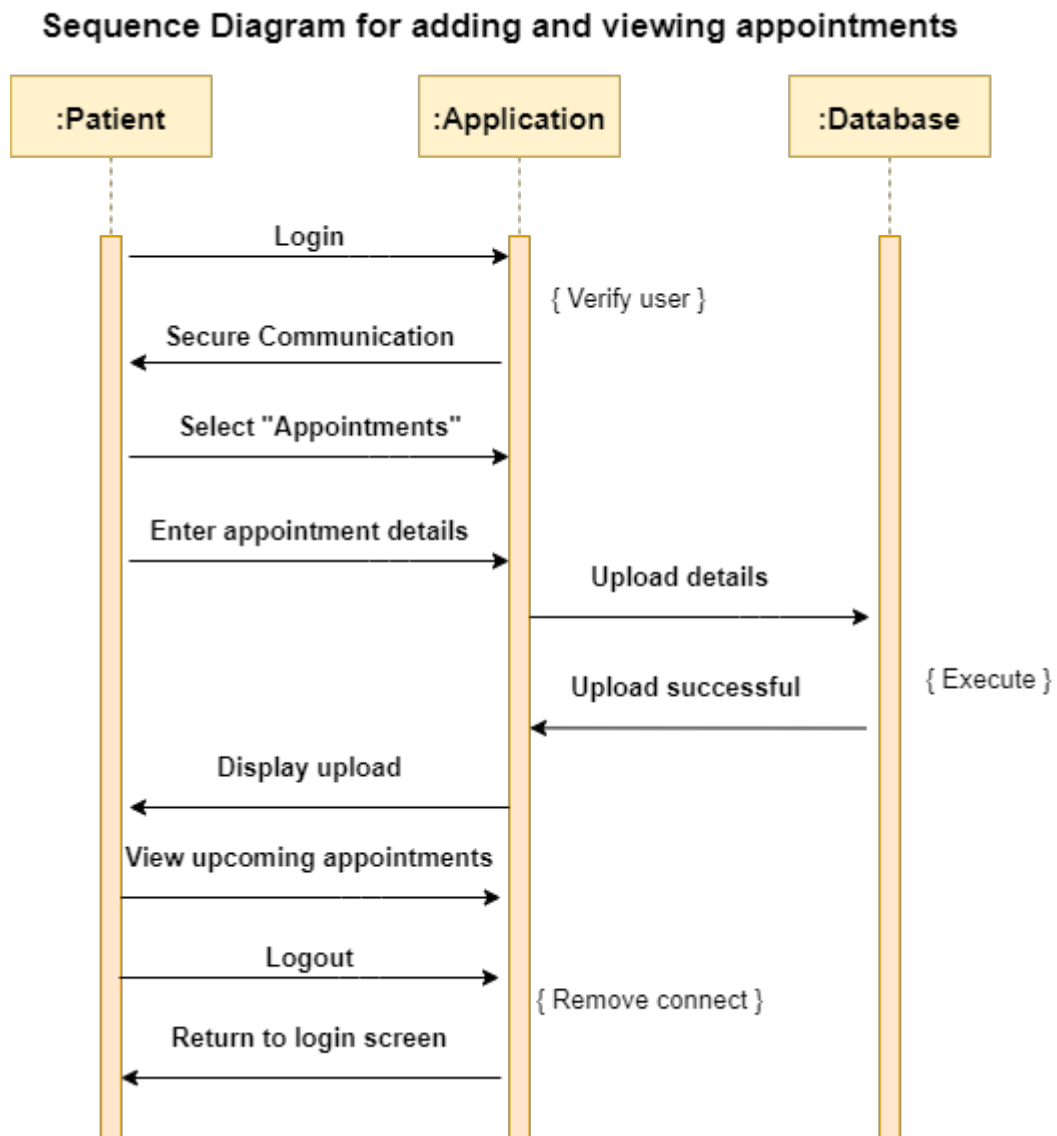


Figure 4.8: Sequence Diagram for appointments

4.2.3 Activity Models

Activity diagram for mobile app

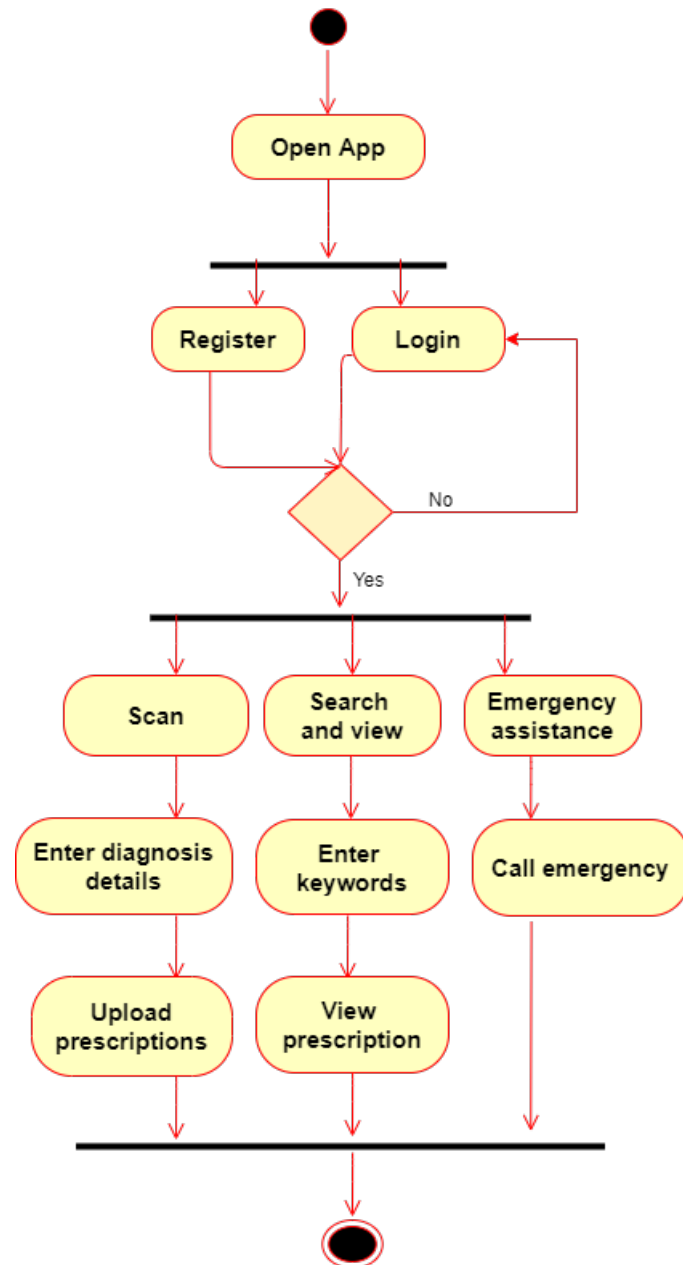


Figure 4.9: Activity diagram for mobile app

An activity diagram shows the sequence of steps that make up a complex process, such as an algorithm or workflow. An activity diagram shows flow of control, similar to a sequence diagram, but focuses on operations rather than on objects. Activity diagrams are most useful during the early stages of designing algorithms and workflows.

The activity model begins with a solid circle. The successive levels represent the various activities that the application can perform. In case of the mobile app, on opening the app, the user is either asked to login with their existing credentials or register as a new user by creating credentials.

Upon successful authentication, the user can choose between three activities. These have been connected with a solid line as these activities can branch out and run parallelly. The three modules have their own functionalities. On finishing the required tasks, the flow of the activities of the app can culminate.

Similarly, for the web application, the user needs to login or register. Then they can select among the 5 branching modules to be used. On successful process flow, the flow can end.

Activity diagram for web application

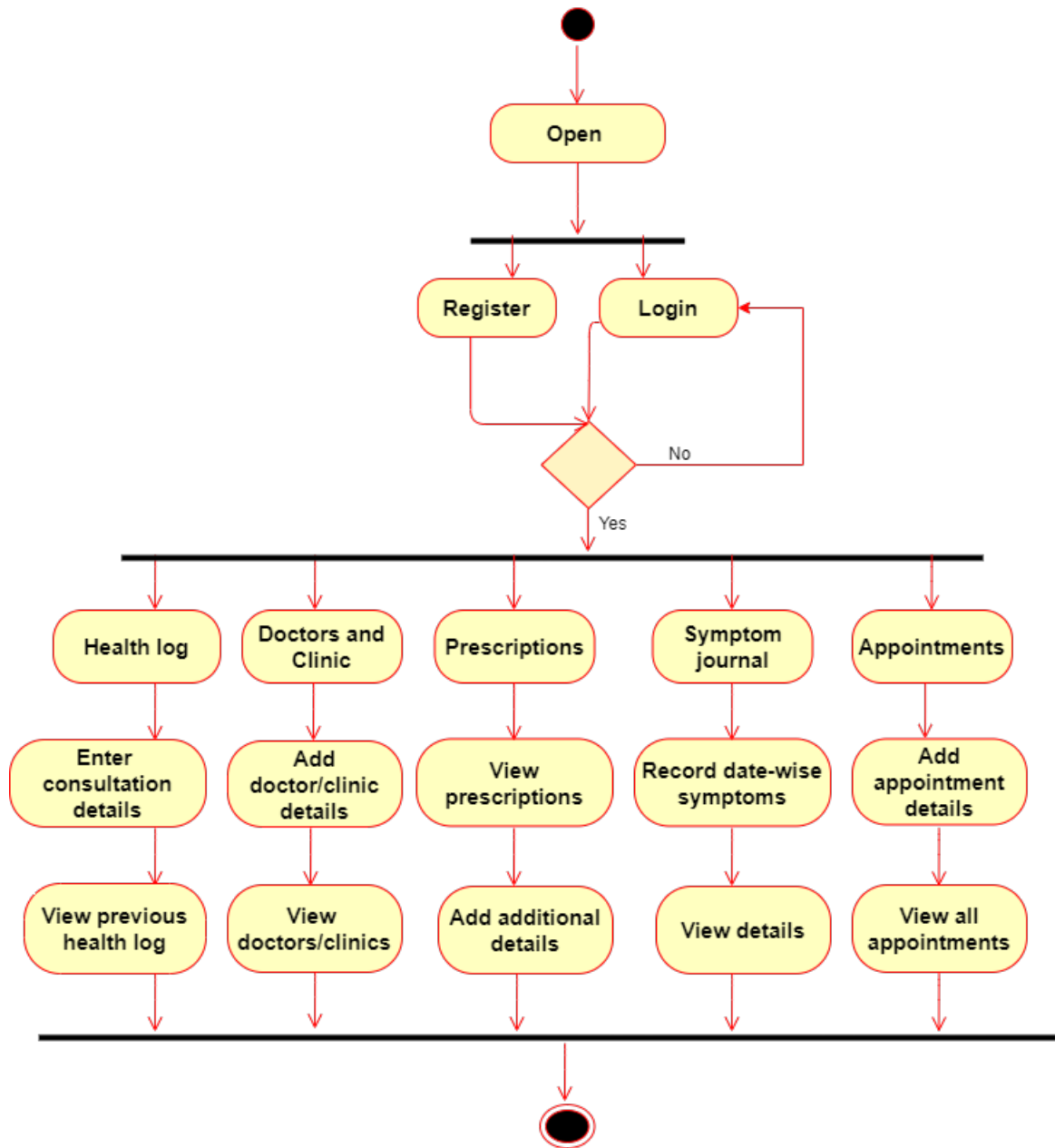


Figure 4.10: Activity diagram for mobile app

4.3 Software development methodology

A software process or methodology is the framework of activities to develop the final software. It is the process of prototyping, dividing the development work into modules which can run parallel or sequentially. It is to ensure that the work is up to the mark, improve design and help in product management.

Our team had initially planned to develop a hospital management system. The main modules that were planned were the doctor, patient, receptionist, pharmacist and laboratory. For that purpose, it decided to adopt the **evolutionary process model** so that after every iteration, an increasingly more complete model could be produces. However, after the first project review, our team decided to specify the project aim, and develop a digital medical health record system. This required agility from the team to quickly adopt the new scope.

Since this specified project was bound to change according to the various requirements of the consumer (example: institute health centre, rural health centre, organizational health record), the **agile developmental process** was more suited. In this methods, our team developed the software in iterations that contained mini-increments of the new functionality. We had regular meetings to check the advantage and working of each feature, before moving forward. The agile methodology was adopted to minimize risk while adding new functionalities. This helped our purpose right to the end and we could come up with the final deliverables.

Team Contribution

- **Web Application front end:** The team first learned HTML, CSS and Bootstrap to grasp the basics of web development. According to the initial project aim, that is hospital management system, Varun, Kalpajeet and Vikash, implemented landing pages, doctor's module and patient's module respectively. However, according to the final project requirements, **Manideep** and **Rohan** designed the front end of web application using ReactJS and MaterialUI.
- **Mobile app front end:** The user interface and various screens for the mobile app was created by **Kalpajeet** using Flutter and Android Development toolkit. The app is cross platform and works for any major operating system.
- **Server-side and Client-side scripting:** This part was implemented by the entire team in phases. API Gateway, Lambda functions, ExpressJS and NodeJS were used for this purpose.
- **Backend:** The team first familiarized themselves with structured query language (SQL) and then moves on to NoSQL, due to its advantages with respect to the project. **Varun** and **Vikash** implemented the back-end using MongoDB and DynamoDB for the mobile app and web application respectively.
- **Testing:** The testing first required the creation of datasets, which was done by **Manideep**, and then going through several different levels of tests. **Manideep** and **Kalpajeet** tested the applications, and the bugs that were found were fixed by **Varun** and **Vikash**.
- **Document preparation:** The required documents required for the project were compiled by **Kalpajeet** with support from the entire team.

Future Scope and Improvement

The main objective of this project was to digitize medical prescriptions and provide a convenient method to store medical history. **This project along with already existing hospital and healthcare management systems can be unified to make an end-to-end, that is, doctor to patient portal.** This will ensure that the prescriptions will directly begin as a digital product from the doctor's end, with the doctor's digital signature, to the patient's device. Thus, in the proposed system, when doctors digitally input medication and diagnosis details, it will be stored into a individual's database. This can be for any hospital and for a specific individual.

Another alternative that employs optical character recognition is when the doctor writes the prescriptions, the written text will be converted into digital readable from by comparing medicine database with the help of a Personal Digital Assistant(PDA), and this prescription will be saved in to patient's medical account in cloud. The patient can be recognized by a unique identity which can be used for all purposes like pharmacists, scans and future consultations. Also when a patient is visiting a new doctor by referring patients medical account the doctor can know all the medical procedures patient has gone through. Patient don't have to worry about losing the prescription. Another direct impact of this is the fact that the use of papers for prescriptions and reports will go down by about 60 percent, according to recent research.

Unifying our project module with a government database like DigiLocker (Government of India) will set a standard and also maintain uniqueness and privacy of all users, further providing convenient documentation.

Other improvements can include syncing the appointment calendar to the Google Calendar, regularly taking medical updates in digital form, adding health insurance details to the module and others, according to the consumer requirements.

Conclusion

The health tracker has many benefits for both patients and healthcare providers. It removes the need for patients to store and hold paper notes every time they visit a doctor. They will basically take their entire medical history with them everywhere they go with the digital medical record.

Digital medical record can be helpful in more than one way in terms of patient safety and better treatment. It avoids prescription and report legibility problems, offers 24/7 access to healthcare information, decreases duplication, saves time, and assists healthcare providers in making better decisions by understanding patient allergies, current medications, and correct dosages, previous diagnoses and treatment plans.

Once adopted, this will serve as a seamless communication platform whenever a patient migrates from one physician to another, as the comprehensive information allows the physician with a better understanding of patient's history. It can also play a pivotal role in documenting vital signs and symptoms, and the retention of information over periods of time can help a physician make competent informed treatment decisions.

This project is a tiny, yet concrete step towards total digitization and unifying the entire medical and healthcare system of a large population. A tremendous amount of needless inconvenience and suffering can be eliminated by ensuring that health records are universally available. India too, needs a individualized digital record that is comprehensive, user friendly, easy to learn and use to make patient healthcare safe and secure. Standardizing such a healthcare system with comprehensive documentation of patients will go a long way in moving hand in hand with the established health scenario, and saving lives.

Acknowledgments

We would like to share our sincere gratitude to everyone who helped us achieve this project. During the development, we did face challenges while learning and executing but we are grateful to our mentors for helping us get over our difficulties and compile our idea into a concrete product.

We would thank our professor of Database Management Systems, **Dr. Uma Seshadri**, and our professor of Software Engineering, **Dr. Manjunath K Vanahalli**, for giving us this opportunity to apprise ourselves with these new concepts and tech stack. We would like to show our gratitude to them for helping us understand the minute details of the project work and continuously helping and monitoring at every step.

We are also thankful to our institute, classmates and families for keeping us motivated during the development of this project

Naik Rohan
Varun B G
V Manideep
Vikash Singh
B M Kalpajeet

Fourth semester, Spring 2021
Indian Institute of Information Technology Dharwad

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