TOWARDS PATIENT-CENTERED CARE: A MOBILE APP FOR DYNAMIC FEEDBACK AND QUALITY ASSESSMENT IN HOSPITAL

BY

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ABSTRACT

This project presents the development of a new mobile application aimed at enhancing patient-centered care through dynamic feedback and quality assessment in hospital. The healthcare industry now emphasises Patient-Centered Care (PCC), focusing on integrating patient preferences into clinical decisions. This approach replaces traditional, provider-driven models with collaborative, patient-involved care. Traditional hospital feedback mechanisms often lack immediacy and fail to capture real patient needs and perceptions. To address these shortcomings, the proposed application provides a platform for users to provide feedback in real-time, allowing users to promptly communicate their concerns and experiences to hospital staff. The application offers a user-friendly interface and seamless communication to enhance user experience. By leveraging real-time feedback, the application aims to assess and improve the quality of care delivered, ultimately enhancing patient satisfaction and promoting patient-centered care practices in hospital environments. This mobile application enables patients to submit real-time feedback and assess the doctor's quality, improving their engagement and allowing personalised care. The app also invites public feedback on healthcare facility functionality, cleanliness and services. Additionally, it provides a communication channel for employees to share insights and observations, fostering collaboration and improving patient outcomes. The application will be developed using Android Studio with Java as the programming language. All associated data will be stored in Firebase, enabling users to access and update information in real-time. Additionally, Firebase will be used for Firebase Cloud Messaging (FCM) to push notifications to users. The application features multiple feedback channels, including phone calls, emails and text-based forms to accommodate different user's preferences. It enables patients to rate doctors and view reviews for transparency. It also provides a channel for employee to give feedback on patient behaviour and care preferences, enhancing communication and service. The area of study for this project includes Mobile Application Development and Database Systems. Keywords associated with this work are Patient-Centered Care, Real-Time Feedback, Mobile Health, Firebase, Android Development, Quality Assessment, Healthcare Communication, User Engagement, Doctor Rating, and Patient Satisfaction.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

PCC	Patient-Centered Care
IOM	Institute of Medicine
Lo-fi	Low-fidelity
Hi-fi	High-fidelity
FCM	Firebase Cloud Messaging

Chapter 1
Introduction

In this chapter, it will present the problem statement of this project, objectives, project scope, contributions and report organisation.

1.1 Problem Statement

In today's healthcare industry, the concept of patient-centered care (PCC) is recognised as a critical component of high-quality care. However, traditional feedback mechanisms in healthcare such as standardised satisfaction surveys and feedback forms are often inadequate and may not be very beneficial to patients and healthcare professionals. These methods are typically passive and fail to capture real-time patient experience and needs and hinder healthcare providers from promptly addressing patient concerns.

1.1.1 Hospital lack of real-time feedback mechanisms

Despite the growing emphasis on patient-centered care and the importance of obtaining patient feedback for quality improvement, traditional feedback mechanisms in hospitals such as periodic satisfaction surveys and paper-based feedback forms are often troublesome, nonresponse, time-consuming and disconnected from patients' care experiences, leading to delays in responding to patient complaints and limiting opportunities for timely improvement [1]. The HCAHPS survey is one of the most standardised methods to collect feedback. Since the survey is collected weeks after a hospitalisation, it may be subject to recall bias and thus cannot be used to address problems in real time to enhance the patient experience [2]. Furthermore, because patients do not always have the opportunity to fill out surveys or feedback forms during their hospital stay, these traditional mechanisms have poor response rates. This lack of engagement will affect the patient's experience and preferences, making it difficult for healthcare providers to obtain insightful information on areas that need improvement. Therefore, there is a need for a feedback mechanism that can collect dynamic feedback from patients.

1.1.2 Patient do not have a proper communication channel.

Patients frequently lack a dedicated platform that allows them to quickly express their problems and feedback to their healthcare provider. This absence of a direct communication channel limits the patients' ability to voice urgent problems or provide timely feedback on their care experiences. Without a designated platform for communication, patients may rely on informal and indirect means of communicating their needs such as verbal communication with nursing staff during rounds. When patients are unable to provide their feedback timely, they may feel disconnected from their care experiences and thus low satisfaction scores or complaints are provided. As a result, healthcare providers face challenges in obtaining feedback from patients which limits their ability to address patient problems and needs effectively.

1.1.3 Employees do not have a communication channel.

On the other hand, there is a significant gap in dedicated communication channels for employees such as doctors, nurses and other hospital staff to express their feedback regarding patient behaviour, care and overall operations. The feedback shared by employees is also considered very important for identifying areas that need improvement and enhancing the quality of patient care.

1.1.4 Patients have limited quality assessment method.

Hospitals often lack effective mechanisms for assessing collected feedback, especially feedback regarding specific healthcare providers such as doctors. Previously, when patients wanted to assess the quality of a specific doctor before scheduling an appointment with that doctor, they may find challenges in finding a channel to assess the quality of the doctor. Besides, traditional methods like periodic surveys or paper-based feedback forms often fail to capture patient feedback towards specific doctors. Moreover, patients are also unable to access reviews from other patients regarding specific doctors. The absence of this kind of transparency will limit patients' ability to make informed decisions about their healthcare provider and undermine patient's confidence in the healthcare system. Therefore, a dynamic feedback mechanism combined with a quality assessment system is required to obtain patient feedback to gain a better understanding of patients' perspectives, identify areas for improvement and ultimately provide more patient-centered care.

1.2 Objectives

There are several goals that this project wants to accomplish. The project objectives are listed as follows:

1. **To develop a mobile application to enhance patient-centered care through dynamic feedback and quality assessment in hospital.**

   This project provides a platform where patients can give real-time feedback on their care experiences, including interactions with healthcare providers and the overall quality of service received. It also enables users to rate and review doctors and view reviews from other patients, enhancing transparency. Additionally, the application allows hospital employees to provide feedback on patient behaviour, care delivery preferences and attitudes, fostering improvements in communication and service delivery.

2 **To facilitate real-time communication channels for patients and hospital employees to provide dynamic feedback.**

   This project must support real-time communication between patients and hospital staff through direct channels such as phone calls or in-app chat. When patients wish to provide immediate feedback, they should be able to quickly initiate a phone call or send a message through the application to reach hospital personnel. In other words, hospital staff should receive these communications without delay and respond promptly either by returning the call or engaging in a chat conversation to address the concern. This is because two-way communication is essential for resolving issues efficiently, improving the patient's experience and fostering grater satisfaction through a proactive and responsive support system.

3 **To develop a mobile application to enhance the user experience by distinguishing between different users within the application.**

   To enhance the overall user experience, this project aims to develop a mobile application that clearly distinguishes between different user types such as public, patients and doctors. The application will feature a clean, user-friendly interface with intuitive navigation, ensuring that users can easily interact with the system based on their roles. Each user type will have a dedicated interface and functionalities tailored to their specific needs. By prioritising ease of use and accessibility, the project aims to

make the feedback process more engaging and efficient, allowing users to quickly become familiar with the application and seamlessly provide their input according to their specific roles.

4 **To assess the quality of care delivered through user feedback**

This project implements a star rating and review system that allows patients to evaluate various aspects of a doctor's performance such as communication, professionalism and overall satisfaction. By viewing these ratings and reviews, patients can make informed decisions when selecting healthcare providers, promoting transparency within the system. At the same time, doctors receive constructive feedback, helping them identify strengths and areas for improvement. This continuous feedback loop plays a crucial role in enhancing the overall quality of care provided and fostering a culture of accountability and excellence within the hospital.

1.3 Project Scope

In this proposal, the main deliverable is an Android application designed to enable dynamic feedback and quality assessment in hospital. The application will cater to both patients and employees, allowing them to interact seamlessly and provide feedback on the services offered. The project will be developed using Android Studio, with Java as the programming language. All the UI designs and features will be created using Android Studio. The project's minimum SDK is API 24, corresponding to Android 7.0, which can run on approximately 96.3% of devices.

To ensure scalability, performance and real-time data synchronisation, Firebase will be used as the backend service for database management and storage, which is efficient handling of large data volumes while ensuring responsiveness across devices. The completed system will feature a fully operational mobile application with a user-friendly interface tailored to different user roles. It will empower patients to submit feedback conveniently and provide hospital staff with actionable insights to enhance the quality of care and operational efficiency. Below are the modules which will include in this project.

Public Users

Table 1.1: Public Users Modules

Module	Description
Choose User Type	Users can select their identity as Public, Patient, or Staff.
Phone	Users can contact the management hotline directly to provide feedback.
Email	Users can email the hospital directly to provide feedback.
App Feedback	Users can provide feedback on the app's functionality, performance and offer suggestions.
Feedback – [General Feedback] Others	Users can provide feedback on the hospital's facilities, environment, staff attitude, and offer suggestions.

Patient Users

Table 1.2: Patient Users Modules

Module	Description
Choose User Type	Users can select their identity as Public, Patient, or Staff.
Login	Users can sign in with their registered email address and password. If users have logged in previously on the device, they will be automatically logged in next time.
Forgot Password	Users can click "Forgot Password" to reset their password.
Upload Profile Picture	Users can update their profile picture by clicking on the profile icon.
View Profile	Users can view their profile information through the right menu drawer.
Edit Profile	Users can edit their profile to update information.
Logout	Users can sign out by using the right menu drawer.
Phone	Users can contact the management hotline directly to provide feedback.
Email	Users can email the hospital directly to provide feedback.
App Feedback	Users can provide feedback on the app's functionality, performance and offer suggestions.

History	Users can review their prior feedback provided to the doctor and modify it if needed. Besides, users also can track the status and progress of the feedback provided.
Feedback – [Enquiry] Doctor Appointment	Users can select a specific doctor to submit feedback or enquiries regarding appointments, contact the doctor's office directly or visit the doctor's room.
Feedback – [General Feedback] Compliments/ Complaints	Users can select a specific doctor to provide feedback, rate and review, and view other patients' reviews regarding the doctor.
Filter Name Function	Users can enter a doctor's name in the search bar to quickly find the doctor.
Feedback – [General Feedback] Others	Users can provide feedback on the hospital's facilities, environment, staff attitude, and offer suggestions.
Chat function	Users can send messages to the doctor for feedback or enquiries.

Employee Users

Table 1.3: Employee Users Modules

Module	Description
Choose User Type	Users can select their identity as Public, Patient, or Staff.
Login	Users can sign in with their registered email address and password. If users have logged in previously on the device, they will be automatically logged in next time.
Forgot Password	Users can click "Forgot Password" to reset their password.
Upload Profile Picture	Users can update their profile picture by clicking on the profile icon.
Logout	Users can sign out by using the right menu drawer.
Notification	Users can receive notifications from patients regarding feedback, inquiries or chat messages.
Chat function	Users can send messages to patients in response to feedback or enquiries.

Feedback	Users can select a specific patient to provide feedback and view other doctors' reviews regarding the patient.
Filter Name Function	Users can enter a patient's name in the search bar to quickly find the patient.

1.4 Contributions

As this application will be used by the public, patients and employees, the application targets are listed below:

1. Patient

This mobile app allows patients to engage in their care journey by offering a user-friendly platform to provide real-time feedback. By encouraging patients to share their experiences, concerns and suggestions, the app fosters a sense of ownership over their care and promotes transparent communication with healthcare providers. This engagement not only enhances patient satisfaction but also enables healthcare providers to better understand patient expectations and quickly address concerns.

Moreover, this app also allows patients to evaluate the quality of the specific doctor. Patients can rate doctors based on services quality provided and view feedback from others. This transparency helps patients make informed decisions when choosing a healthcare provider.

2. Public

Besides patients, this mobile app also allows the general public to share valuable feedback regarding healthcare services. They can suggest improvements related to hospital functionality, cleanliness, infrastructure and overall service delivery. By including the public in the feedback process, healthcare institutions can gain broader community insights, identify areas needing enhancement and promote a culture of transparency and continuous improvement.

3. Employees

This application also provides a dedicated communication and feedback channel for hospital employees. Employees can use the platform to share observations, insights and concerns regarding patient needs, behaviours and overall healthcare experiences. The

communication channel fosters a culture of collaboration and teamwork among healthcare professionals, promoting the exchange of information and improving patient outcomes.

1.5 Report Organization

The details of this mobile application's development are shown in the following chapters. Chapter 1 provides an introduction to the project, covering the problem statement, objectives, project scope and the contributions of this project. In Chapter 2, the literature review is reviewed by some mobile applications that are relevant to my project. Then, the proposed solution and methodology used in this project will be shown in Chapter 3. Then, the system design will be shown in Chapter 4, which will discuss the project using some diagrams such as use case diagrams. Next, the system implementation will be presented including software and hardware setup and configuration, UI screenshot, implementation issues and challenges. In Chapter 6, the system evaluation and discussion will be shown by performing test cases. Lastly, the conclusion and recommendations will be the last chapter.

Chapter 2
Literature Review

Based on my research at Play Store, I found some applications which have suitable features that can be implemented as one of the features in the proposed mobile app. The applications I studied are GlenPlus, Penang Adventist Hospital and SMC Penang. Lastly, I also research the review and quality assessment of Google Map.

2.1 Previous Works on Feedback Mechanisms Related Application

2.1.1 Gleneagles Hospital Medini Johor – GlenPlus [3]

Gleneagles is an accredited leading hospital that promises to deliver the best in healthcare and management to patients. The aim of developing GlenPlus is to provide a platform for patients to make clinic appointments. The mobile application allows users to able to check doctor's availability and choose their preferred time slot.

Strengths

The mobile application provides a simple and clear interface to users which ensures users use it without putting too much effort when launching the application. Besides being designed with simplicity, it focuses on only delivering key functionalities and incorporating easily recognisable icons to enhance user understanding and interaction. For example, the combination of phone and envelope icons represents the function for users to communicate with the hospital such as asking inquiries and providing feedback.

The application provides two different methods to let users communicate with hospital staff which are through direct phone calls or virtual Zoom meetings. By using these methods, users gain flexibility in how they engage with hospital staff whether they are inpatient or outpatient. For urgent inquiries or emergencies, users can initiate a phone call directly by using the application, communicating them promptly with hospital staff to get the problem resolved. This real-time interaction fosters a sense of responsiveness and support, ensuring that users' problems are always addressed promptly and effectively.

On the other hand, users can schedule virtual Zoom meetings with hospital staff and provide dynamic feedback during these meetings. This feature enables users to engage in face-to-face conversations from the convenience of their mobile devices, eliminating the need to visit the hospital in person, thereby saving time and effort and minimising disruptions to their daily routines.

Limitations

Phone calls and virtual Zoom meetings may not be accessible to all users, especially for patients in the hospital. Many patients may be unable to speak due to hearing or speech impairments, injuries from accidents or a lack of access to the internet or use outdated phones. Therefore, these factors could prevent certain segments of the population from providing feedback through these feedback channels.

Besides that, scheduling and conducting virtual Zoom meetings may require users and hospital staff to coordinate their schedules, which could lead to delays in providing feedback. Also, the high traffic time zone in the hospital may cause users unable to communicate with hospital staff to provide their perception by using the phone call.

When conducting a phone call or virtual Zoom meetings, although these two channels can be recorded, but transcribing and analysing spoken feedback can be time-consuming and may cause errors. So, these two channels may not provide a tangible record of the feedback provided by patients. Over time, the lack of written documentation could pose a challenge for hospital staff when they need to refer back to or track specific details of complaints or feedback from certain users.

Moreover, when users use phone calls or Zoom meetings, they may feel uncomfortable sharing their feedback openly because of a lack of anonymity. They may fear retaliation from hospital staff if they provide negative feedback to specific doctor or hospital staff. When users feel that their feedback could be traced back to them, they may be hesitant to share their true perceptions and feelings, leading to biased or incomplete feedback.

Resolved solution

The solution to overcome these limitations is to introduce another feedback mechanism that offers an option of text-based feedback form which provides users with convenience and flexibility to share their perceptions or feedback at their own pace. Besides that, the feedback form can be designed to offer partial anonymity, allowing users to choose whether they wish to remain anonymous when providing feedback. This ensures that users can share their feedback without fear of retaliation. Moreover, using feedback forms facilitates the documentation and analysis of feedback data. Responses can be automatically recorded, making it easier for hospital staff to analyse the feedback.

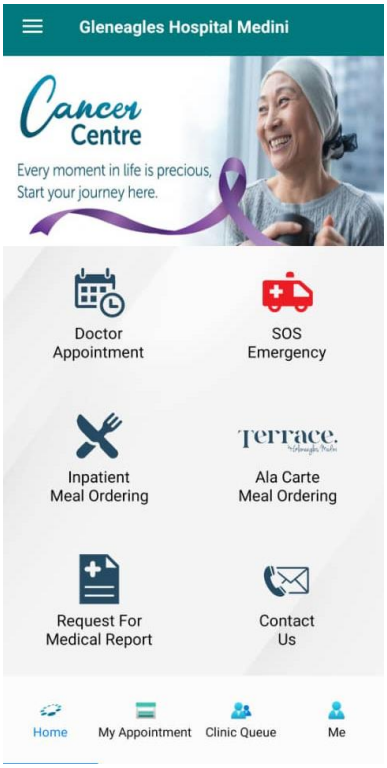

Figure 2.1: GlenPlus-Home Page

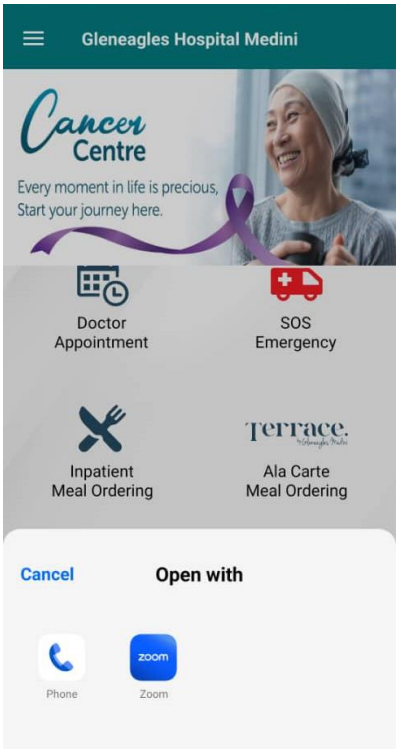

Figure 2.2: GlenPlus–Contact Us

2.1.2 Penang Adventist Hospital [4]

The Penang Adventist Hospital is a tertiary healthcare centre serving the Malaysian community and international visitors. The aim of developing the Penang Adventist Hospital mobile application is to enable users to make appointments anytime, anywhere with just a few clicks. With real-time mobile app data integrated into the hospital system, patients can manage their appointments much more efficiently.

Strengths

The mobile application provides a simple and clear interface for users, ensuring they can navigate without putting too much effort when launching the application. Besides being designed with simplicity, it focuses on delivering key functionalities and incorporating easily recognisable icons to enhance user understanding and interaction. For example, the phone icon represents the function for users to communicate with the hospital staff such as making enquiries and providing feedback.

Within the contact/feedback function, the application provides users with a range of options which users can choose their preferred method of communication with hospital staff. Users can choose direct phone calls or emails provided by the hospital to give feedback. Additionally, the application offers the convenience of accessing the hospital's physical address by providing navigation to guide users to their destination using the Google Maps app or Waze app.

Besides that, the application provides a feedback option for users. The feedback and survey form includes a "customer survey" and a "report technical problems on the apps and websites", allowing users to provide feedback according to the elements of the complaint. To gather user feedback, the application integrates with external platforms such as Google Forms which enable users to provide detailed feedback about their hospital experience. Moreover, it is considered good practice for the Google feedback form to offer different languages for users, eliminating the issue of language barriers. Similarly, a "report technical problem on the apps and websites" dedicated form allows users to report technical problems encountered when using the application.

Limitations

The user interface of the application lacks visual appeal, presenting a monotonous colour scheme that fails to captivate users' attention. As a result, navigating through the application may feel uninteresting, potentially lowering user satisfaction.

One major issue with the feedback form is that it requires too many steps to provide feedback. Users need to click more than 3 times to access the Google feedback form and submit their feedback to hospital staff, which adds unnecessary complexity to the user experience. This may cause patients who are mad to feel mad because it is difficult to make a complaint. This long process not only hampers the timely resolution of issues but also discourages users from providing valuable feedback.

Additionally, there is also a technical challenge in the "Customer Survey" section, where users may encounter technical difficulties accessing the function to give feedback, particularly older individuals or those less familiar with technology. Without clear guidance, these users may struggle to find the link they need to access and complete the feedback form.

Besides that, there is no option for employees such as doctors or hospital staff to provide feedback regarding patients' attitudes and behaviours. This represents a significant gap in the feedback mechanism. Employee feedback is also considered as one of the important aspects for improvement and identifying opportunities to enhance patient experience.

Resolved solution

The solution to overcome this limitation is to develop a streamlined feedback mechanism with a colourful user interface. Design the application with colourful, visually appealing elements to make it more engaging. Simplify the feedback process by reducing the number of steps required to access the feedback form. Instead of having users go through multiple pages to get access to the feedback form, consider having a direct button that should directly lead users to the feedback form, minimising the effort required to keep providing feedback.

Besides that, the application should provide clear instructions and navigation to guide users to the feedback form. The application can consider adding tooltips, pop-up windows or

messages that explain how to access the feedback function within the application. Ensure that the link to the feedback form is well displayed and easily identifiable, especially for users who may be less familiar with technology.

Moreover, the application should introduce a dedicated button for employees to provide feedback on patient details such as attitudes and behaviours. This feature will empower frontline staff to share their observations and insight on patient interactions. By using this, hospitals can gain valuable perspectives on areas for improvement.

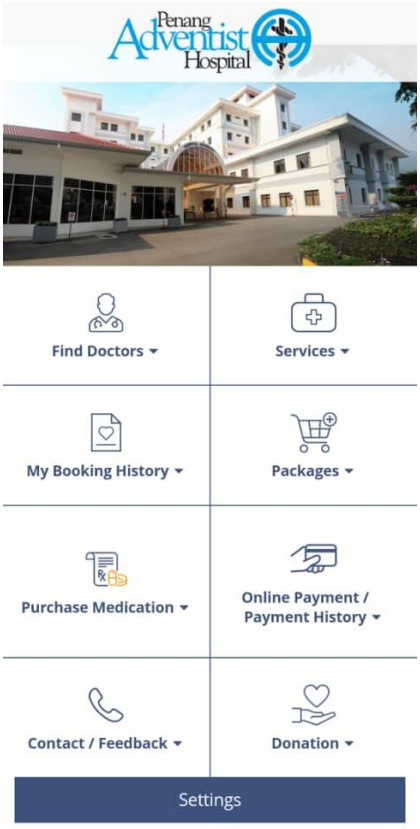

Figure 2.3: Penang Adventist Hospital – Home Page

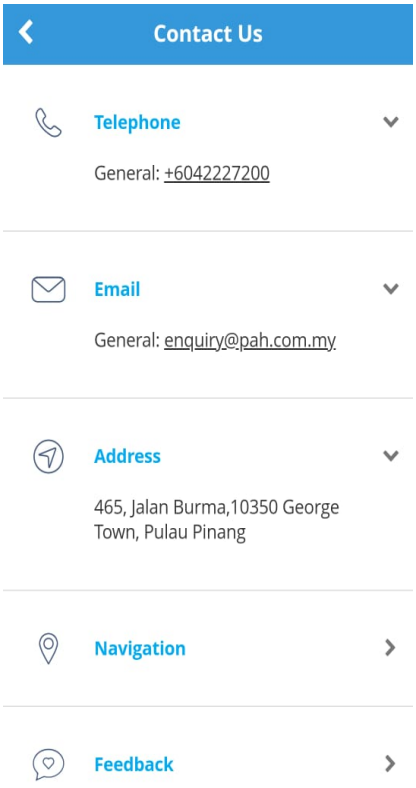

Figure 2.4: Penang Adventist Hospital – Contact Us

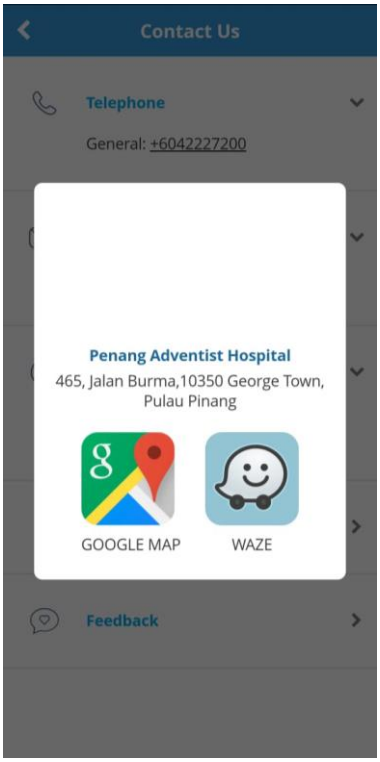

Figure 2.5: Penang Adventist Hospital – Navigation function

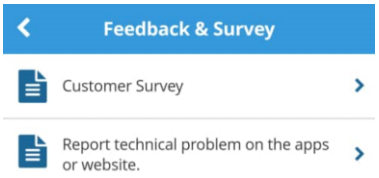

Figure 2.6: Penang Adventist Hospital –Feedback & Survey

Figure 2.7: Penang Adventist Hospital – Customer Survey

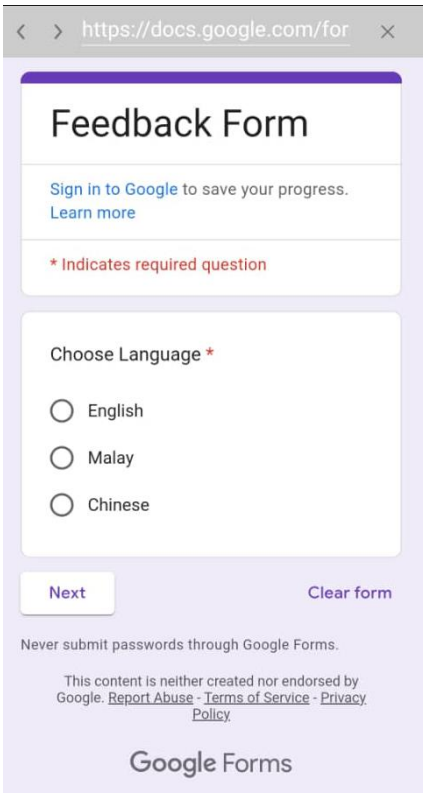

Figure 2.8: Penang Adventist Hospital – Google Feedback Form

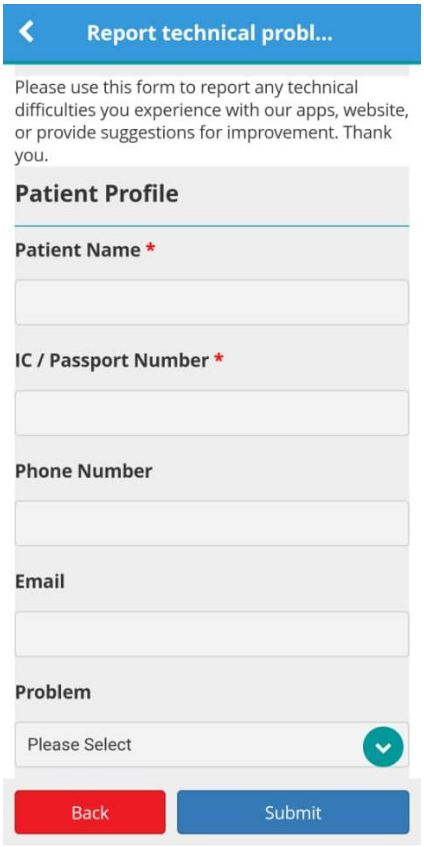

Figure 2.9: “Report technical problem on apps or websites”

2.1.3 SMC Penang (Sunway Medical Centre Penang) [5]

Sunway Medical Centre Penang is a comprehensive tertiary care hospital that aims to provide quality and compassionate healthcare to families and communities in the surrounding area.

Strengths

The mobile application provides a good interface design with well-arranged functionalities and good colour combinations. When users use the application, they can immediately know each of the functions used because each function is clearly represented. For example, the phone icon represents the function for users to communicate with the hospital staff such as making enquiries and providing feedback.

The application offers two methods of communication, which are direct phone calls and the text-based feedback form. These dual methods ensure flexibility for users in providing feedback. Besides, the interface is also simple, attractive and user-friendly. One of the notable features is the in-house development of the feedback mechanism, which eliminates the need for third-party platforms like Google Forms. This method assures data security and privacy, minimising the risk of potential data breaches.

Regarding the feedback form, it clearly allows users to directly select the type of enquiry and provide details for compliments or complaints. The process is streamlined, avoiding unnecessary questions and ensuring a smooth user experience.

Moreover, another notable feature is the design of the application, which allows users to access the feedback page directly, eliminating the need for users to click multiple times to reach the feedback section. This type of design further enhances user convenience and encourages users to actively participate in providing feedback.

Limitations

Despite the feedback form allowing users to provide feedback, the application does not distinguish between different user types. Normally, the patients and the public can access the application to provide feedback, but without segmentation, there will be some feedback options that may be irrelevant to certain user groups. For example, feedback options related to doctor appointments may only be useful for patients.

Besides, if the patients wish to inquire about doctor appointments during the feedback process, the application does not clearly provide an option to select which doctor they wish to inquire about. Similarly, if a patient would like to compliment or complain about a particular doctor, the patient still cannot directly choose which doctor.

The application also lacks an option for employee feedback. It does not include a feature for employees to provide feedback, which limits the opportunity for frontline staff to share their insights and observations on service delivery.

Furthermore, the application does not offer an option for users to submit feedback anonymously. This limitation could hamper users from providing honest feedback, especially if the feedback is sensitive and negative to specific doctors.

Moreover, the application may have language barriers and may not fully address the needs of users with disabilities. This could prevent certain populations from effectively accessing and using the feedback forms within the application.

Resolved problem

The solution to overcome this limitation is to develop a feedback system with implements the population segmentation. The application should distinguish between patients, employees and the public. Each segment should have access to relevant feedback systems to their needs and roles within the application. Besides, the application should create a section for employees to provide feedback.

The feedback system should include an interface for patients to select the specific doctor they wish to inquire about or provide feedback on. This can be done by providing a list of available doctors within the feedback system for patients to choose from when submitting their feedback.

The application should also provide a function that allows users to submit feedback anonymously if they prefer. Besides, it should support multiple languages to accommodate users from different backgrounds and countries.

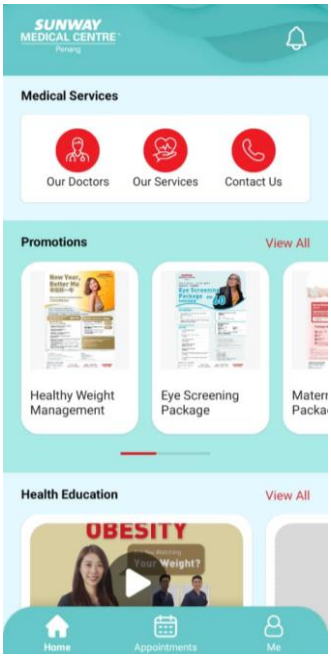

Figure 2.10: SMC Penang – Home Page

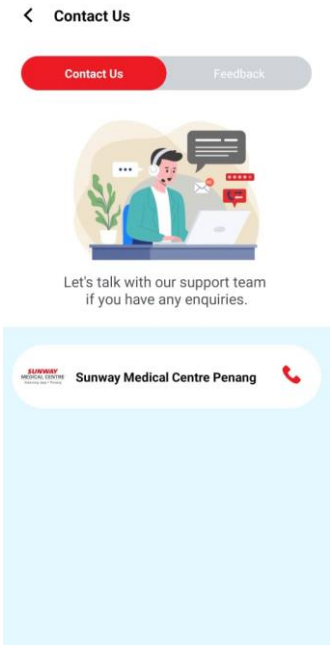

Figure 2.11: SMC Penang – Contact Us

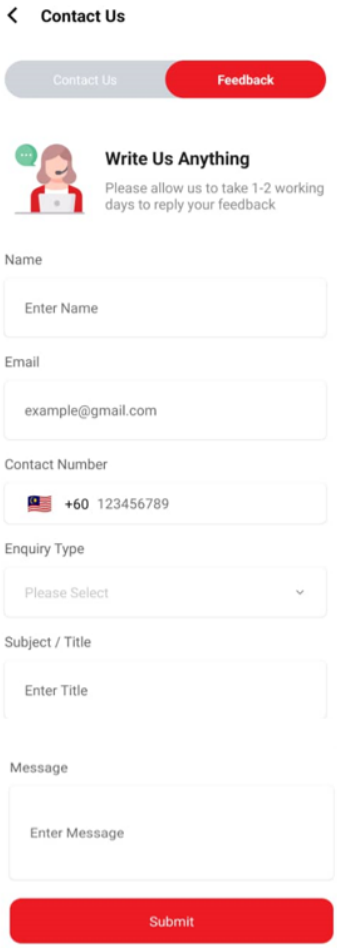

Figure 2.12: SMC Penang – Feedback form

2.1.4 Google Map [6]

On Google Maps, users can write reviews for places they visit. They can also leave information, post photos, or share video updates about a place.

Strengths

Google Maps uses a star rating system which offers a quick way for users to evaluate businesses. This system allows users to make quick judgments about the quality of a business or place based on the ratings. Besides that, reviews on Google Maps are visible to potential customers who are searching for restaurants, shops and places on the platform. This visibility can significantly impact a business's reputation and influence potential customers to come to places. Typically, when users search for a business or location on Google, they can see the business's rating and reviews directly in the search results.

Google Maps review provides an opportunity for businesses to respond to reviews directly. This feature allows businesses to engage with their customers and address their concerns or issues posted in the review.

Limitations

Some reviews on Google Maps may lack of context, as users often provide only brief comments or simply ratings without detailed explanations. This can make it challenging for other users to understand the reasons behind certain ratings or comments.

Besides, Google Maps is easily influenced by biased or fake reviews. Businesses may receive unfairly negative reviews from competitors or bad customers. Google's review feedback system may not catch all fraudulent reviews which will cause potential inaccuracies in overall ratings and a bad reputation.

Moreover, Google Maps reviews typically do not require users to verify themselves or confirm whether they have visited the place or used the services being reviewed. This lack of verification can affect the credibility of reviews.

Resolved solution

Google Maps can enhance review guidelines and review moderation such as implementing stricter guidelines for reviewers, encouraging them to provide more detailed reviews and enhancing their review moderation algorithms to better detect and filter out fake reviews and bad words. Besides, google Maps can implement user verification mechanisms such as requiring users to confirm their visit to a place by uploading a photo before can write a review.

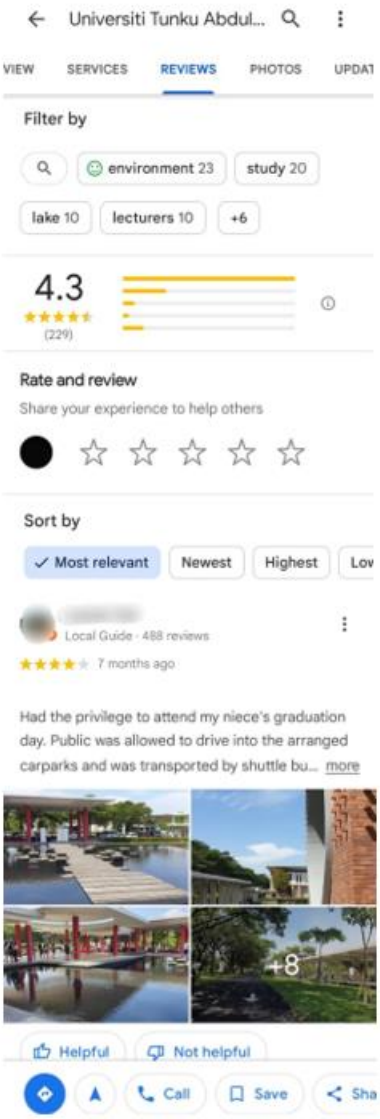

Figure 2.13: Google Map Review

2.2 Comparison between existing system and proposed solution

A simple comparison between the features of the reviewed applications is shown in the table below (Table 2.1).

Table 2.1: Comparison among reviewed applications and proposed solution

Features / Application	GlenPlus	Penang Adventist Hospital	SMC Penang	Google Map	Proposed Project
Ease of use	Yes	No	Yes	Yes	Yes
Colorful UI	No	No	Yes	No	Yes
Phone call	Yes	Yes	Yes	Yes	Yes
Text-based feedback form	Yes	Yes	Yes	No	Yes
Specific enquiry type	No	No	Yes	No	Yes
Multi-language support	No	Yes	No	Yes	No
Tacking status	No	No	No	No	Yes
History	No	No	No	No	Yes
Verification Mechanism	No	No	No	Yes	Yes
Employee feedback option	No	No	No	Yes	Yes
Quality assessment	No	No	No	Yes	Yes
Report on App problem	No	Yes	No	No	Yes
Third-party involved	No	Yes	No	No	No
Star rating system	No	No	No	Yes	Yes
User segmentation	No	No	No	No	Yes
Chat	No	No	No	No	Yes

Chapter 3

System Methodology/Approach

3.1 System Design Diagram

3.1.1 Methodologies and General Work Procedures

The title of this project is “Towards Patient-Centered Care: A Mobile App for Dynamic Feedback and Quality Assessment in Hospital”. This project focuses on developing an Android application that empowers patients, doctors and the general public to provide real-time feedback on hospital services. The app will allow patients to review and provide feedback on specific doctors, while the public can share their feedback or experiences regarding the hospital's facilities and overall functionality. Additionally, doctors will have the ability to give feedback to their patients. To ensure the application is user-friendly and meets the needs of all stakeholders, wireframes will be developed prior to the coding phase. These wireframes will serve as a blueprint for the application’s design and functionality, offering a clear vision of the user interface and overall user experience.

This mobile application will be developed using Agile Software Development Methodology. Agile is an iterative approach that allows for flexibility and adaptability. The application can continually be updated to fix bugs and introduce new features based on user feedback. As users interact with the application, they will identify bugs and provide timely feedback to the developers. Rapid feedback is essential for periodically improving the application, making Agile a suitable approach for developing this project. The phases of the Agile Software Development Life Cycle (SDLC) include conception, inception, development, release and maintenance.

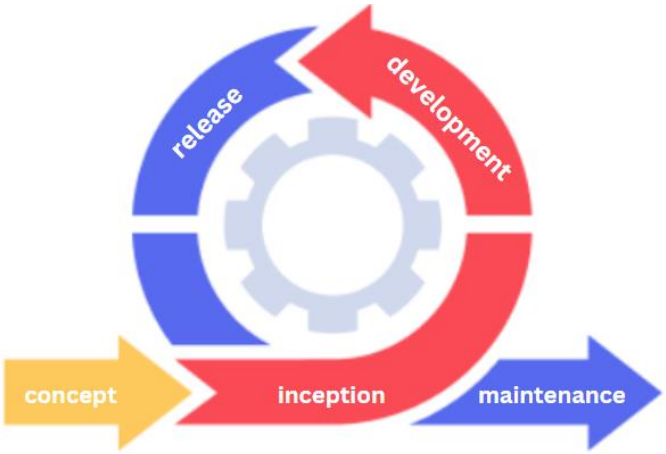

Figure 3.1: Agile Software Development Life Cycle (SDLC)

Agile Software Development

In Agile Software Development, the first phase is conception, where the project's scope, objectives and high-level requirements are defined. During this phase, it is essential to identify the project's needs, prioritize tasks especially when managing multiple projects and outline key deliverables. Next, the requirements for the software will be determined in the inception phase and the development team start to build the software. The development phase is the longest because the programmer needs to combine all product requirements and feedback to deliver small working parts of the software. Moreover, the release stage requires checking the quality and functionality to make sure the product is fine. Besides, it also involves users' training feedback for future development. The next phase is the maintenance phase which resolves the problem when issues arise or updates the features when needed.

1. **Concept**

During the conception phase, the scope and objective of this project were clearly defined. The main goal is to enhance patient-centered care by enabling dynamic feedback and quality assessment within the hospital environment. Additionally, this project aims to establish an effective communication channel that allows both patients and hospital employees to share feedback in real-time, thereby improving service delivery and overall patient experience.

2. **Inception**

During the inception phase, a list of useful features was created for implementation in the application. This stage also involved designing mock-ups of the user interface and establishing the overall project architecture. The core features such as providing a platform for

users to submit feedback and review existing feedback should be done first. Additionally, the timetable was developed for each activity depending on the difficulty of the task, the workload and so on.

3. **Development**

During the development phase, the application requirements are clearly defined, then the actual development process begins. All the listed features will be done in this phase. The core features such as real-time feedback and review features will be delivered at the end of the first spring. Additional features such as support for direct phone calls are scheduled for later iterations. This is the longest phase of the project, but using Agile methodology helps streamline the development process, making it faster and more efficient.

4. **Release**

During the release phase, the application is nearly complete and enters the testing stage to ensure quality and reliability. Testers carefully identify and resolve any bugs or performance issues to confirm the application functions as intended. Once testing is successful, the application is delivered to users. User feedback is then collected and analysed to guide future updates and enhancements, ensuring the app continues to meet user needs effectively.

5. **Maintenance**

During the maintenance phase, the fully developed application is made available to users. Any problems faced by users will be resolved during this phase to ensure all the features are performing well. Besides resolving the problem, this phase also involves implementing updates and introducing new features based on user feedback and evolving needs, ensuring the application continues to improve over time.

3.1.2 User requirements

- Users (patients, employees) should be able to login to their account
- Users (patients) should be able to easily access a list of doctors to interact with and provide feedback
- Users (patients) should be able to view, edit or update their previous feedback if necessary
- Users (patients) should be able to review and rate the doctor.
- Users (doctors) should be able to provide feedback on their patients
- Users (public) should be able to provide feedback on hospital facilities and functionality.

3.1.3 System Performance Definition

The system performance for the "Towards Patient-Centered Care: A Mobile App for Dynamic Feedback and Quality Assessment in Hospital" project will be defined by the following targeted improvements:

Firstly, the project focuses on ensuring user feedback precision. The system will accurately record feedback provided by users and correctly associate it with the relevant doctors. It will also offer prompts and suggestions as users enter data to minimise errors in data entry and retrieval. To further enhance accuracy, validation checks will be implemented to ensure that only complete and relevant data is received and stored, reducing the likelihood of inaccurate information. For example, the email address input field will strictly accept valid email addresses.

Additionally, the project aims to achieve real-time synchronisation. The application will ensure instant data synchronisation with Firebase, reflecting data and feedback updates across all user devices within milliseconds. Moreover, the application will maintain a response time of less than one second for all user interactions, including loading feedback forms, submitting feedback, and retrieving historical data.

Furthermore, the project emphasises smooth navigation, ensuring that users experience uninterrupted and seamless interaction with the application. Loading times for different sections will be minimised. Robust error-handling mechanisms will also be implemented,

providing clear and helpful feedback to users in case of any issues, thereby minimising frustration and ensuring a seamless user experience.

These performance targets will guide the development process, ensuring the final application is both efficient and reliable, providing high-quality user experience.

3.1.4 Verification Plan

Test all text input fields such as feedback forms and user registration details, to ensure they accept valid inputs and reject invalid ones. For example, the email address field should only accept correctly formatted email addresses. Additionally, verify that dropdowns and selectors present the correct options and handle selections appropriately.

Test the feedback submission process to ensure that all feedback is correctly recorded and associated with the appropriate entities. Also, test the login and registration processes for different users to ensure secure and accurate access. Furthermore, test real-time data updates to confirm that feedback and other data are synchronised across all user devices within milliseconds.

3.2 System Architecture Diagram

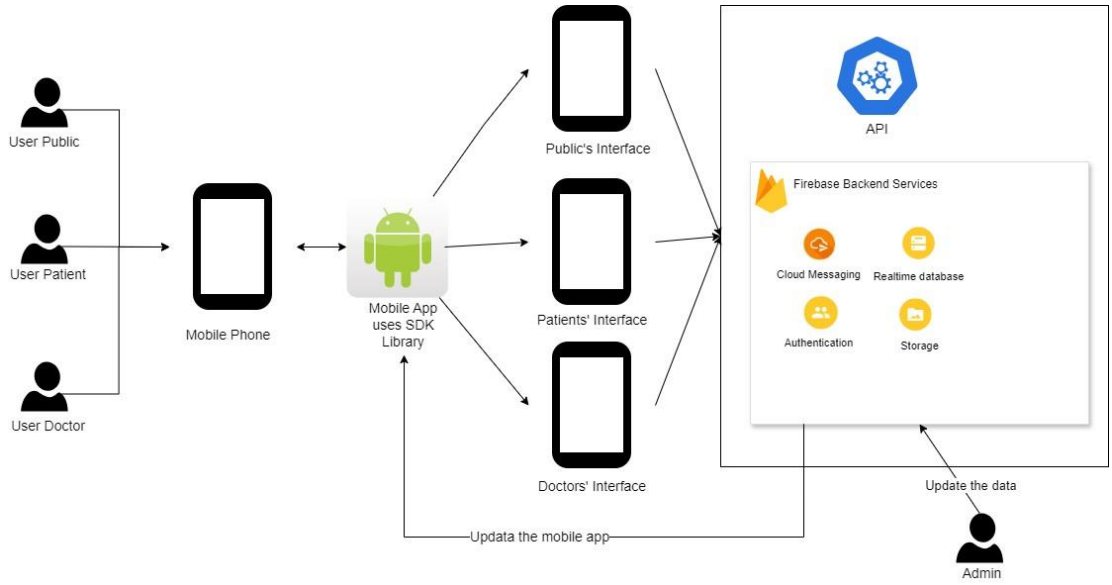

Figure 3.2: System Architecture Diagram

This system architecture diagram shows the structural flow of the mobile application. The app is built on the Android platform using SDK libraries, enabling seamless interaction between users and the system through their mobile device.

There are three distinct user groups, Public, Patients and Doctors, each accessing the application through customised interfaces designed to meet their specific needs. These interfaces connect directly to Firebase Backend Services, which include Cloud Messaging, Realtime Database, Authentication, and Cloud Storage. This ensures efficient real-time data synchronization and secure data management. Besides, administrators have the capability to update the Firebase database directly, ensuring efficient data handling and maintenance.

3.3 Use-case Diagram

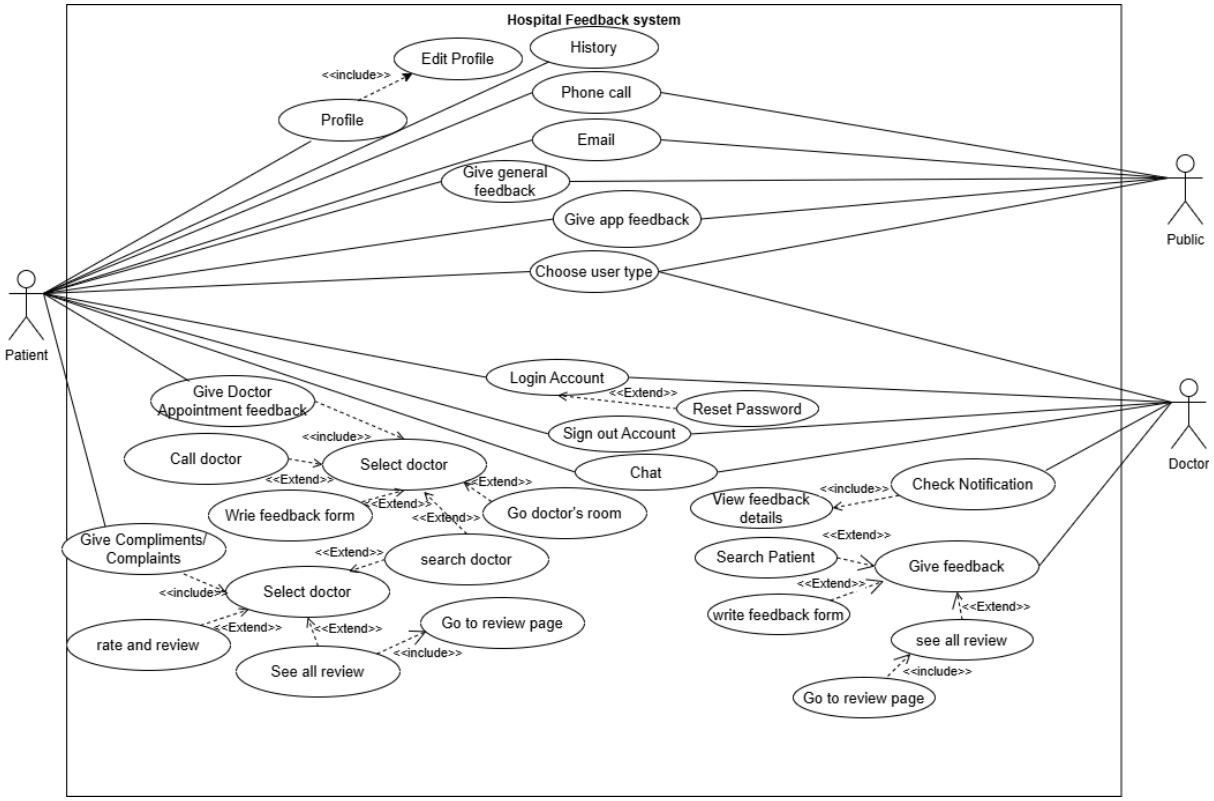

Figure 3.3: Use case Diagram

3.4 Use-case Description

3.4.1 Choose User Type Use Case Description

Table 3.1: Choose User Type Use Case Description

<table>
<tr><td>Use Case ID</td><td colspan="2">UC001</td></tr>
<tr><td>Use Case</td><td colspan="2">Choose User Type</td></tr>
<tr><td>Purpose</td><td colspan="2">To allow users to choose the user type.</td></tr>
<tr><td>Actor</td><td colspan="2">Public, Patients, Staff</td></tr>
<tr><td>Trigger</td><td colspan="2">Users launch the application.</td></tr>
<tr><td colspan="3">Main Flow
1. User launches the application.
2. System requests the user to choose one of the user types.
3. User selects a user type.
- If the public user type is selected, sub flow UC-3a is performed.
- If the patient user type is selected, sub flow UC-3b is performed.
- If the staff user type is selected, sub flow UC-3c is performed.
4. System verifies the option.
5. User will be redirected to their respective interface.</td></tr>
<tr><td colspan="3">Sub Flow
<table><tr><td>Public user type</td><td>UC-3a</td><td>1. User clicks the public user type.
2. System redirects the user to the Public interface.</td></tr><tr><td>Patient user type</td><td>UC-3b</td><td>1. User clicks the patient user type.
2. System redirects the user to the Patient login interface.</td></tr><tr><td>Staff user type</td><td>UC-3c</td><td>1. User clicks the staff user type.
2. System redirects the user to the Staff login interface.</td></tr></table></td></tr>
<tr><td colspan="3">Alternative Flow – User Cancels to Choose User Type
2.1.1 User clicks the “Back” button.
2.1.2 System verifies the action.
2.1.3 System terminates the application .</td></tr>
</table>

3.4.2 Login Account Use Case Description

Table 3.2: Login Account Use Case Description

<table>
<tr><td>Use Case ID</td><td colspan="2">UC002</td></tr>
<tr><td>Use Case</td><td colspan="2">Login Account</td></tr>
<tr><td>Purpose</td><td colspan="2">To allow users to login to their account.</td></tr>
<tr><td>Actor</td><td colspan="2">Patients, Staff</td></tr>
<tr><td>Trigger</td><td colspan="2">The user selects their user type.</td></tr>
<tr><td colspan="3">Main Flow
1. User selects their user type.
2. System prompts the user for login credentials.
3. User enters the registered email and password.
- If the user is already logged in, sub flow UC-2a will be performed.
- If the user forgot their password, sub flow UC-2b will be performed.
4. System verifies the email and password.
5. System redirects the user to the menu.</td></tr>
<tr><td colspan="3">Sub Flow
<table><tr><td>Already Logged In Check</td><td>UC-2a</td><td>1. System checks if the user has an active session.
2. If yes, system skips the login process and redirects the user directly to the menu.</td></tr><tr><td>Forget password</td><td>UC-2b</td><td>1. User clicks the "Forgot Password" button.
2. User enters their registered email to reset the password.
3. System allows password reset and redirects the user back to Main Flow Step 2</td></tr></table></td></tr>
<tr><td colspan="3">Alternative Flow – Invalid Email or Password
2.1.1 User inputs an invalid email or password.
2.1.2 System displays the error message “Invalid email or password!”
2.1.3 System returns to Main Flow Step 2 for the user to retry.</td></tr>
</table>

3.4.3 Sign Out Account Use Case Description

Table 3.3: Sign Out Account Use Case Description

Use Case ID	UC003
Use Case	Sign Out Account
Purpose	To allow users to sign out of their account.
Actor	Patients, Staff
Trigger	User selects the "Sign Out" option.
Main Flow 1. User selects the "Sign Out" option from the menu. 2. System terminates the user's session. 3. System redirects the user to the Login Page.	
Sub Flow -	
Alternative Flow -	

3.4.4 Profile Use Case Description

Table 3.4: Profile Use Case Description

Use Case ID	UC004
Use Case	Profile
Purpose	To allow users to view and update their profile information.
Actor	Patients
Trigger	User selects the “Profile” option from the menu.
Main Flow 1. User selects the “Profile” option from the menu. 2. System displays the user's profile information and details. 3. System displays the “Edit Profile” option. 4. User clicks the "Edit Profile" option to update their profile. 5. System redirects the user to the profile edit page. 6. System displays the profile edit form pre-filled with current data. 7. User makes the necessary changes. 8. System saves the updated information in Firebase. 9. System displays a “Profile updated successfully” message.	
Sub Flow -	
Alternative Flow – Missing or Incorrect Information 5.1.1 User attempts to save changes without filling in all required fields. 5.1.2 System detects missing or incorrect information. 5.1.3 System displays an error message (e.g., "Name can’t be empty"). 5.1.4 System returns to Main Flow Step 4 to let the user correct the form.	
Alternative Flow – User Cancels the Edit Process 5.2.1 User clicks the “Back” button during the edit process. 5.2.2 System verifies the action. 5.2.3 System returns to Main Flow Step 2 without saving changes.	

3.4.5 History Use Case Description

Table 3.5: History Use Case Description

Use Case ID	UC005
Use Case	History
Purpose	To allow users to view and update the feedback history provided to doctors.
Actor	Patients
Trigger	User selects the “History” option from the menu.

Main Flow

1. User selects the “History” option from the menu.
2. System displays all feedback previously submitted to doctors.
3. User clicks on a feedback entry to view its details.
    - If the status of the feedback is "Sent" or "Being Reviewed", sub-flow UC-3a will be performed.
    - If the status is "Being Resolved" or "Completed", sub-flow UC-3b will be performed.
4. System redirects the user to the Feedback Edit page.
5. System displays a pre-filled form containing the existing feedback details.
6. User makes the necessary changes.
7. System saves the updated information in Firebase.
8. System displays a message “Feedback updated successfully”.

Sub Flow

Editable Feedback	UC-3a	1. System checks if the feedback status is "Sent" or "Being Reviewed". 2. If yes, system allows editing and redirects the user to the feedback edit page.
Non-editable feedback	UC-3b	1. System checks if the feedback status is "Being Resolved" or "Completed". 2. If yes, the feedback becomes non-clickable and editing is disabled.

Alternative Flow – Missing or Incorrect Information 6.1.1 User attempts to save changes without filling in all required fields. 6.1.2 System detects missing or incorrect information. 6.1.3 System displays an error message. 6.1.4 System returns to Main Flow Step 4 to let the user correct the form.
Alternative Flow – User Cancels the Edit Process 4.1.1 User clicks the “Back” button during the edit process. 4.1.2 System verifies the action. 4.1.3 System returns to Main Flow Step 2 without saving changes.

3.4.6 Phone call Use Case Description

Table 3.6: Phone call Use Case Description

Use Case ID	UC006
Use Case	Phone call
Purpose	To allow users to directly contact the hospital for inquiries.
Actor	Public, Patients
Trigger	User selects the “Phone” option.
Main Flow 1. User selects the “Phone” option from the menu. 2. System prompts the user to either initiate a call or close the dialog. 3. User selects the “Call” option. 4. System verifies the option. 5. System opens the phone dialer with the hospital's number pre-filled.	
Sub Flow -	
Alternative Flow – Close Option Selected 2.1.1 User selects the “Close” option. 2.1.2 System redirects user to menu interface.	

3.4.7 Email Use Case Description

Table 3.7: Email Use Case Description

Use Case ID	UC007
Use Case	Email
Purpose	To allow users to directly contact the hospital via email for inquiries.
Actor	Patients, Staff
Trigger	User selects the "Email" option.
Main Flow 1. User selects the "Email" option from the menu. 2. System prompts the user to ask whether to continue with email or close. 3. User selects the "Email" option. 4. System verifies the option. 5. System opens the default email client with the hospital's email address pre-filled.	
Sub Flow -	
Alternative Flow – Close Option Selected 2.1.3 User selects the "Close" option. 2.1.4 System redirects user to menu interface.	

3.4.8 Give General Feedback Use Case Description

Table 3.8: Give General Feedback Use Case Description

Use Case ID	UC008
Use Case	Give General Feedback
Purpose	To allow users to give general feedback on cleanliness, facilities and other services.
Actor	Public, Patients
Trigger	User selects the "[General Feedback] Others" option.

Main Flow

1. User selects the "[General Feedback] Others" option.
2. System determines the user type.
    - If the user is public, sub flow UC-2a will be performed.
    - If the user is patients, sub flow UC-2b will be performed.
3. System verifies the user's identity information and option.
4. System redirects the user to the "[General Feedback] Others" page.
5. User enters feedback and optionally uploads a picture.
6. System verifies the input.
7. System stores the feedback and picture in Firebase.
8. System displays a "Feedback submitted successfully" message.

Sub Flow

Public User Verification	UC-2a	1. System prompts the user to enter their full name and IC number/passport. 2. User enters their full name and IC number/passport. 3. System validates the provided information.
Patient User Verification	UC-2b	1. System automatically retrieves the logged-in patient's name and IC/passport from their profile.

Alternative Flow – Missing and Invalid IC number/passport

3.1.1 User inputs an invalid or empty IC number/passport.

3.1.2 System verifies the data.

3.1.3 System displays error message "Enter a valid IC or Passport number"

3.1.4 Return to Main Flow Step 2.

Alternative Flow – Missing and Invalid Feedback Message

8.1.1 User inputs an invalid feedback message.

8.1.2 System verifies the input.

8.1.3 System displays error message "Please enter your feedback".

8.1.4 Return to Main Flow Step 5.

3.4.9 Give App Feedback Use Case Description

Table 3.9: Give App Feedback Use Case Description

Use Case ID	UC009
Use Case	Give App Feedback
Purpose	To allow users to give app feedback on functionality and performance.
Actor	Public, Patients
Trigger	User selects the "App" option.
Main Flow 1. User selects the "App" option. 2. System prompts the user for a functionality rating. 3. User enters the functionality rating. 4. System prompts the user for a performance rating. 5. User enters the performance rating. 6. System prompts the user for additional feedback (optional). 7. User may provide additional comments. 8. System validates the input. 9. System stores the feedback in Firebase. 10. System displays a "Submitted successfully" message. 11. System redirects the user to the menu page.	
Sub Flow -	
Alternative Flow – Missing and Invalid Rating Validation 8.1.1 User enters an invalid or incomplete rating. 8.1.2 System checks if all required fields are filled. 8.1.3 System displays the error message "Please rate both functionality and performance" 8.1.4 Return to Main Flow Step 2.	

3.4.10 Give Doctor Appointment Feedback Use Case Description

Table 3.10: Give Doctor Appointment Feedback Use Case Description

Use Case ID	UC010
Use Case	Give Doctor Appointment Feedback
Purpose	To allow users to provide feedback on doctor appointments, focusing on the quality of care.
Actor	Patients
Trigger	User selects the "[Enquiry] Doctor Appointment" option.

Main Flow

1. User selects the "[Enquiry] Doctor Appointment" option.
2. System auto-fills the user's full name and IC/passport number since the user is already logged in.
3. System verifies the user's information and option.
4. System redirects the user to the "[Enquiry] Doctor Appointment" page.
5. System prompts the user to select a doctor for feedback.
6. User selects the specific doctor.
    - If the user searches by doctor's name, sub flow UC-6a will be performed.
7. System verifies the selected doctor.
8. System redirects the user to the "Doctor Details" page.
9. User can initiate a call to the doctor (optional).
10. User can check the doctor's room (optional).
11. System displays the doctor's details.
12. System prompts the user to enter a title for their feedback.
13. User enters the feedback title.
14. System prompts the user to enter a feedback message.
15. User enters the feedback message.
16. System verifies the input.
17. System stores the feedback in Firebase
18. System displays a "Feedback sent successfully" message.
19. System redirects the user to the "Menu" Page.

Sub Flow

User Searches for a Doctor	UC-6a	1. User clicks the search field. 2. User types in the doctor's name or part of it. 3. System displays a list of matching doctors based on the input. 4. User selects the correct doctor. 5. Return to Main Flow Step 8.

Alternative Flow – Invalid or Missing Feedback Message or Title

12.1.1 User inputs an invalid or empty title or feedback message.

12.1.2 System verifies the input.

12.1.3 System displays an error message “Please Enter Title”

12.1.4 Return to Main Flow Step 12.

Alternative Flow – Cancel Feedback Submission

8.1.1 User clicks the “Back” button on “Doctor Details” page.

8.1.2 System verifies the action.

8.1.3 Return to Main Flow Step 4.

Alternative Flow – Doctor Not Found

6.1.1 User clicks the search field.

6.1.2 User types a name in the search field.

6.1.3 System searches for matching doctors.

6.1.4 No matches are found.

6.1.5 System displays the error message “No data found”

6.1.6 Return to Main Flow Step 6.

3.4.11 Give Compliments/ Complaints Use Case Description

Table 3.11: Give Compliments/ Complaints Use Case Description

Use Case ID	UC011
Use Case	Give Compliments/ Complaints
Purpose	To allow users to provide compliments or complaints based on their experience with a doctor.
Actor	Patients
Trigger	User selects the "[General Feedback] Compliments/ Complaints" option.

Main Flow

1. User selects the "[General Feedback] Compliments/ Complaints" option.
2. System auto-fills the user's full name and IC/passport number since the user is already logged in.
3. System verifies the user's information and option.
4. System redirects the user to the "[General Feedback] Compliments/ Complaints" page.
5. System prompts the user to select a doctor for feedback.
6. User selects the specific doctor.
    - If the user searches by doctor's name, sub flow UC-6a will be performed.
7. System verifies the selected doctor.
8. System redirects the user to the "Doctor Review" page.
9. System displays the doctor's details.
10. System displays reviews from other patients.
    - If the user wants to see more reviews, sub flow UC-10a will be performed.
11. System prompts the user to input a rating.
12. User inputs the rating.
13. System prompts the user to input a detailed feedback message.
14. User inputs the feedback message.
15. System verifies the input.
16. System stores the feedback in Firebase
17. System displays a "Review submitted successfully" message.
18. System redirects the user to the "All Reviews" Page.

Sub Flow

User Searches for a Doctor	UC-6a	1. User clicks the search field. 2. User types in the doctor's name or part of it. 3. System displays a list of matching doctors based on the input. 4. User selects the correct doctor. 5. Return to Main Flow Step 8.
See All Reviews	UC-10a	1. User clicks the "See All Reviews" option. 2. System loads and displays all reviews. 3. User can scroll through the reviews.

Alternative Flow – Invalid or Missing Rating or Details

12.1.5 User leaves the rating or message empty or enters invalid input.

12.1.6 System verifies the input.

12.1.7 System displays the error message "Please share your experience".

12.1.8 Return to Main Flow Step 12.

Alternative Flow – User Cancels Feedback Submission

8.1.1 User clicks the "Back" button on "Doctor Reviews" page.

8.1.2 System verifies the action.

8.1.3 Return to Main Flow Step 4.

Alternative Flow – Doctor Not Found

6.1.1 User clicks the search field.

6.1.2 User types a name in the search field.

6.1.3 System searches for matching doctors.

6.1.4 No matches are found.

6.1.5 System displays error message "No data found"

6.1.6 Return to Main Flow Step 6.

3.4.12 Chat Use Case Description

Table 3.12: Chat Use Case Description

<table>
<tr><td>Use Case ID</td><td>UC012</td></tr>
<tr><td>Use Case</td><td>Chat</td></tr>
<tr><td>Purpose</td><td>To allow seamless, real-time communication between patients and doctors for inquiries, assistance, clarification on medical matters and appointment scheduling.</td></tr>
<tr><td>Actor</td><td>Patients, Doctors</td></tr>
<tr><td>Trigger</td><td>User selects the “Chat” option.</td></tr>
<tr><td colspan="2">Main Flow
1. User selects the “Chat” option.
2. System displays a list of available users that the current user can chat with.
- If user search for a specific person, sub flow UC-2a will be performed.
3. User selects a contact to initiate a chat.
4. System verifies the selected user.
5. System redirects the user to the chat room.
6. System displays the chat history if there are any previous messages.
7. User can send new messages.</td></tr>
<tr><td colspan="2">Sub Flow
<table><tr><td>Searches for a User</td><td>UC-2a</td><td>1. User clicks the search field.
2. User types in the username or part of the name.
3. System displays a list of matching users based on the input.
4. User selects the correct user from the list.
5. Return to Main Flow Step 3.</td></tr></table></td></tr>
<tr><td colspan="2">Alternative Flow – Invalid Message
7.1.1 User inputs an invalid or empty message.
7.1.2 System verifies the input.
7.1.3 System displays an error message “You can’t send an empty message”.
7.1.4 Return to Main Flow Step 7.</td></tr>
</table>

Alternative Flow – User Cancels Chat 5.1.1 User clicks the “Back” button on Chat room page. 5.1.2 System verifies the action. 5.1.3 Return to Main Flow Step 2.
Alternative Flow – User Not Found 2.1.1 User clicks the search field. 2.1.2 User types a name or part of a name. 2.1.3 System searches for matching usernames. 2.1.4 No matches are found. 2.1.5 System displays error message “No matching doctors found”. 2.1.6 Return to Main Flow Step 2.

3.4.13 Check Notification Use Case Description

Table 3.13: Check Notification Use Case Description

<table>
<tr><td>Use Case ID</td><td colspan="2">UC013</td></tr>
<tr><td>Use Case</td><td colspan="2">Check Notification</td></tr>
<tr><td>Purpose</td><td colspan="2">To allow users to review and manage notifications received from patients.</td></tr>
<tr><td>Actor</td><td colspan="2">Doctors</td></tr>
<tr><td>Trigger</td><td colspan="2">User selects the “Notification” option.</td></tr>
<tr><td colspan="3">Main Flow
1. User selects the “Notification” option.
2. System displays a list of notifications received from patients.
- If user search for a specific person, sub flow UC-2a will be performed.
3. User selects a notification from the list.
4. System verifies the selected notification.
5. System redirects the user to the “Feedback Detail” page.
6. System displays the full feedback details.
7. User can click the “Chat” button to initiate a conversation with the patient.
- If user resolves the feedback or issue, sub flow UC-7a will be performed.</td></tr>
<tr><td colspan="3">Sub Flow
<table><tr><td>Searches for a User</td><td>UC-2a</td><td>1. User clicks the search field.
2. User types in the username or part of the name.
3. System displays a list of matching users based on the input.
4. User selects the correct user.
5. Return to Main Flow Step 3.</td></tr><tr><td>Mark Feedback as Completed</td><td>UC-7a</td><td>1. User clicks the “Complete” button.
2. System updates the status.
3. System displays a confirmation message “Feedback mark as completed”.
4. Return to Main Flow Step 2.</td></tr></table></td></tr>
</table>

Alternative Flow – User Cancels View of Feedback Details 5.1.1 User clicks the “Back” button on “Feedback Detail” page. 5.1.2 System verifies the action. 5.1.3 Return to Main Flow Step 2.
Alternative Flow – User Not Found 2.1.1 User clicks the search field. 2.1.2 User types in the username or part of the name. 2.1.3 System searches for matching usernames. 2.1.4 No matches are found. 2.1.5 System displays error message “No matching patients found”. 2.1.6 Return to Main Flow Step 2.

3.4.14 Give Feedback Use Case Description

Table 3.14: Give Feedback Use Case Description

Use Case ID	UC014
Use Case	Give Feedback
Purpose	To allow users to provide feedback on their patients.
Actor	Doctors
Trigger	User selects the “Feedback” option.
Main Flow 1. User selects the “Feedback” option. 2. System displays a list of patients eligible for feedback. - If user searches for a specific person, sub flow UC-2a will be performed. 3. User selects a patient from the list. 4. System prompts the user to input feedback. 5. User enters the feedback. 6. System verifies the provided input. 7. System redirects the user to the “All Feedback” page. 8. System displays the feedback details.	
Sub Flow	
Searches for a User	UC-2a 1. User clicks the search field. 2. User types in the username or part of the name.

		3. System displays a list of matching users based on the input. 4. User selects the correct user from the list. 5. Return to Main Flow Step 3.

Alternative Flow – User Cancels Giving Feedback

2.1.1 User clicks the “Back” button on “Doctor Feedback” page.

2.1.2 System verifies the action.

2.1.3 System redirects the user to the menu page.

Alternative Flow – User Not Found

2.2.1 User clicks the search field.

2.2.2 User types in the username or part of the name.

2.2.3 System searches for matching usernames.

2.2.4 No matches are found.

2.2.5 System displays error message “No matching patients found”.

2.2.6 Return to Main Flow Step 2.

3.5 Activity Diagram

3.5.1 Choose User Type Activity Diagram

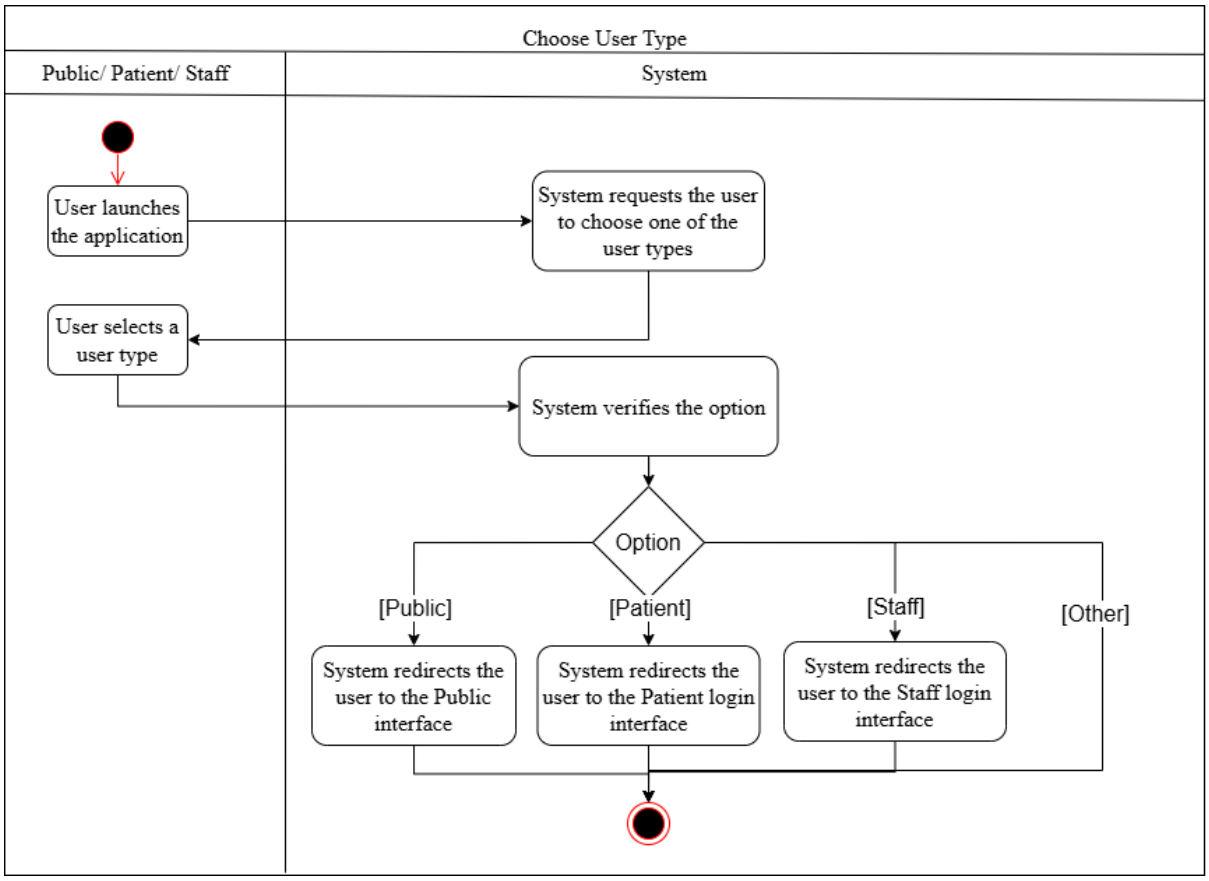

Figure 3.4: Choose User Type Activity Diagram

3.5.2 Login Account Activity Diagram

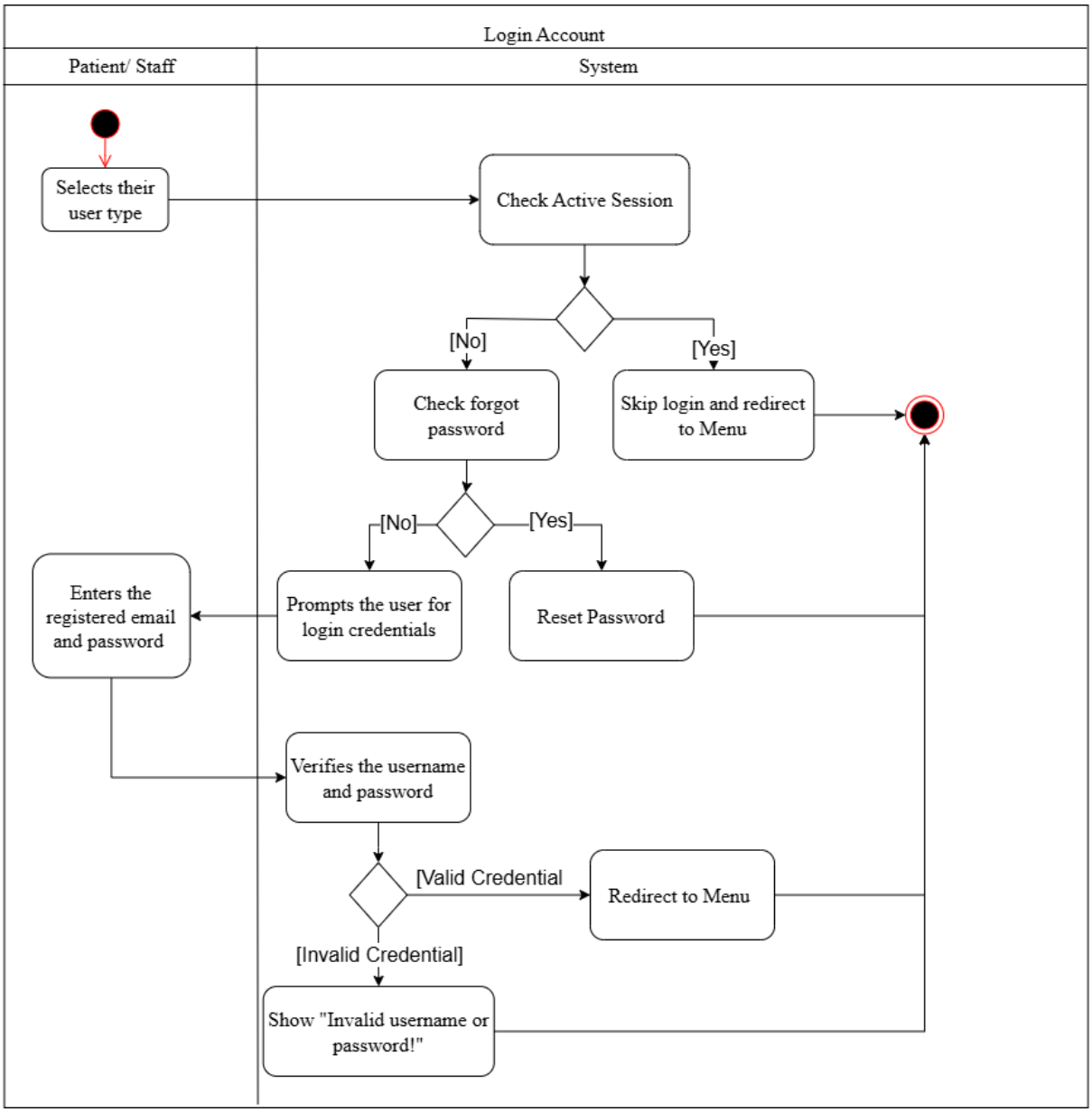

Figure 3.5: Login Account Activity Diagram

3.5.3 Sign Out Account Activity Diagram

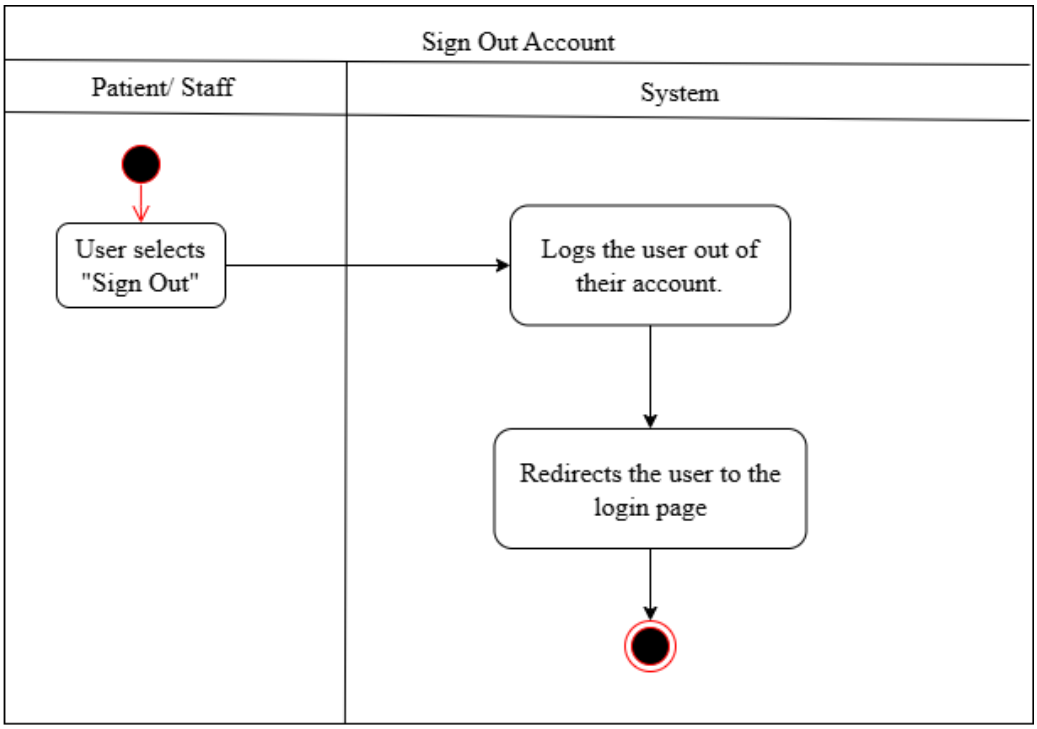

Figure 3.6: Sign Out Account Activity Diagram

3.5.4 Profile Activity Diagram

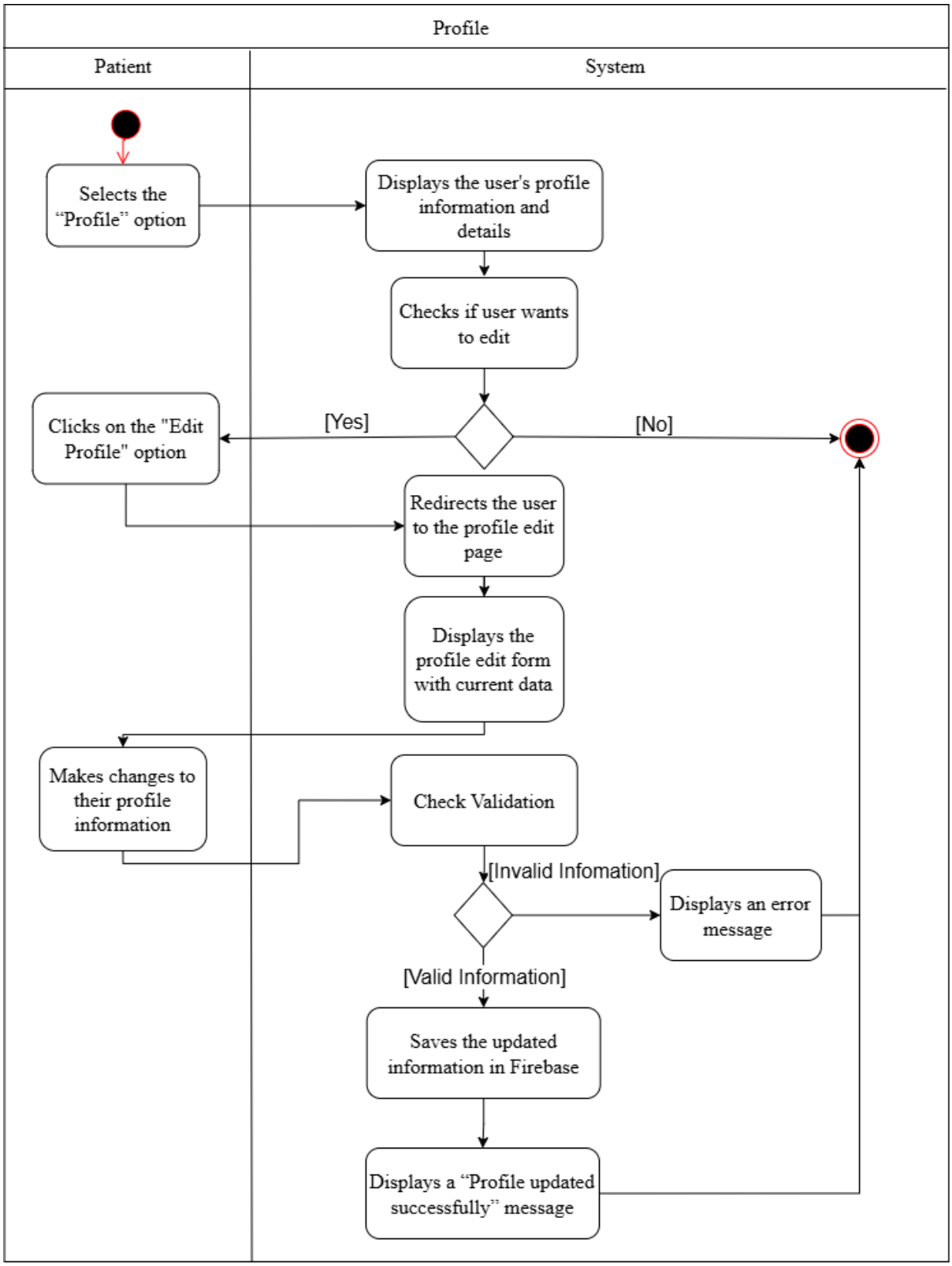

Figure 3.7: Profile Activity Diagram

3.5.5 History Activity Diagram

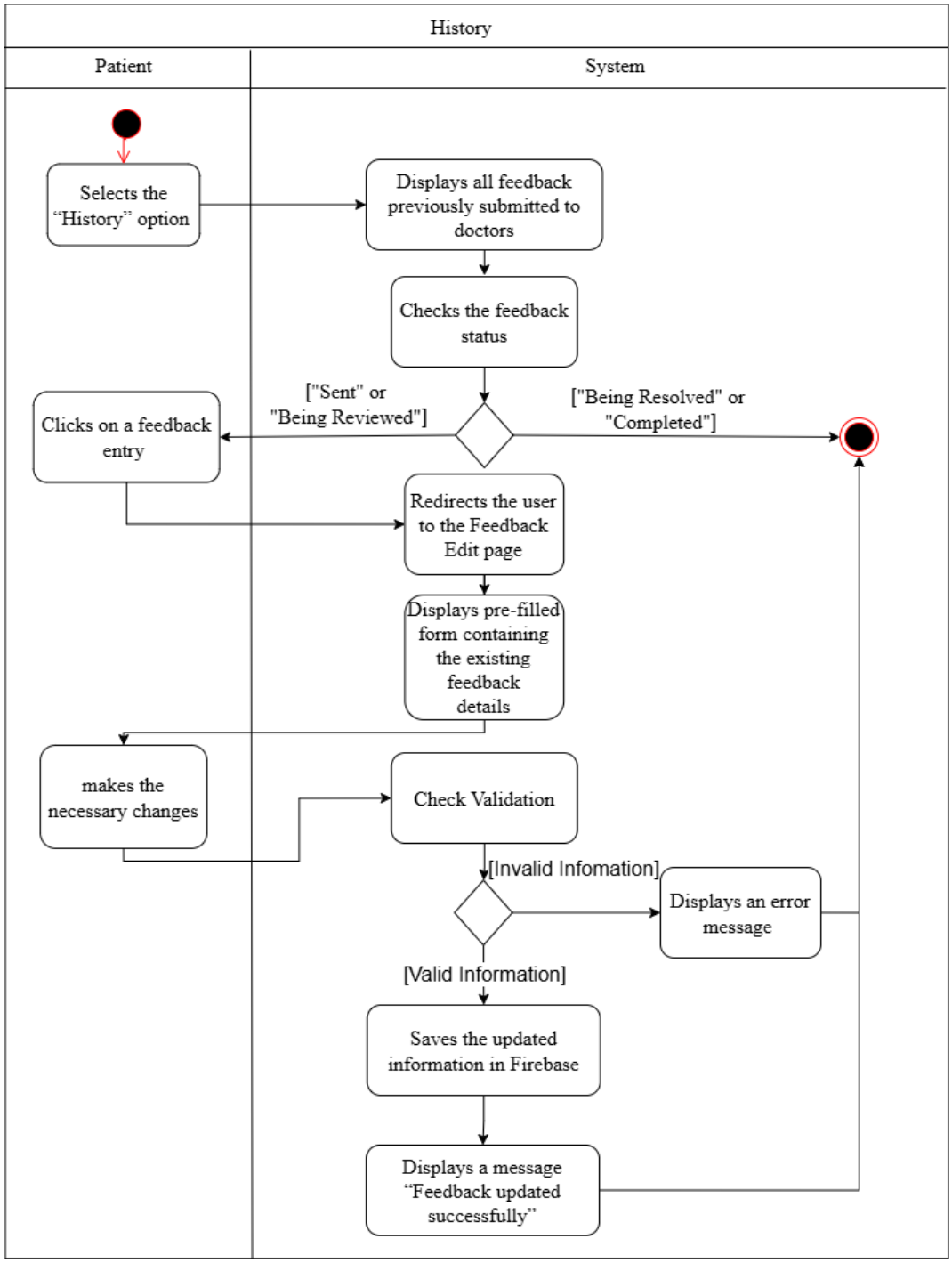

Figure 3.8: History Activity Diagram

3.5.6 Phone call Activity Diagram

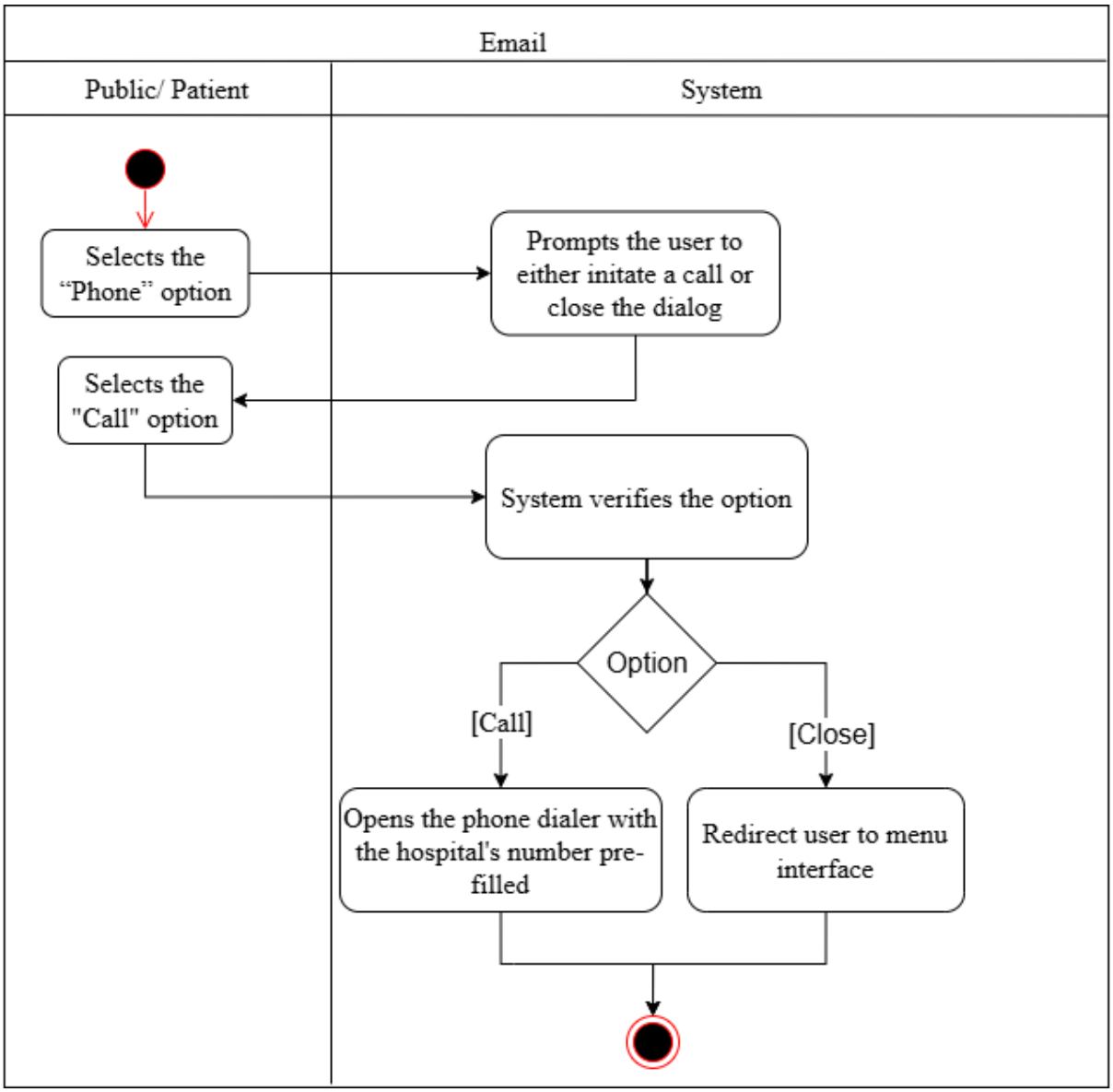

Figure 3.9: Phone call Activity Diagram

3.5.7 Email Activity Diagram

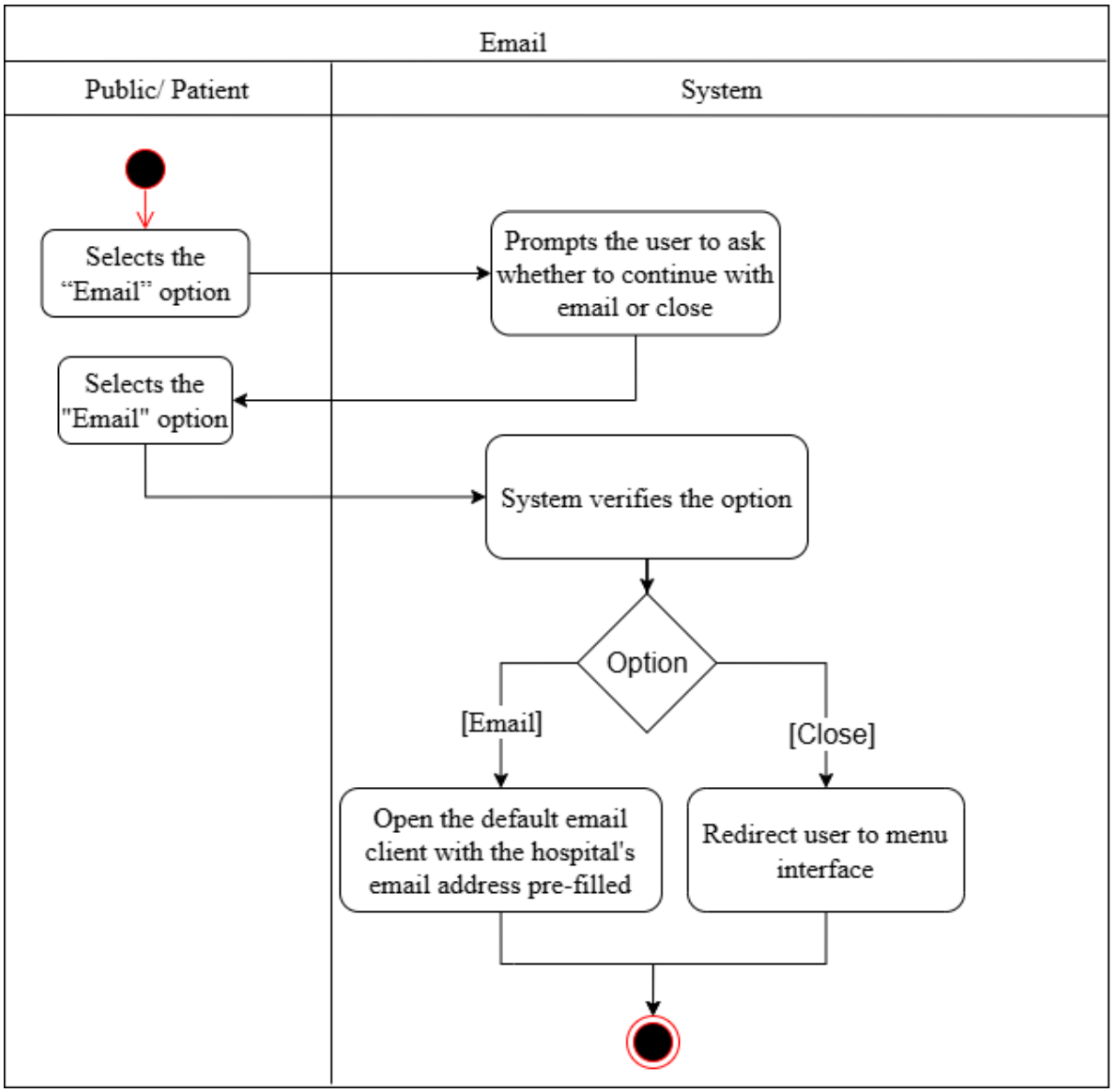

Figure 3.10: Email Activity Diagram

3.5.8 Give General Feedback Activity Diagram

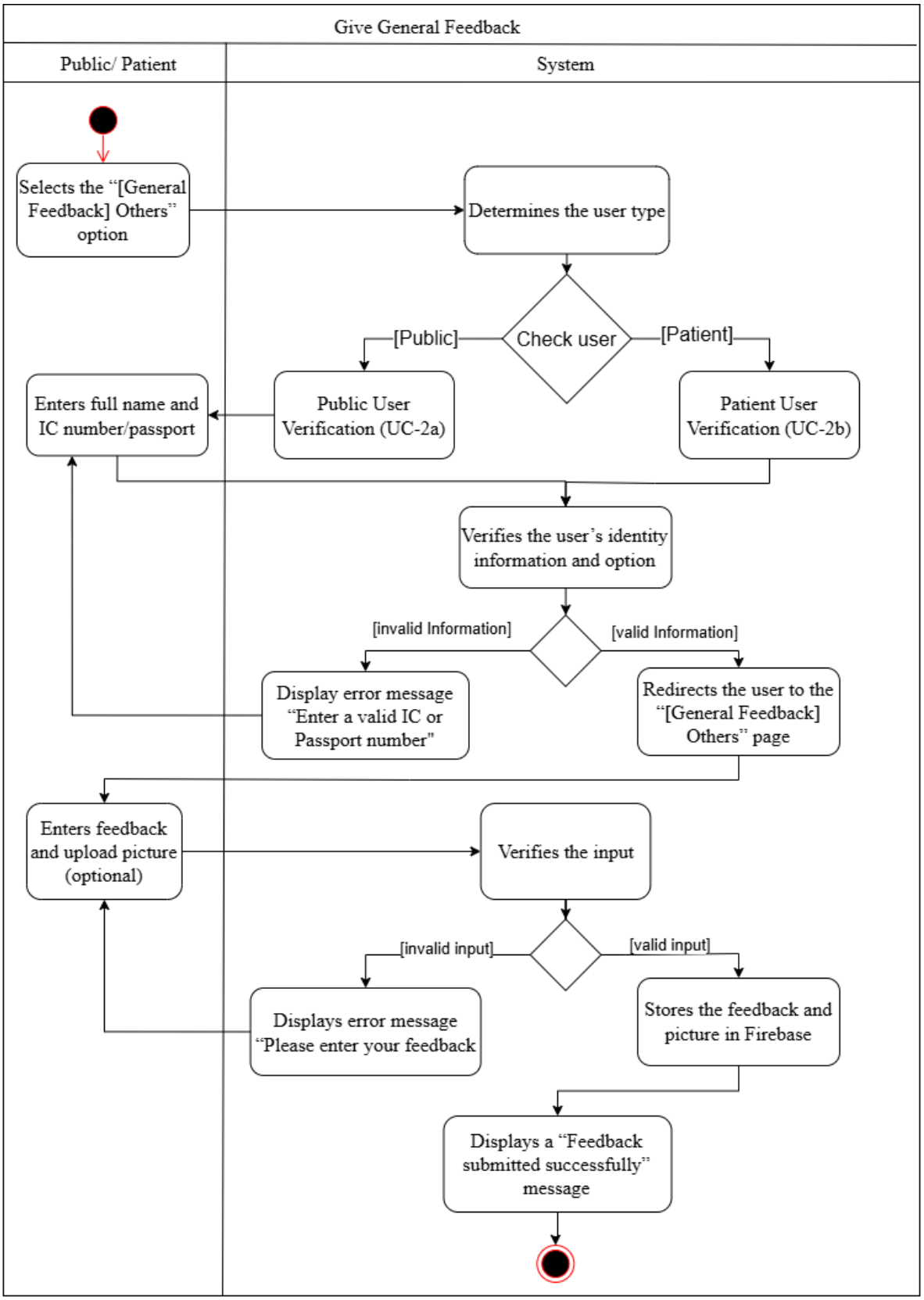

Figure 3.11: Give General Feedback Activity Diagram

3.5.9 Give App Feedback Activity Diagram

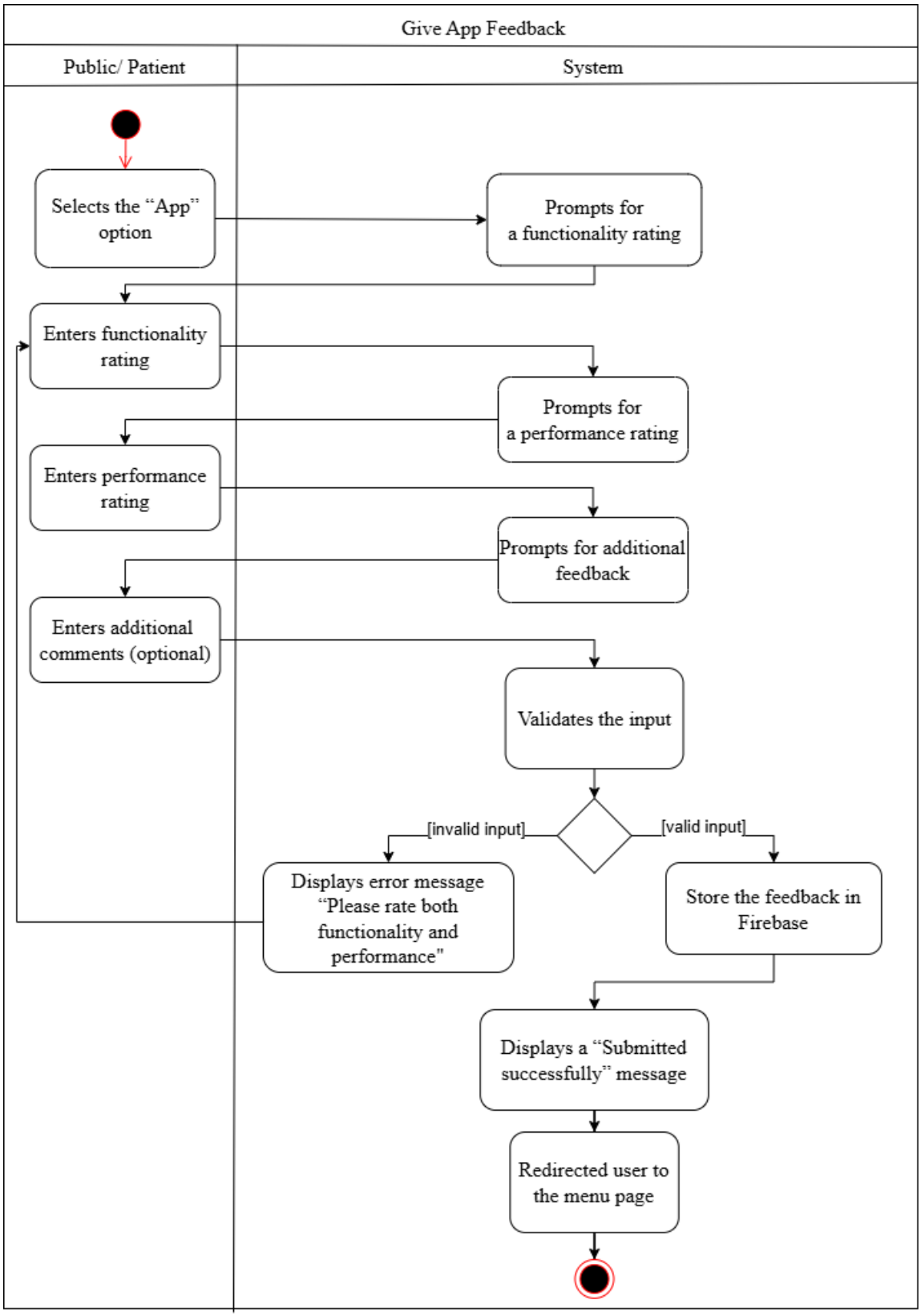

Figure 3.12: Give App Feedback Activity Diagram

3.5.10 Give Doctor Appointment Feedback Activity Diagram

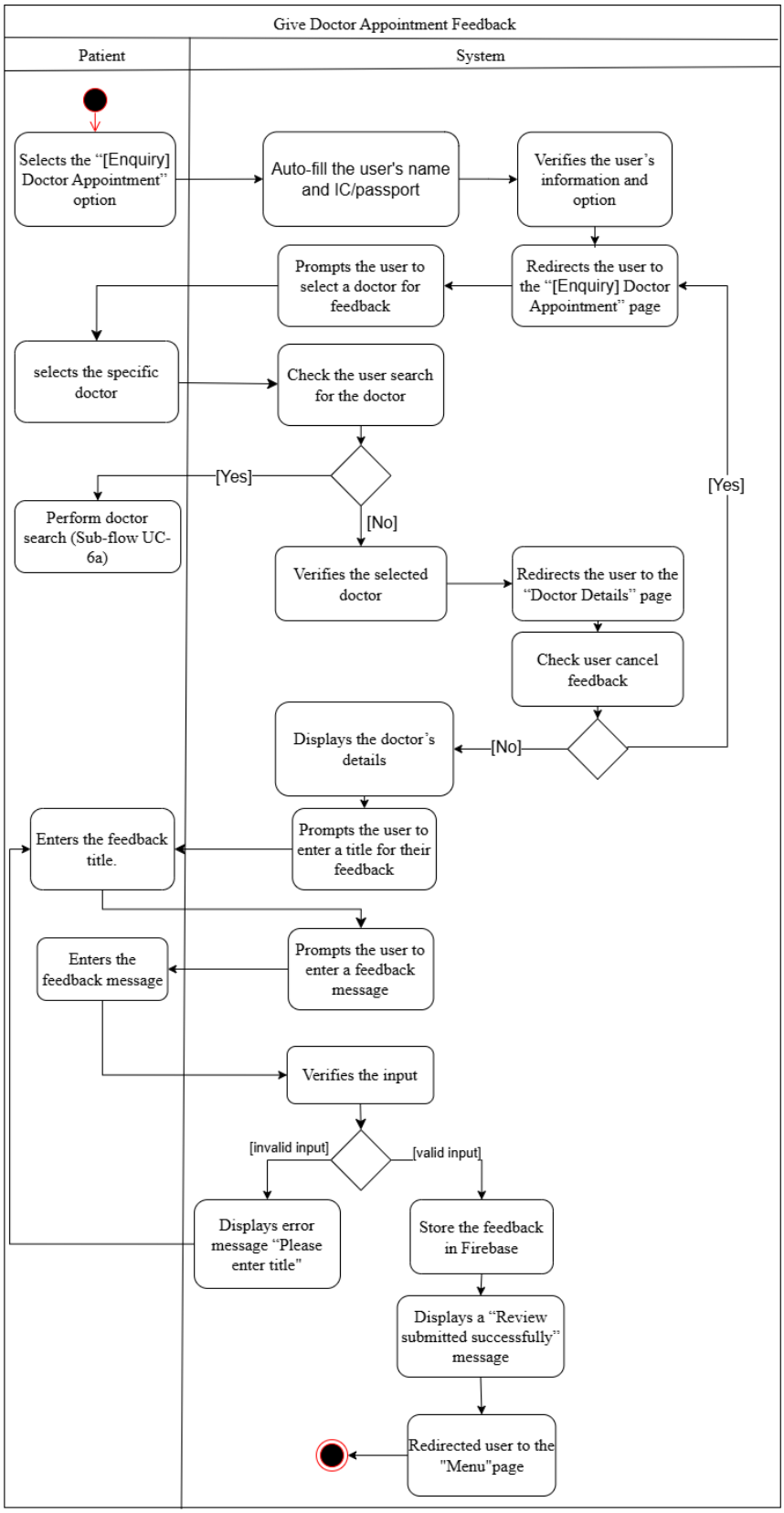

Figure 3.13: Give Doctor Appointment Feedback Activity Diagram

3.5.11 Give Compliments/ Complaints Activity Diagram

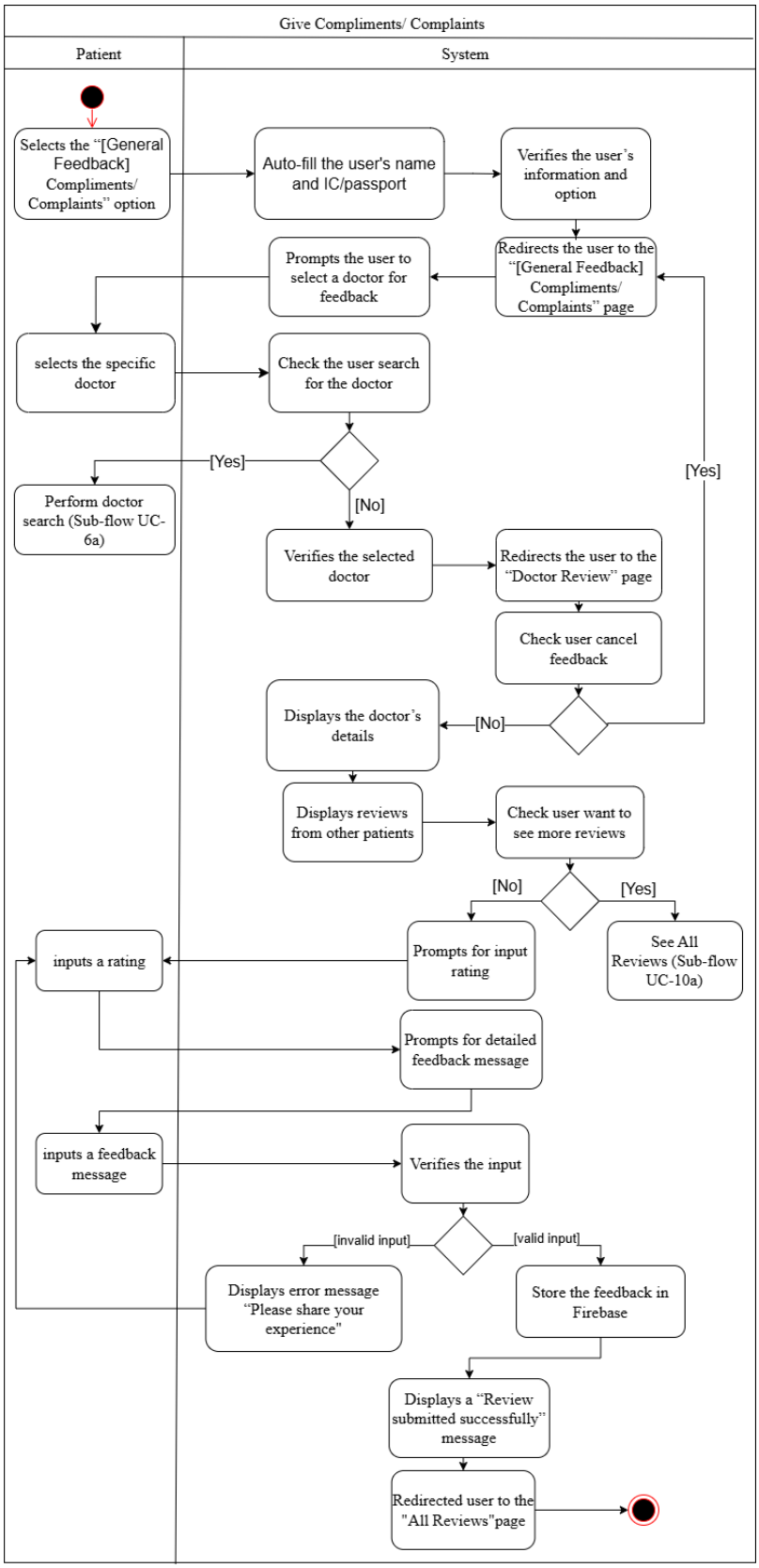

Figure 3.14: Give Compliments/ Complaints Activity Diagram

3.5.12 Chat Activity Diagram

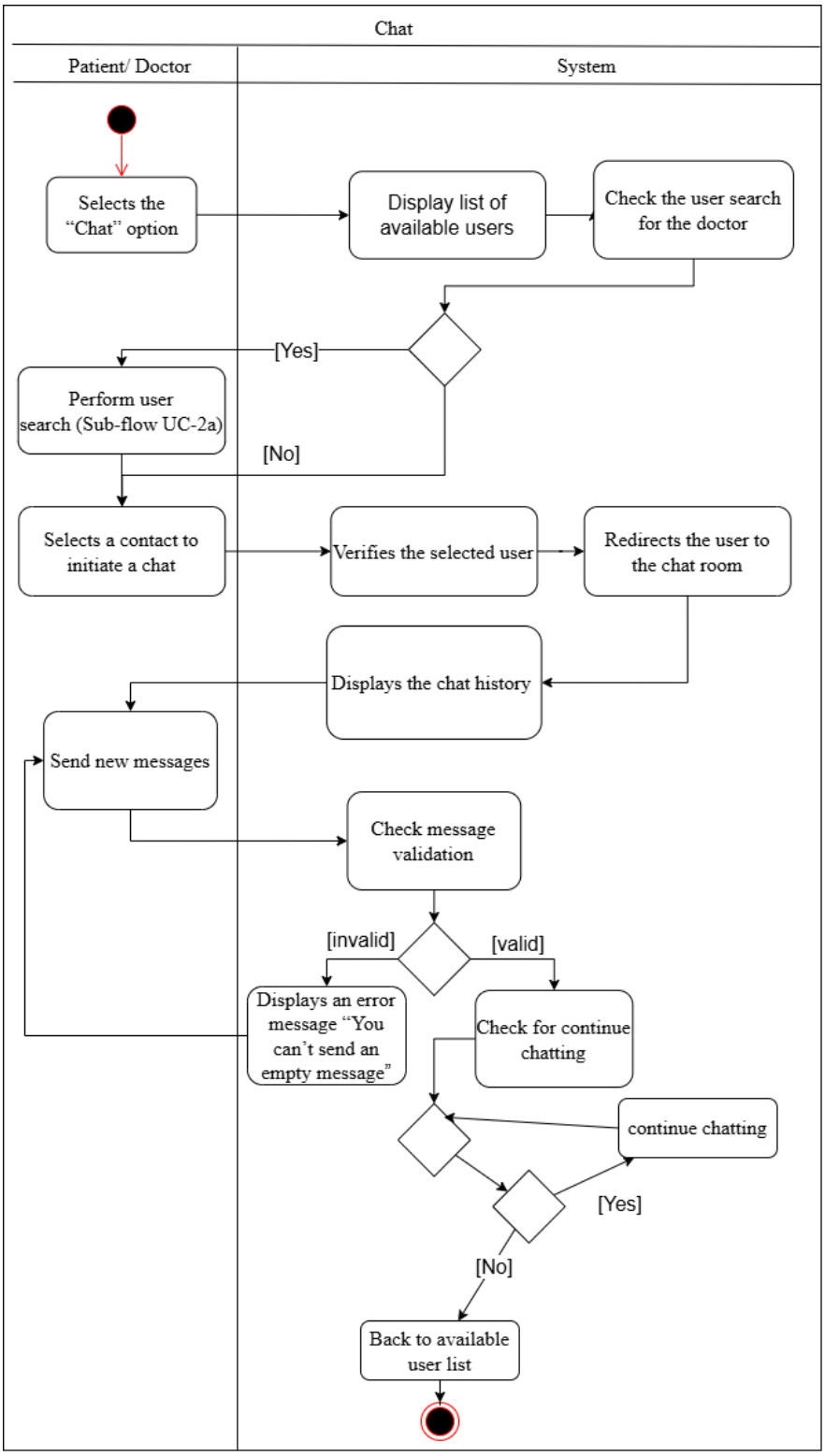

Figure 3.15: Chat Activity Diagram

3.5.13 Check Notification Activity Diagram

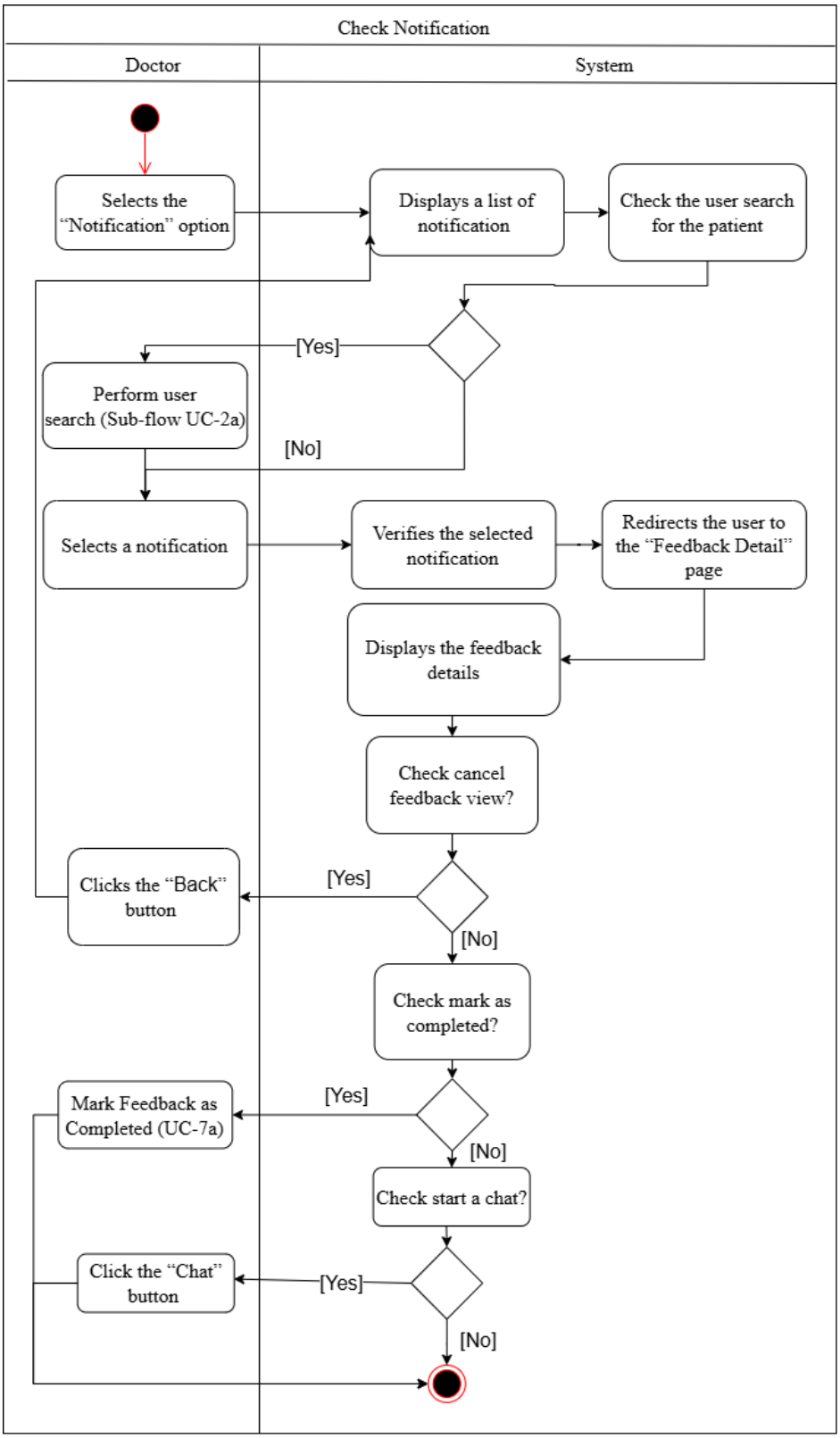

Figure 3.16: Check Notification Activity Diagram

3.5.14 Give Feedback Activity Diagram

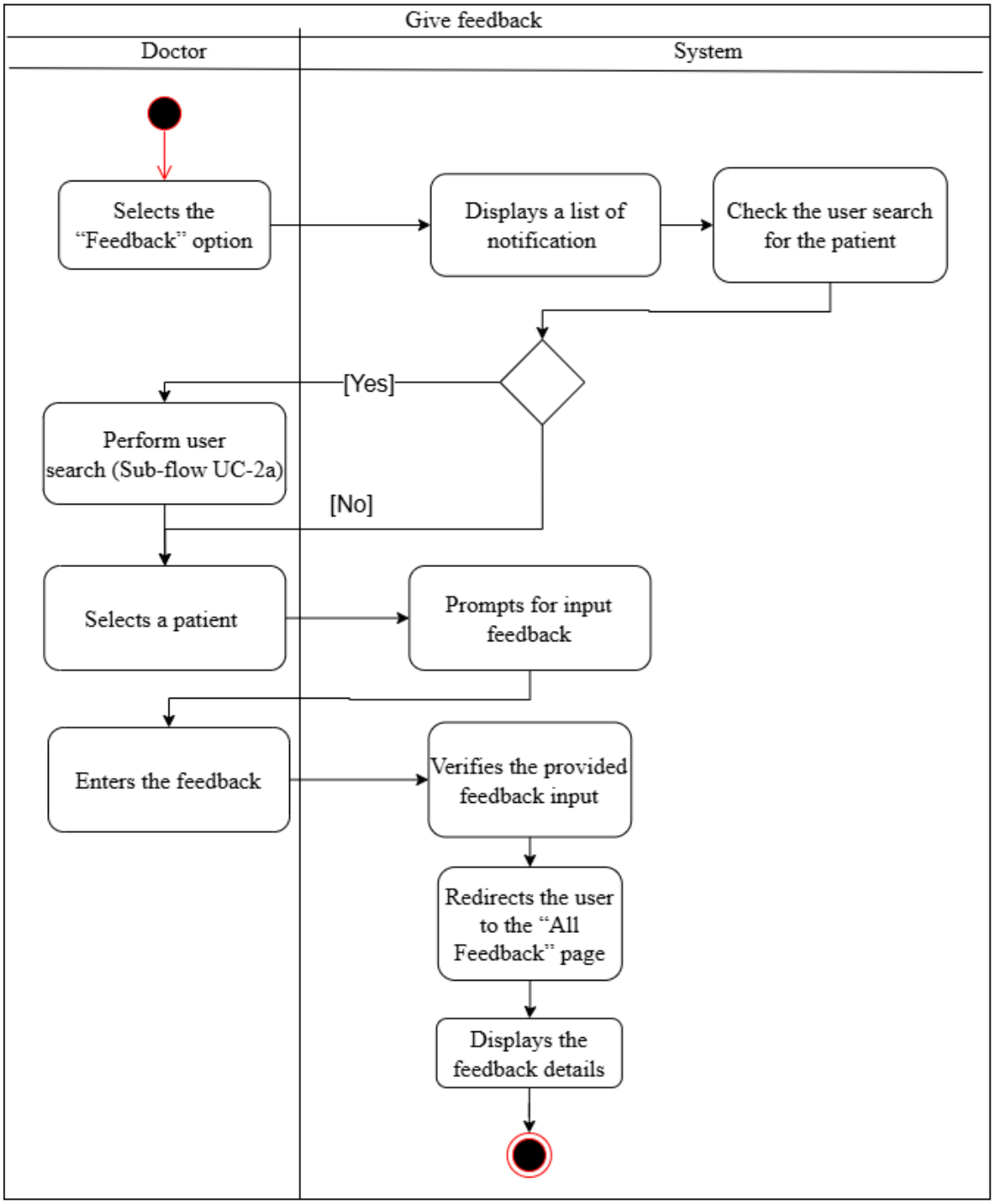

Figure 3.17: Give Feedback Activity Diagram

Chapter 4

System Design

4.1 Storyboard

Public users

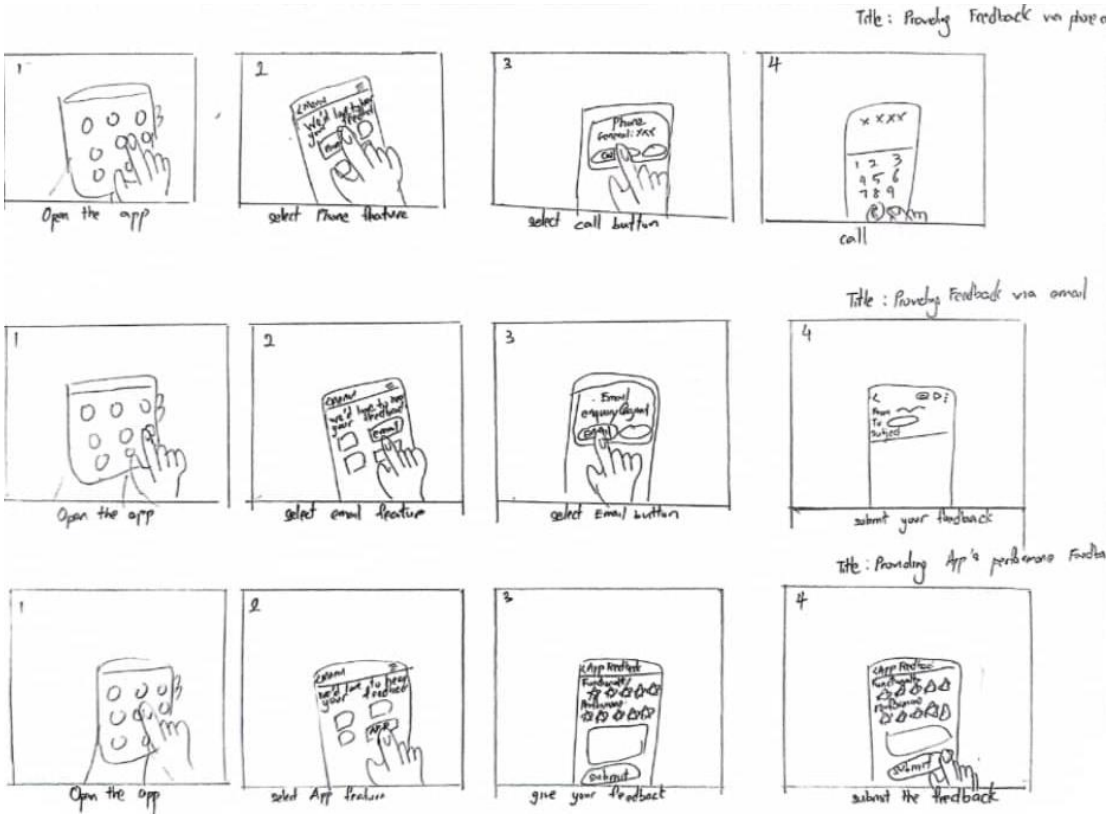

Figure 4.1: Providing feedback via phone call, email and app feedback feature (Public)

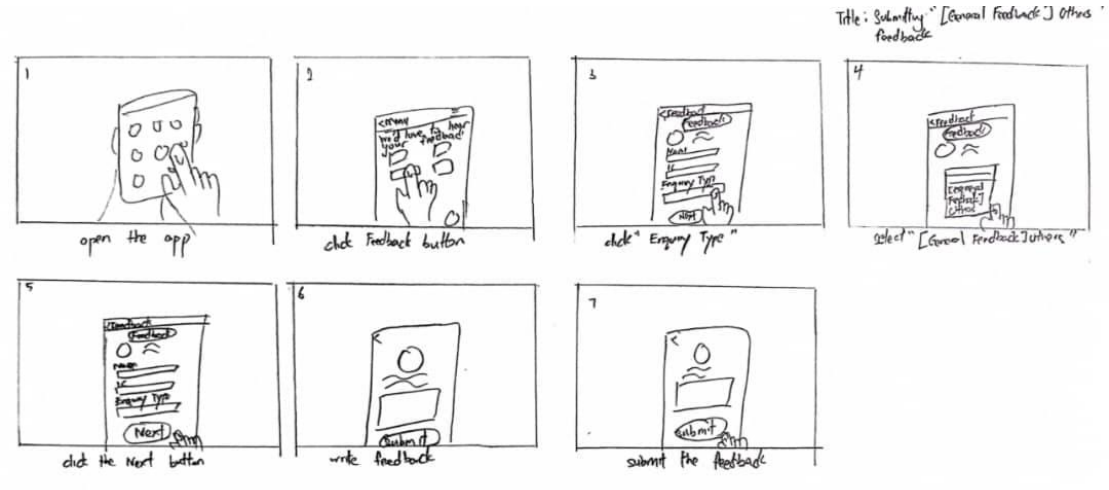

Figure 4.2: Providing "[General Feedback] Others" feedback (Public)

Patient users

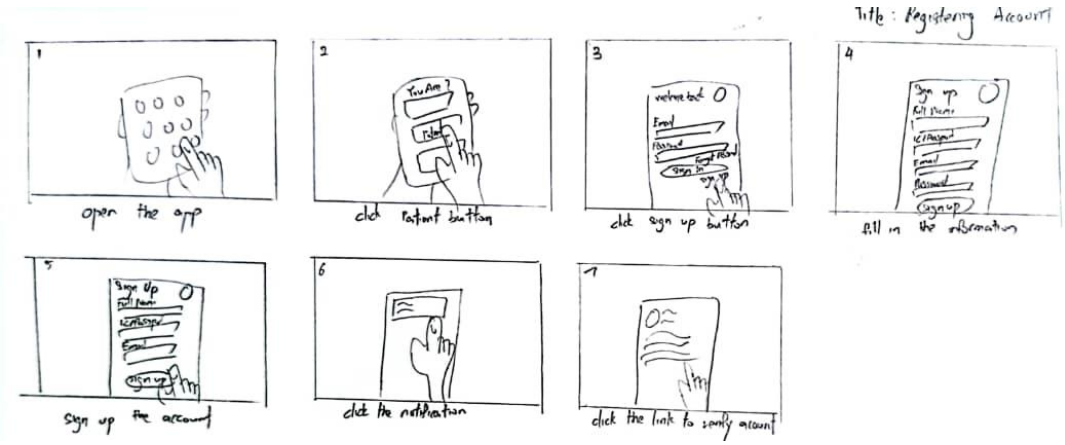

Figure 4.3: Registering user account

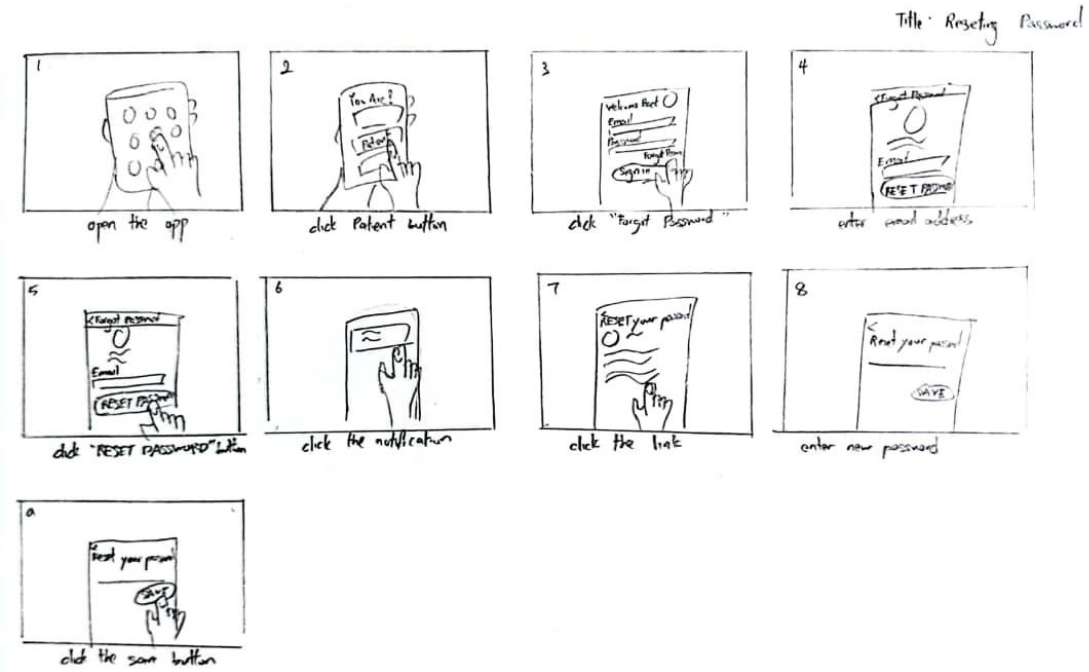

Figure 4.4: Resetting password

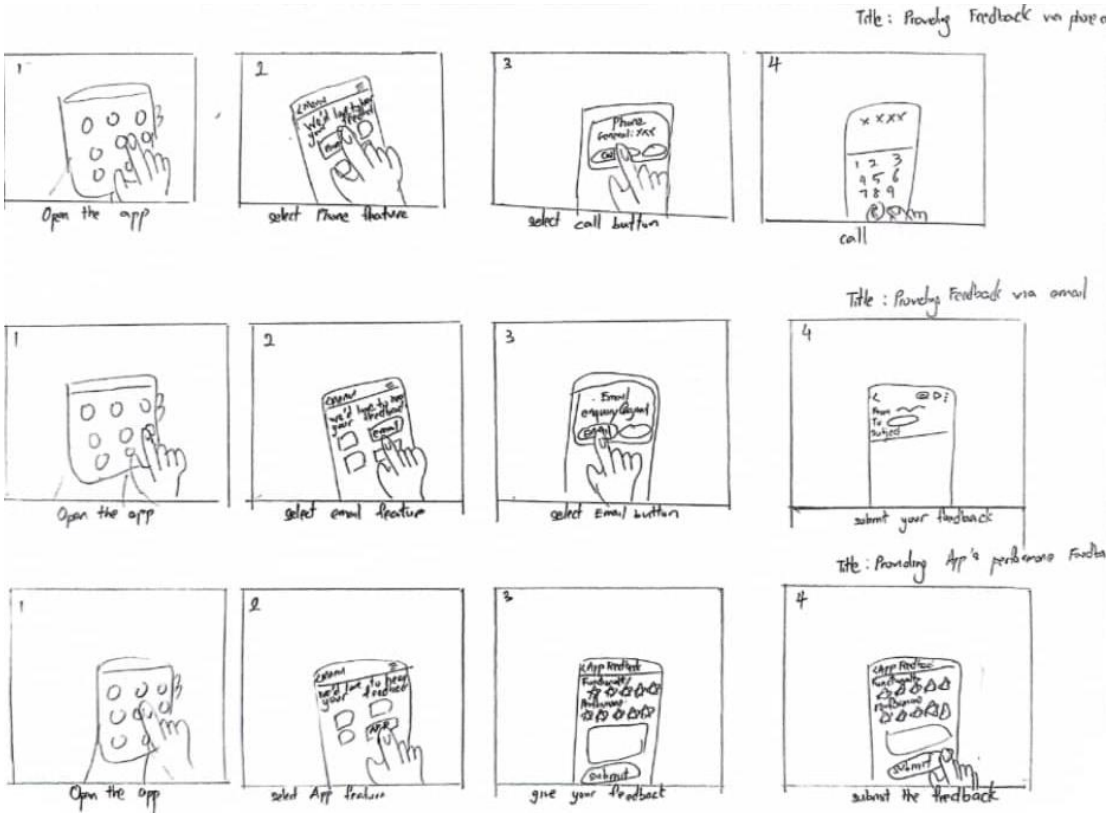

Figure 4.5: Providing feedback via phone call, email and app feedback feature

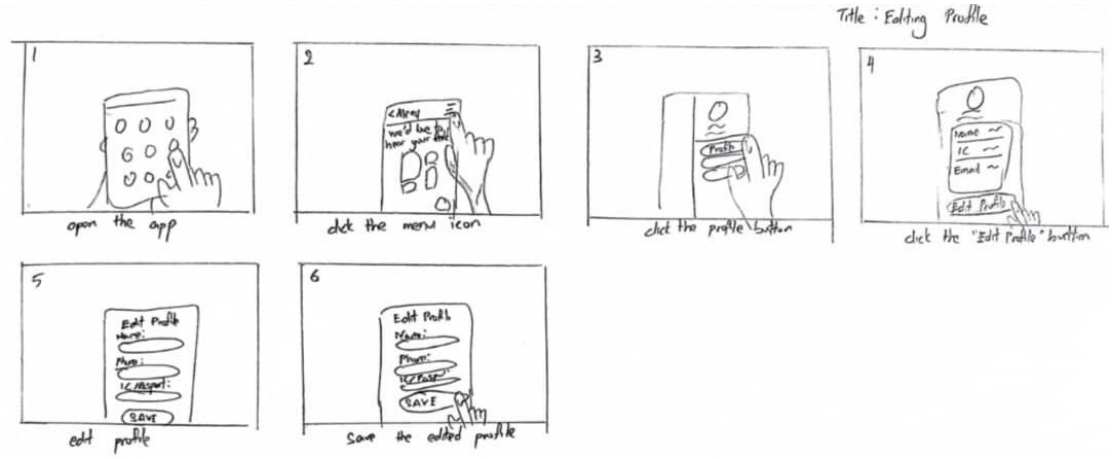

Figure 4.6: Editing Profile

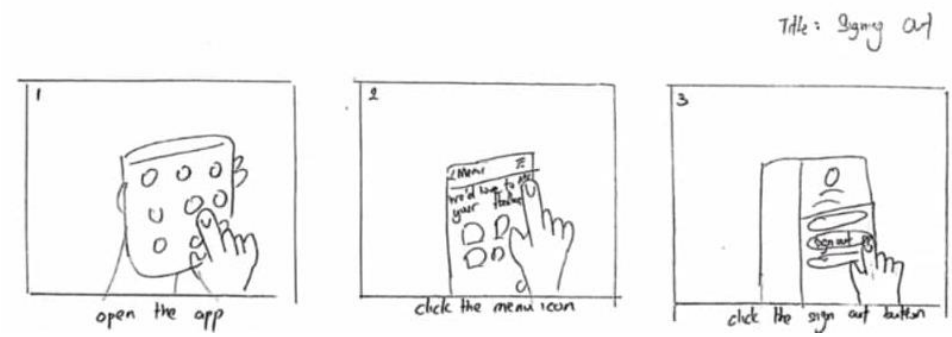

Figure 4.7: Signing out

Figure 4.8: Submitting "[Enquiry] Doctor Appointment" feedback

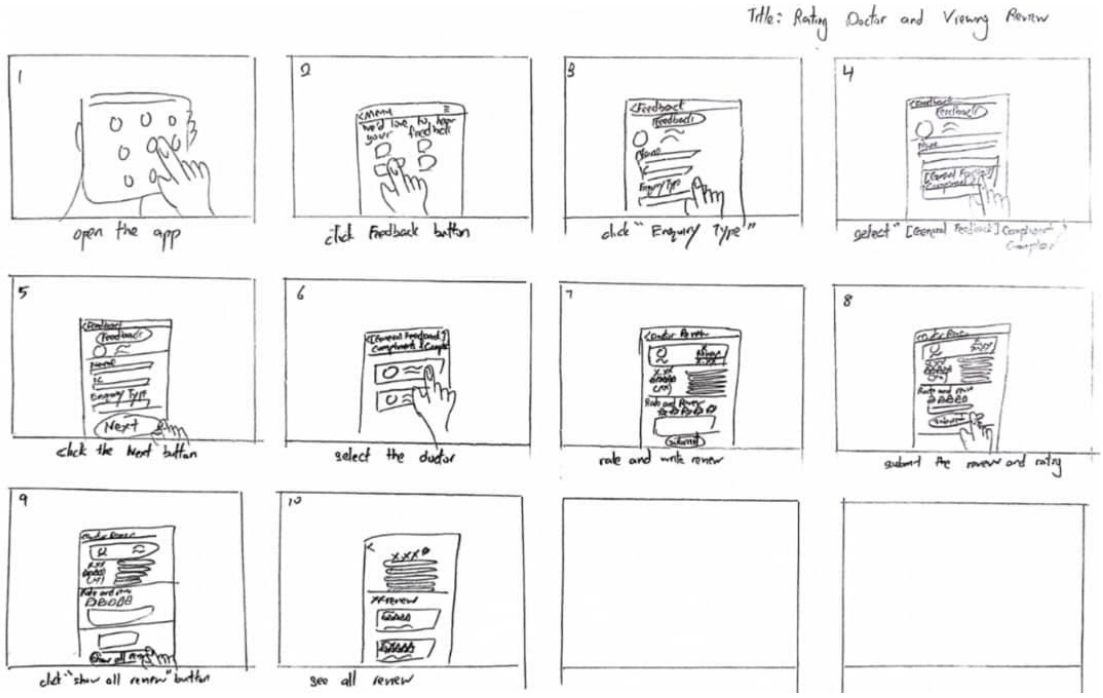

Figure 4.9: Rating Doctor and Viewing Review

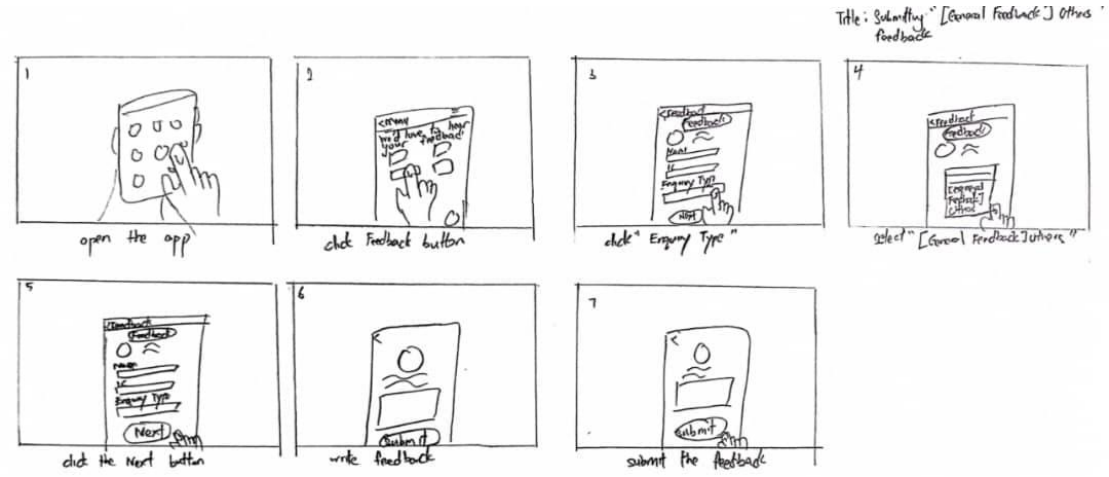

Figure 4.10: Providing "[General Feedback] Others" feedback

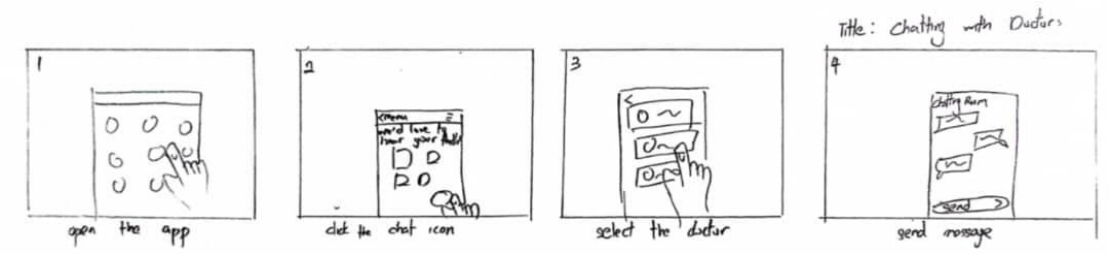

Figure 4.11: Chatting with doctor

Doctor users

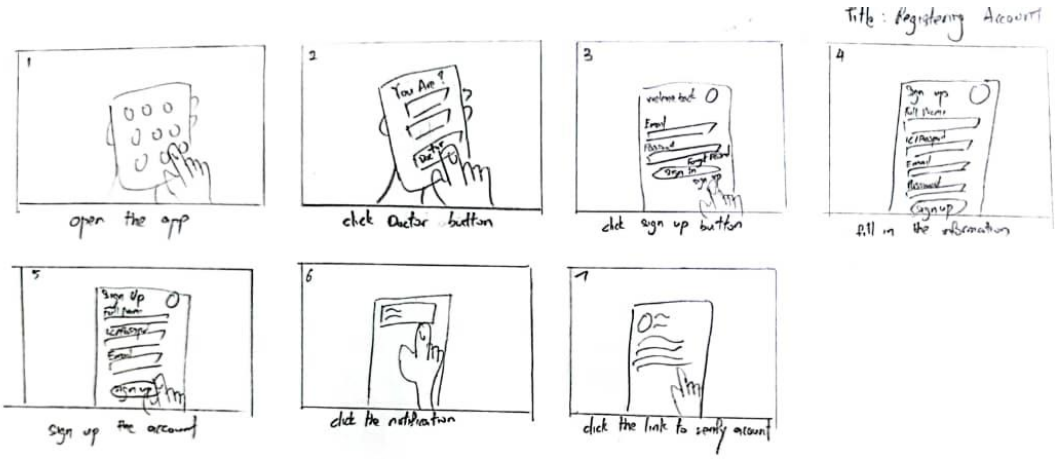

Figure 4.12: Registering doctor account

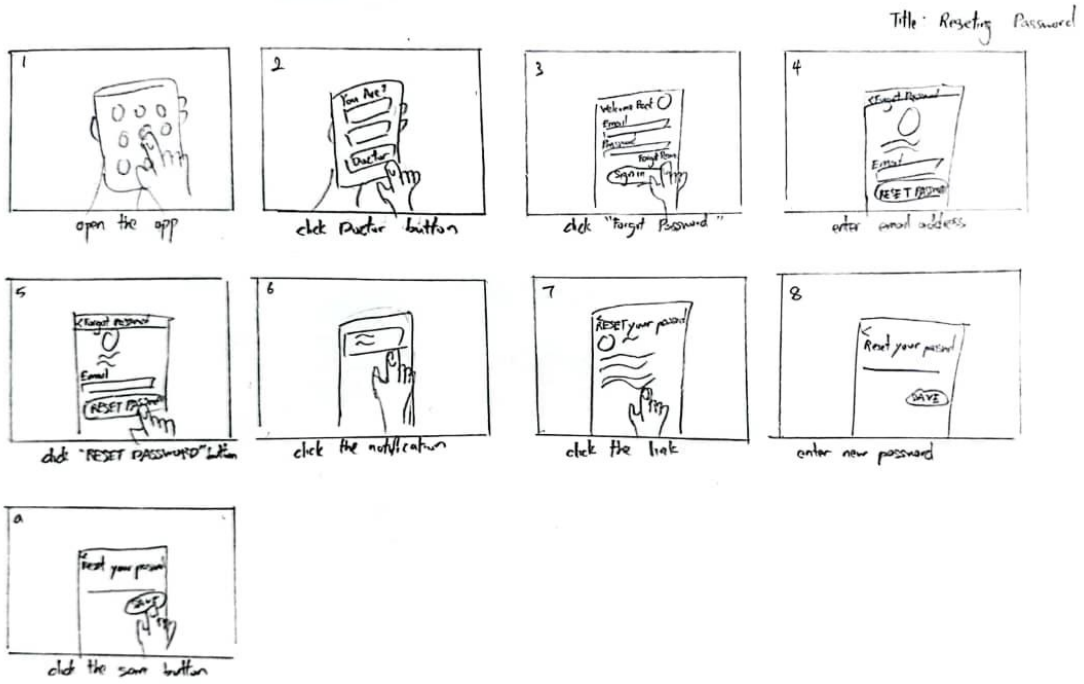

Figure 4.13: Resetting password (Doctors)

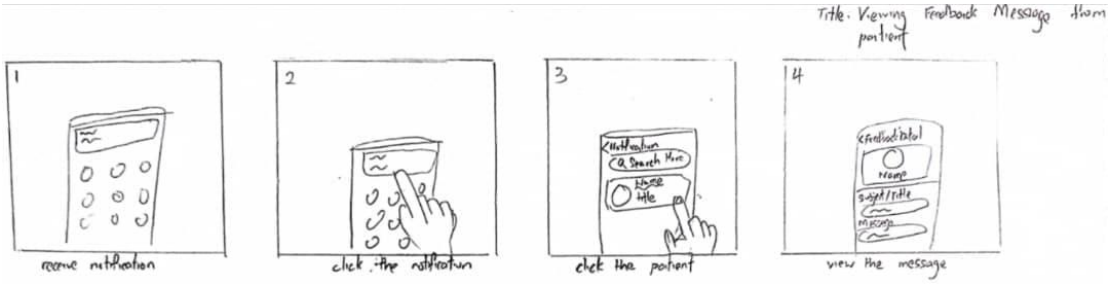

Figure 4.14: Receiving and Viewing feedback message from patients

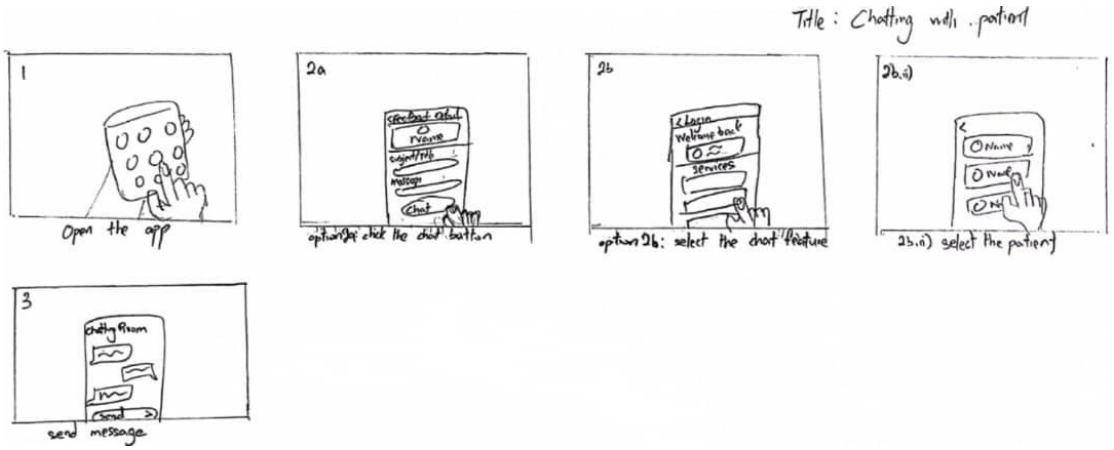

Figure 4.15: Chatting with patients

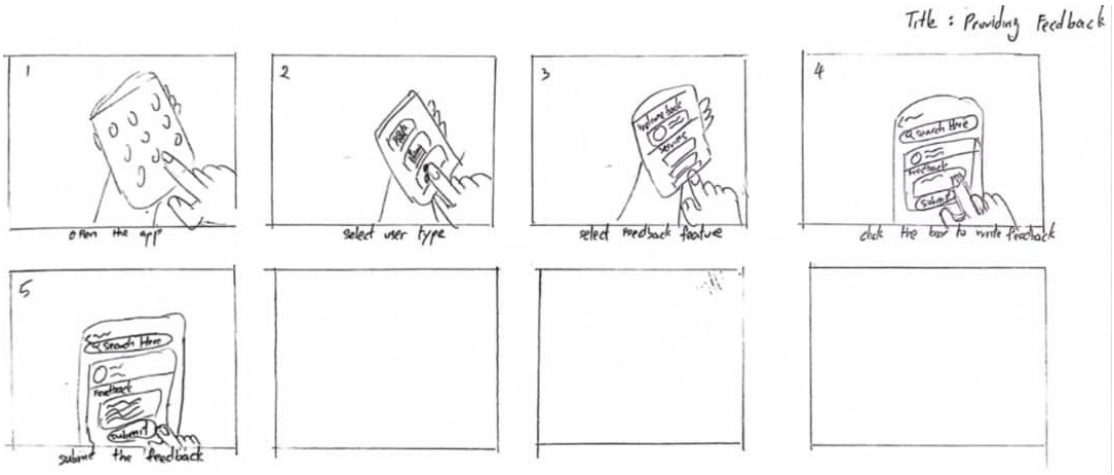

Figure 4.16: Providing feedback

4.2 Flow-chart

General Flow-chart

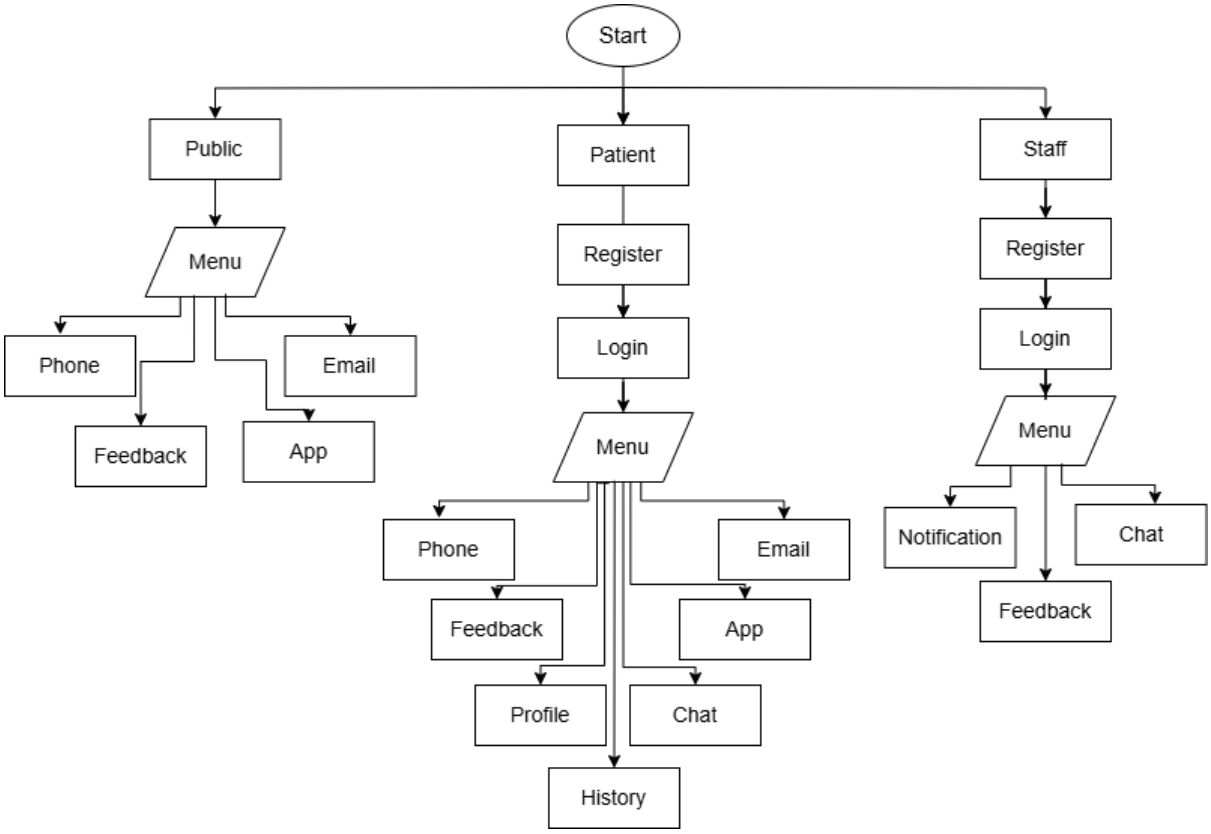

Figure 4.17 : General flow-chart

Details version for each module flowchart

i. Login and Registration module

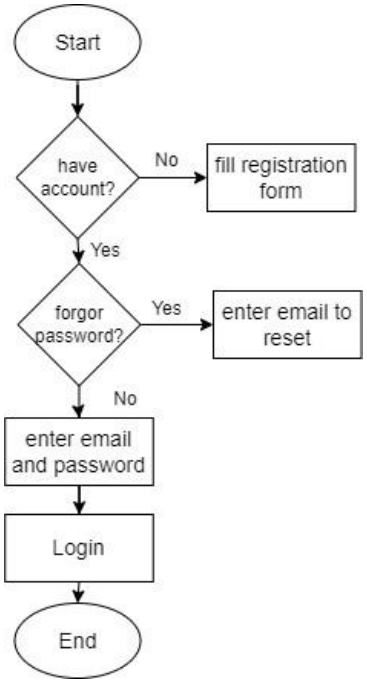

Figure 4.18 : Login and Registration module

In this application, besides public users, both patients and doctors are required to log in to their accounts to access the features. They must enter their registered and verified email address along with the correct password. This application uses Firebase for user authentication (signInWithEmailAndPassword(email, password)). If the entered credentials match data in the database, the user can proceed to their respective interface within the application. If a user forgets their password, Firebase provides an option to reset it by entering their email address.

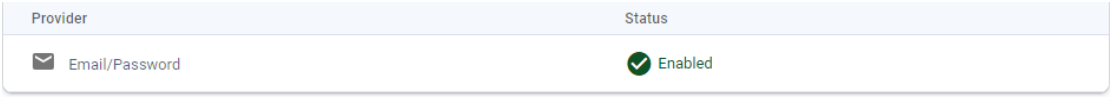

Figure 4.19: Firebase login with email and password

Users who do not have an account yet can fill out their information in the registration form, then their information will be sent to the Firebase for authentication using the createUserWithEmailAndPassword(email, password) method. Firebase will use the user's email and password to create the account, while other information will be stored for additional purposes.

Figure 4.20: Firebase registration data

ii. User Type module

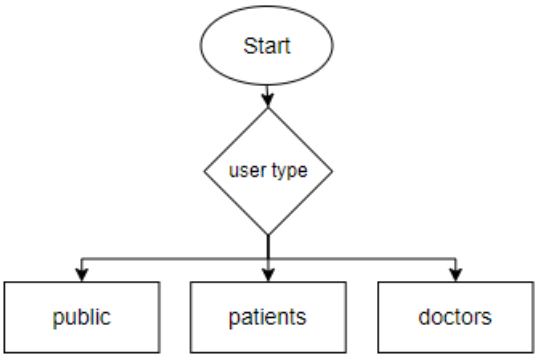

Figure 4.21: Use type module

In this application, users are categorised into different user types based on their identity. After the user selects the user type, the system automatically assigns each user to their appropriate category to ensure they are directed to different interfaces and features.

Figure 4.22: User type data in real-time database

iii. Dashboard (Public)

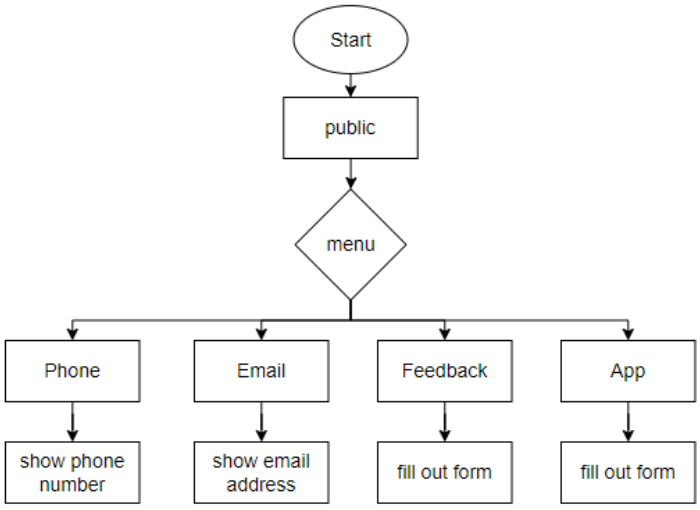

Figure 4.23: Dashboard (Public)

Since public users do not need to log in, there are some limitations on how they can provide feedback. After selecting the public user type, they are directed to the public interface. From there, they can choose to provide feedback via phone call, email, or by filling out a feedback form and submitting it. Additionally, they can provide feedback according to the mobile application's functionality by using the "App" option.

iv. Dashboard (Patient)

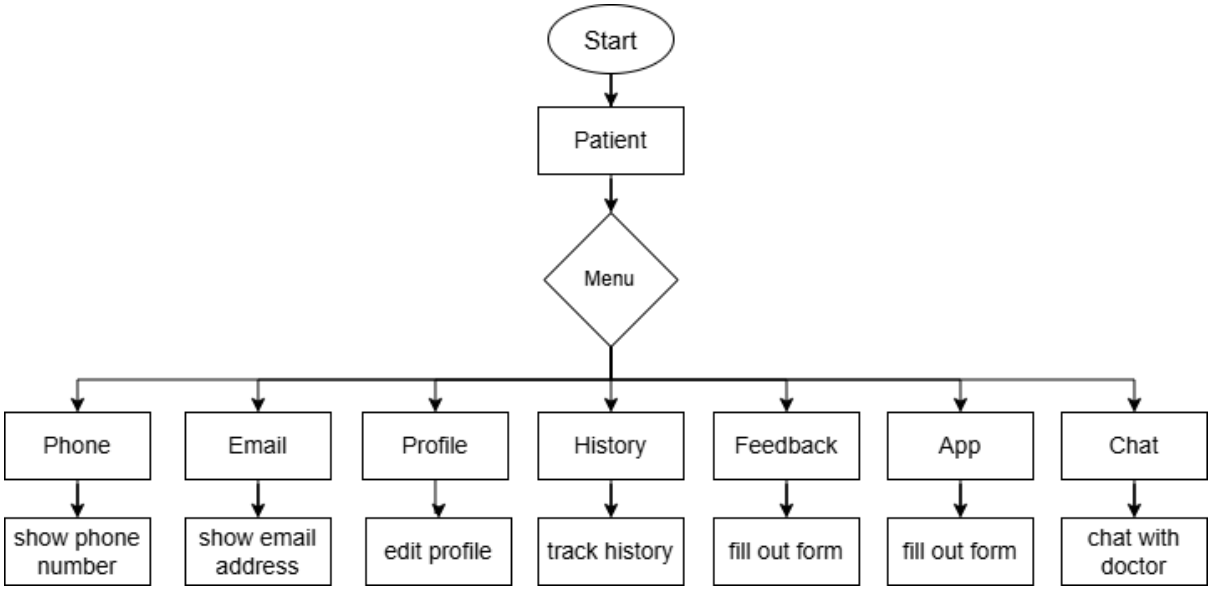

Figure 4.24: Dashboard (Patient)

After selecting the patient user type, users are directed to the patient interface. From there, they can choose to provide feedback via phone call, email or by filling out and submitting a feedback form. The "Profile" feature allows patients to view and update their personal information, while the "History" section enables them to view and track their submitted feedback along with its current status. Additionally, patients can submit feedback according to the mobile application's functionality and performance through the "App" option. The menu for patients is similar to that of public users but with some differences. The "Feedback" option offers additional features for patients to provide feedback. Besides, there is a chat function that allows patients to communicate directly with doctors for more detailed feedback.

iv. Feedback module (Patient)

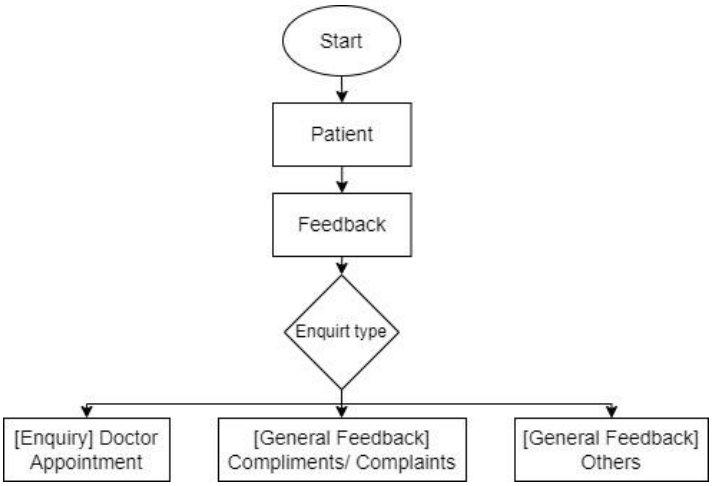

Figure 4.25: Feedback module (Patient)

For patients, the "Feedback" option offers additional features for providing feedback. Since they are already signed in to their accounts, their information such as name and IC is automatically filled into the form. They simply need to select the type of enquiry for which they want to provide feedback.

[Enquiry] Doctor Appointment

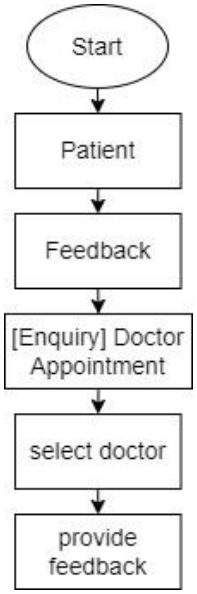

Figure 4.26: [Enquiry] Doctor Appointment

After a patient selects the “[Enquiry] Doctor Appointment” option and clicks the “Next” button, they are directed to a page with a list of doctors to choose from for providing feedback. The list includes information such as the doctor's name, qualifications, and speciality. Once the patient selects the doctor, they wish to provide feedback on, they are redirected to a page displaying the doctor's details at the top. From there, the patient can either call the doctor or

visit the doctor’s office. Additionally, patients can fill out a feedback form by providing a title and message, which will be submitted directly to the doctor

[General Feedback] Compliments/ Complaints

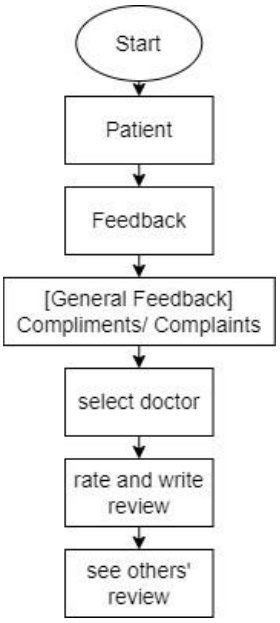

Figure 4.27: [General Feedback] Compliments/ Complaints

After a patient selects the “[General Feedback] Compliments/Complaints” option and clicks the “Next” button, they are directed to a page with a list of doctors to choose from for providing feedback. The list includes information such as the doctor's name, qualifications, and speciality. Once the patient selects the doctor they wish to compliment or complain about, they are redirected to a page displaying the doctor's details at the top, including the doctor’s name, the number of reviews received, and their overall rating. This allows the patient to view ratings given by other patients. Additionally, patients can rate and review the doctor based on the services provided. At the bottom, the patient can also view all reviews given by others, which are displayed on a separate page.

[General Feedback] Others

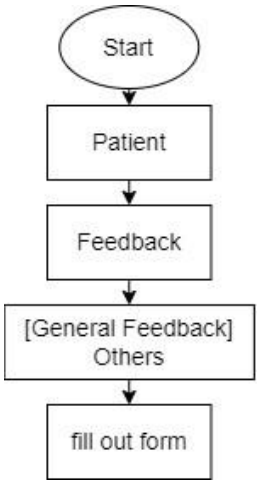

Figure 4.28: [General Feedback] Others

After a patient selects the "[General Feedback] Others" option and clicks the "Next" button, they are directed to a page containing a feedback form. The patient can provide any suggestions, note areas for improvement, or share likes and dislikes in the form and then submit it.

vi. Chatting function module (Patient)

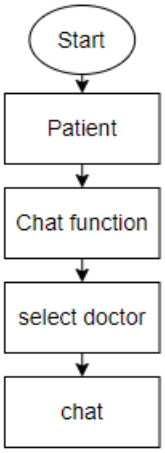

Figure 4.29: Chatting function module (Patient)

This application also provides a chat function for patients to interact with doctors. Patients are not allowed to initiate the conversation; only the doctor can start the conversation with the patient. Once the conversation is initiated, patients can choose to continue the discussion with the doctor to provide more detailed feedback.

vii. Dashboard (Doctor)

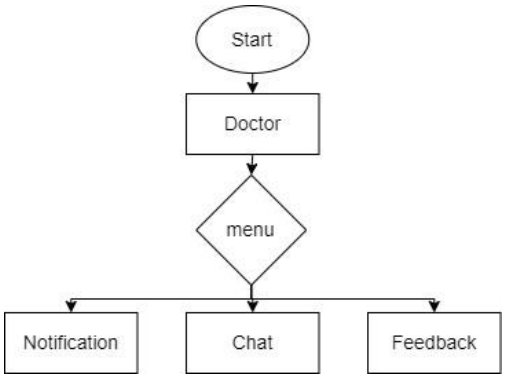

Figure 4.30: Dashboard (Doctor)

After selecting the doctor user type, users are directed to the doctor interface. From there, they can choose to view notifications, access the chat function, or give feedback. They can check notifications to see if any patients have provided feedback. They can also use the chat function to communicate directly with patients, addressing their concerns or answering questions. Additionally, doctors can provide feedback to patients as well.

viii. Notification module

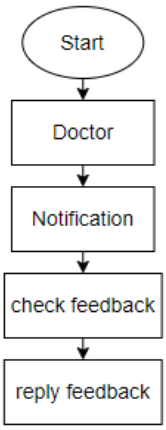

Figure 4.31: Notification module

After a doctor selects the “Notification” option, they are directed to a page displaying a list of feedback submitted by different patients. Each entry includes a summary, such as the title and a snippet of the comment. The doctor can select any feedback to view the full details, including the patient’s concerns. From there, the doctor can provide a reply, addressing the issues raised and offering solutions or explanations to help resolve the patient’s concerns. Once the doctor replies to the patient who provided the feedback, the conversation is initiated.

ix. Chatting function module (Doctor)

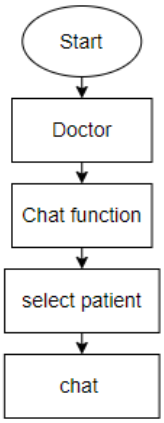

Figure 4.32: Chatting function module (Doctor)

This application also provides a chat function that allows doctors to interact with patients. Patients cannot initiate a conversation; only the doctor can start a conversation with a patient. When a doctor wants to respond to feedback provided by a patient, they can open a chat with that patient and send their reply directly through the conversation. This feature allows doctors to address concerns more personally and in real-time, fostering better communication and understanding between doctors and patients.

x. Feedback module (Doctor)

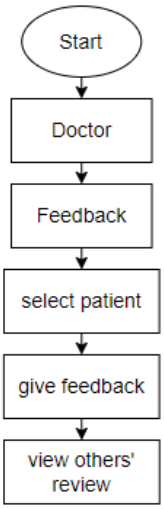

Figure 4.33: Feedback module (Doctor)

For doctors, the "Feedback" option offers specialised features for providing feedback. Doctors can give feedback to specific patients and share it with other employees. Additionally, doctors can view all reviews or feedback provided by other doctors regarding a particular patient. This functionality fosters better collaboration among doctors, ensuring continuous improvement in patient care

4.3 Entity Relationship Diagram

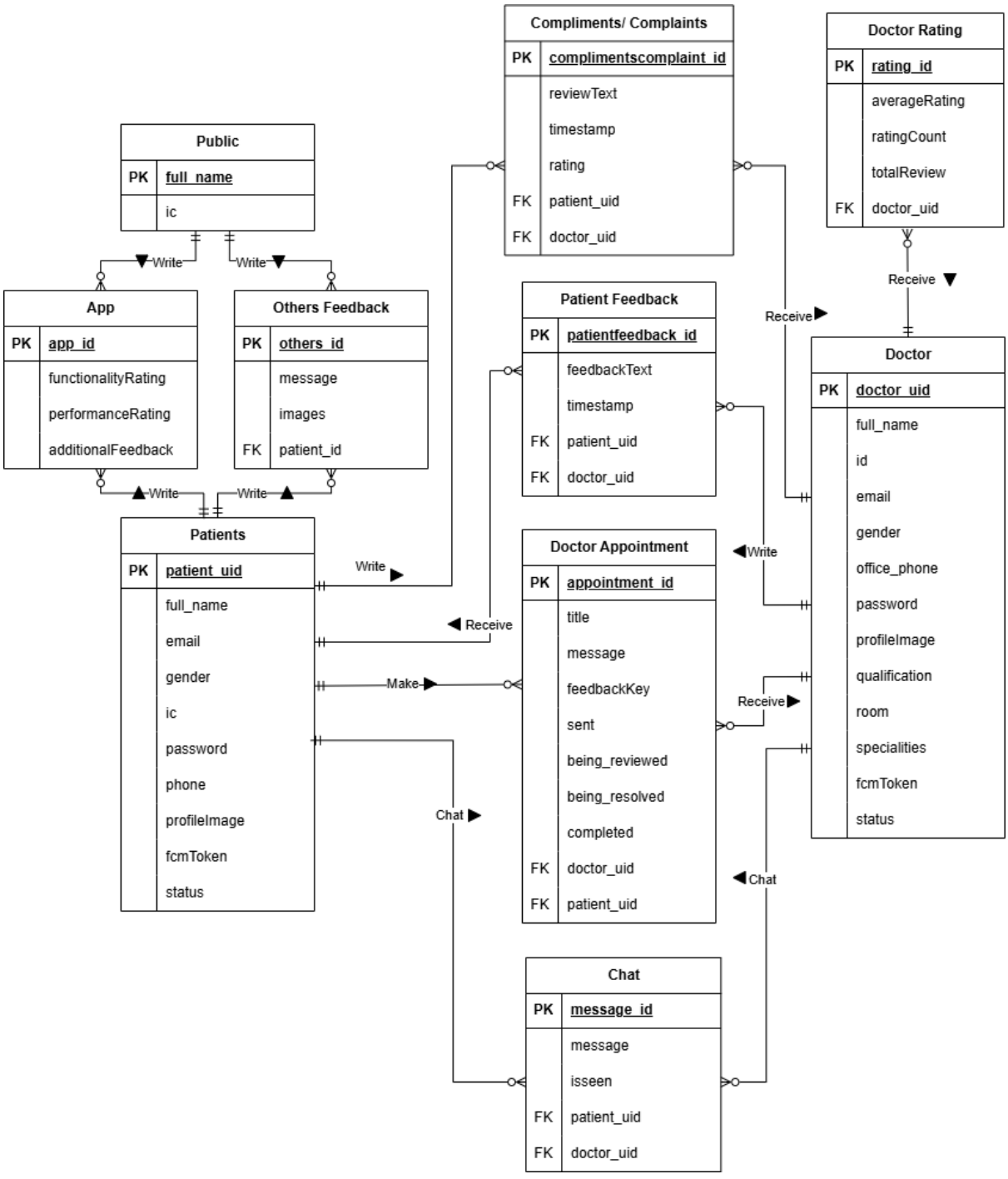

Figure 4.34: ERD Diagram

4.4 Wireframe Prototype Design

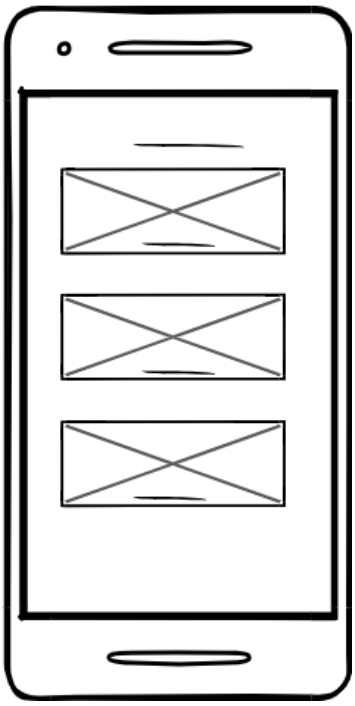

Figure 4.35: Wireframe - User type Page

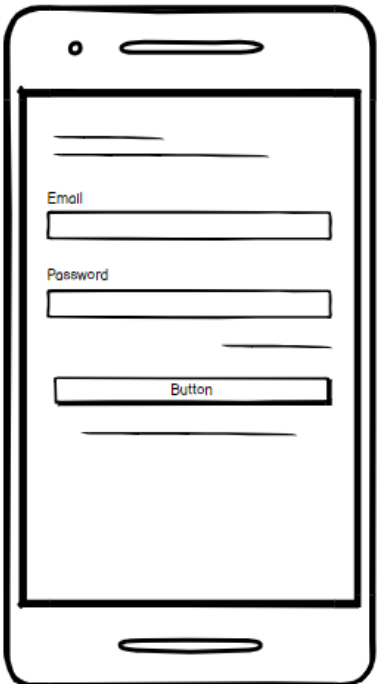

Figure 4.36: Wireframe - Login Page

Figure 4.37: Wireframe - Forgot Password Page

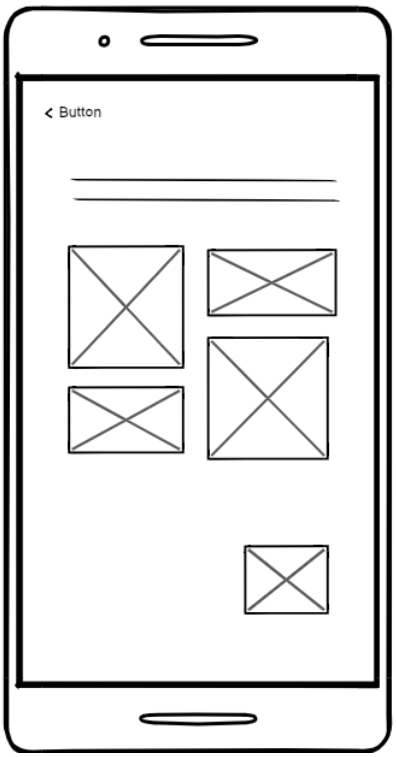

Figure 4.38 : Wireframe - Menu Page(Patient)

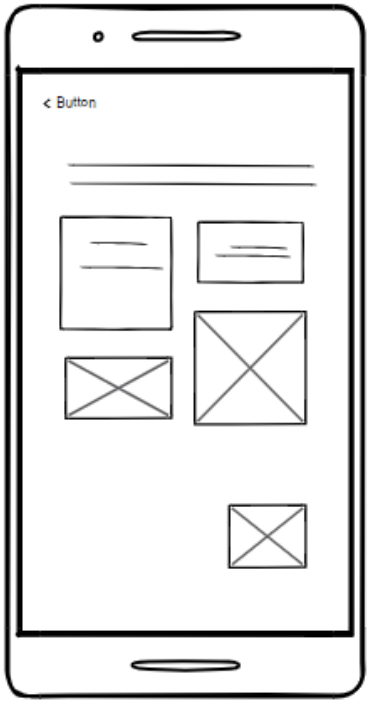

Figure 4.39 : Wireframe - Menu Page after clicking on phone and email

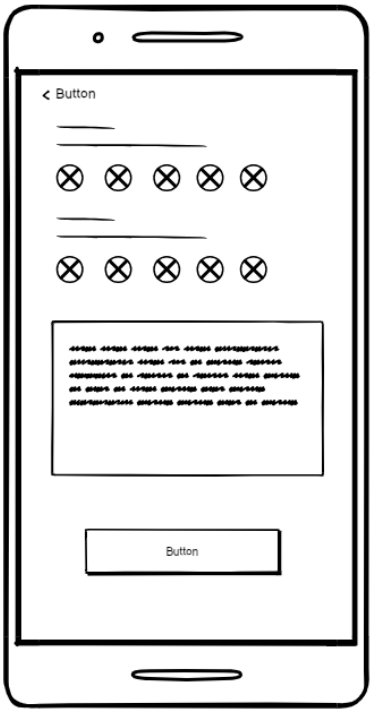

Figure 4.40: Wireframe –Feedback Page after clicking “App”

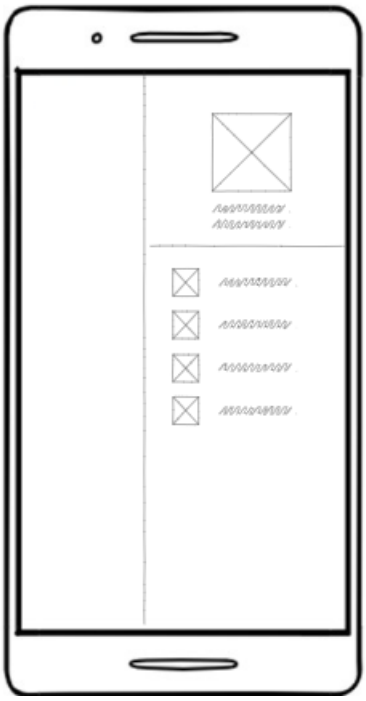

Figure 4.41 : Wireframe - Menu Page after clicking the menu icon

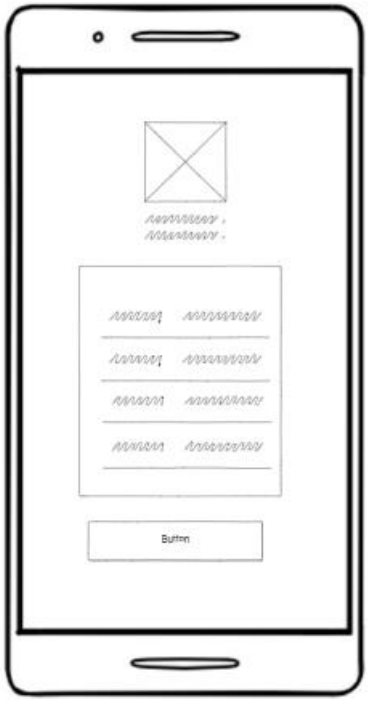

Figure 4.42: Wireframe –Profile Page after clicking “Profile”

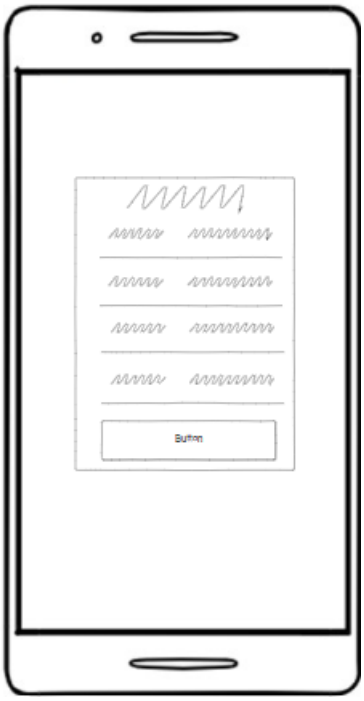

Figure 4.43 : Wireframe – Edit Profile form

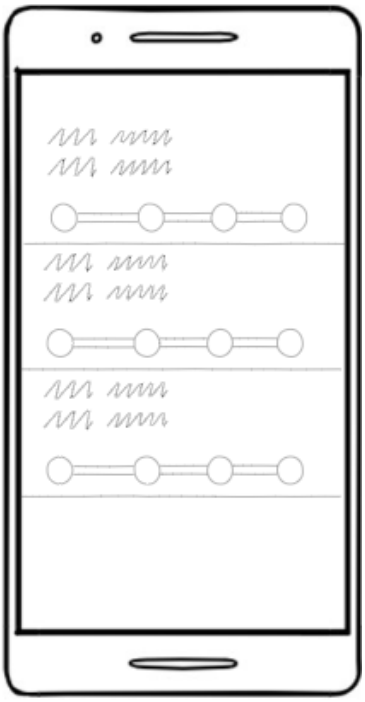

Figure 4.44: Wireframe –History Page after clicking “History”

Figure 4.45 : Wireframe – History Detail after clicking the feedback entry

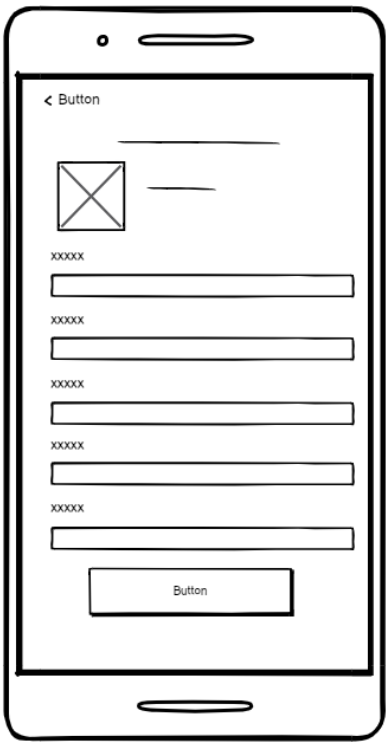

Figure 4.46: Wireframe – Feedback Form after clicking “Feedback”

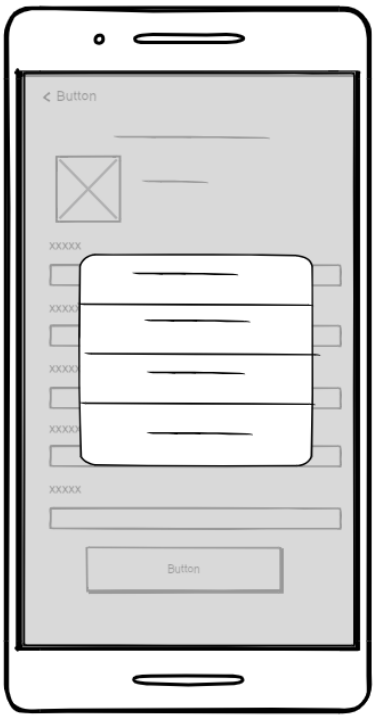

Figure 4.47: Wireframe -Feedback Form after selecting “Enquiry Type”

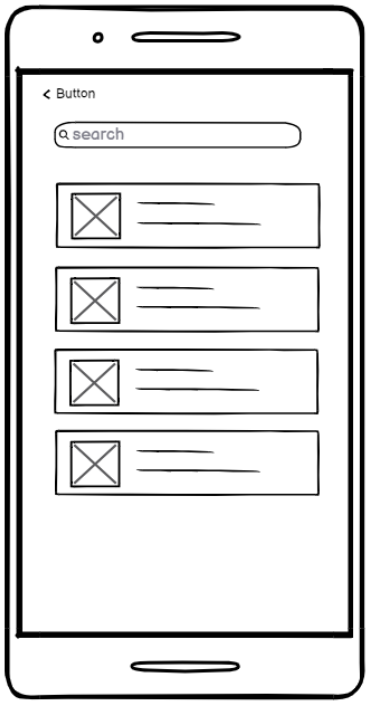

Figure 4.48:Wireframe - Doctor list after selecting “Doctor Appointment”

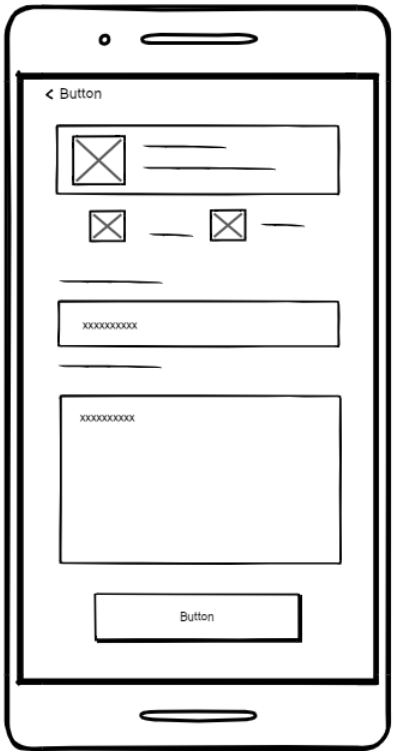

Figure 4.49: Wireframe –Doctor Details after selecting specific doctor

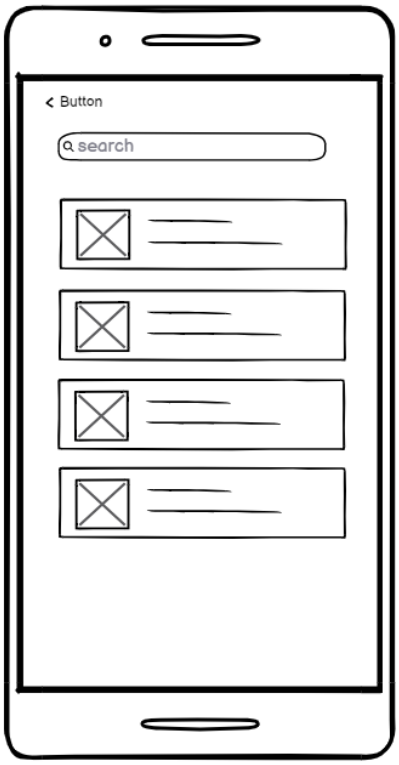

Figure 4.50: Wireframe –Doctor list after selecting “Complements / Complaints”

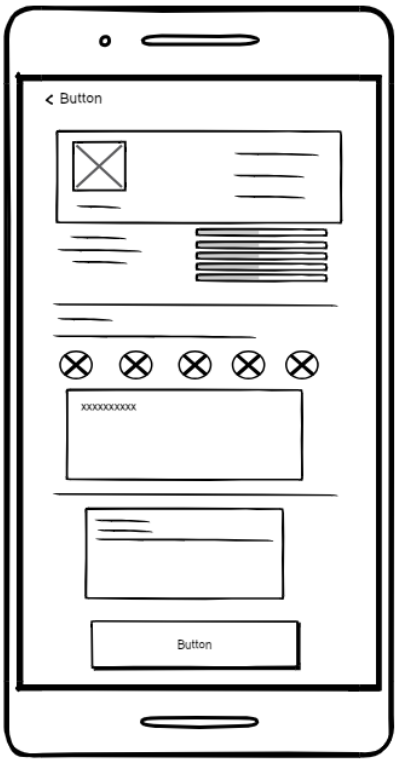

Figure 4.51: Wireframe –Doctor Review after selecting specific doctor

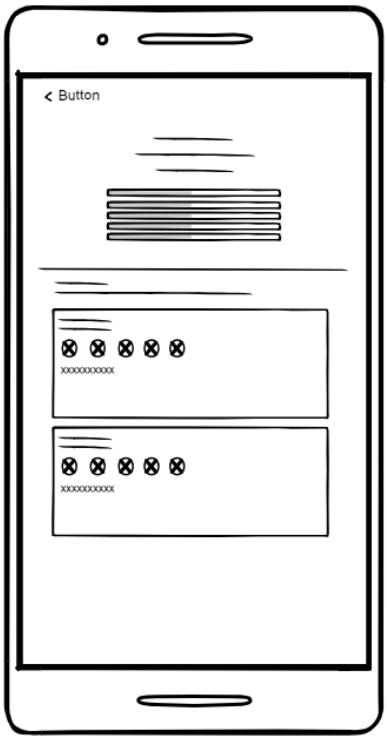

Figure 4.52: Wireframe – All Review page

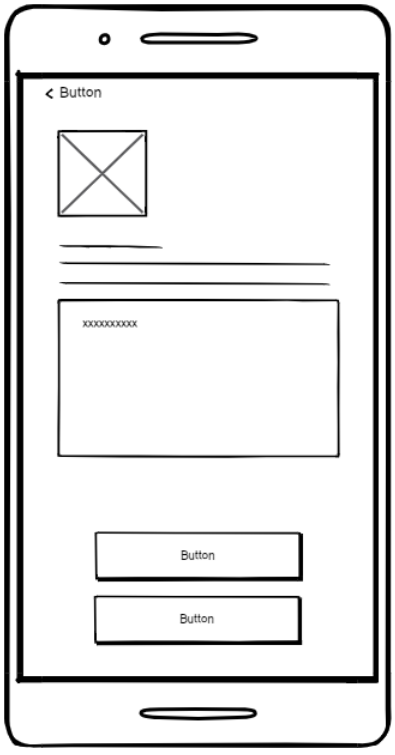

Figure 4.53: Wireframe – Feedback Form after selecting "Others"

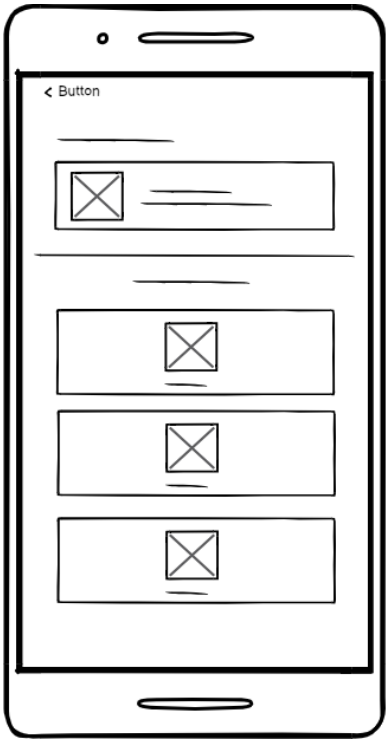

Figure 4.54: Wireframe – Menu Page (Staff)

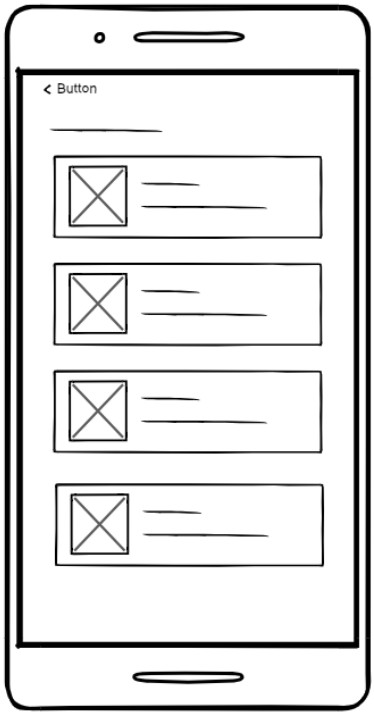

Figure 4.55: Wireframe – Notification after clicking "Notification"

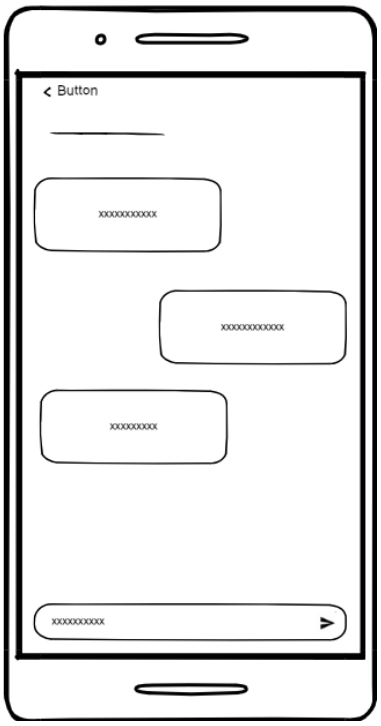

Figure 4.56: Wireframe – Chatting room after clicking "Chat"

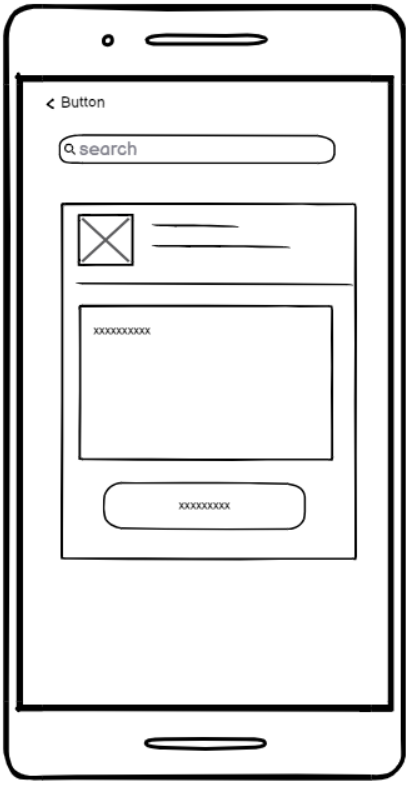

Figure 4.57: Wireframe – Doctor Feedback Page after clicking "Feedback

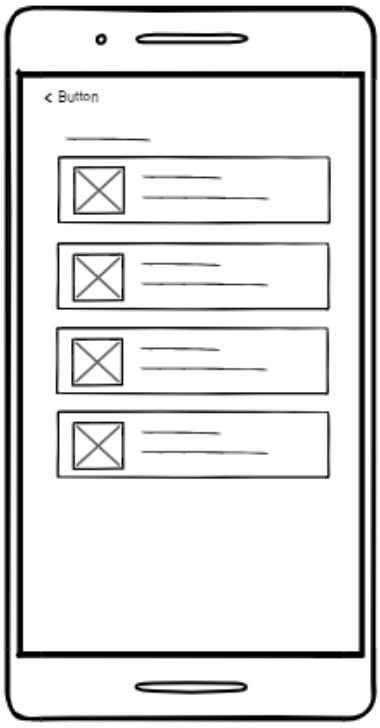

Figure 4.58: Wireframe – Doctors Review Page

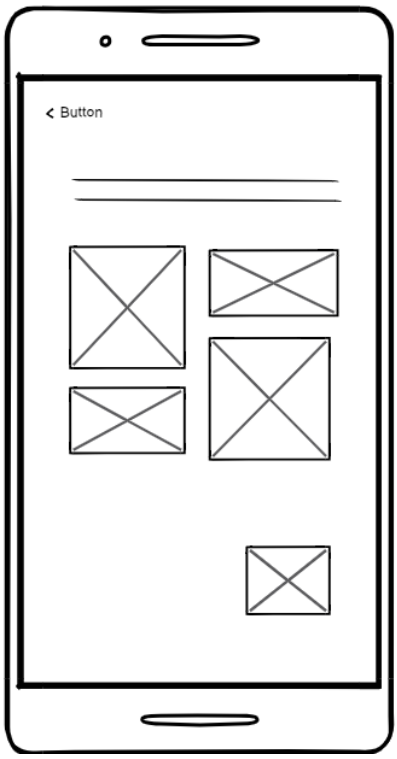

Figure 4.59: Wireframe – Menu Page(Public)

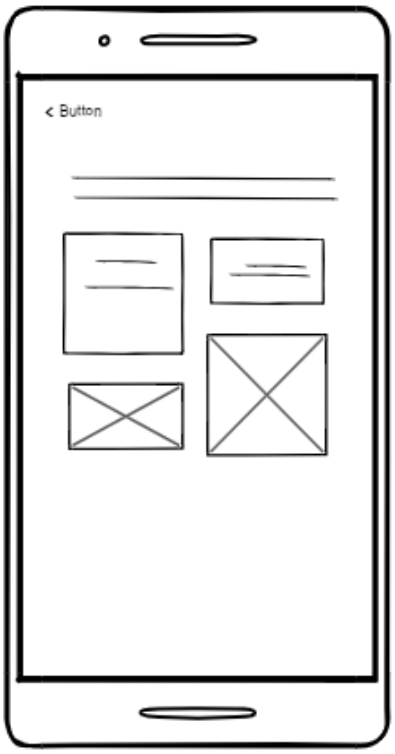

Figure 4.60: Wireframe – Menu Page after clicking on phone and email (Public)

4.5 Low-fidelity Prototype

Figure 4.61: Lo-fi -User type Page

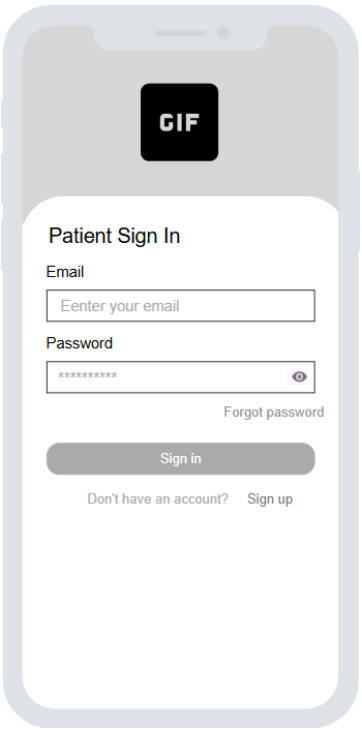

Figure 4.62: Lo-fi - Login Page

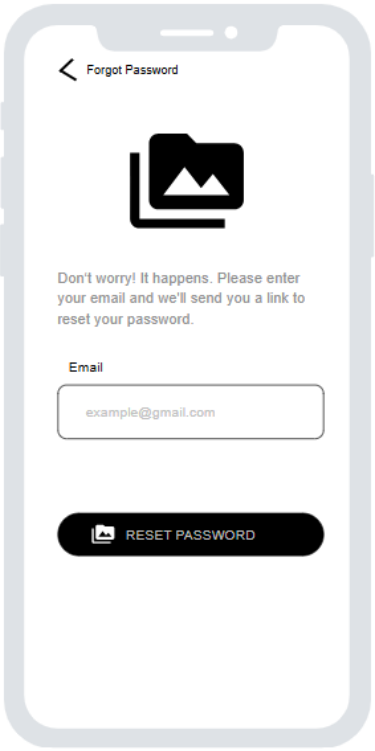

Figure 4.63: Lo-fi – Forgot Password Page

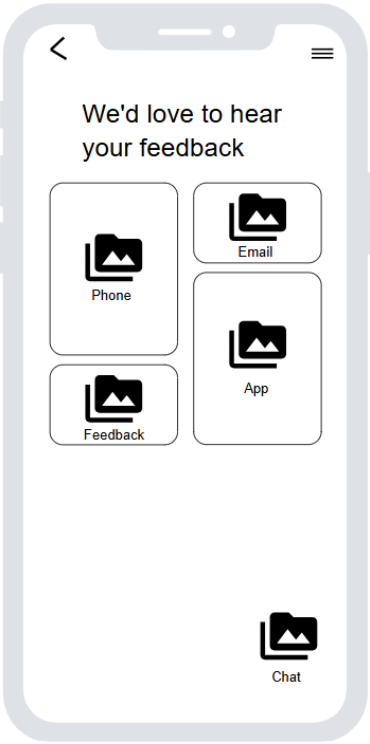

Figure 4.64: Lo-fi - Menu Page(Patient)

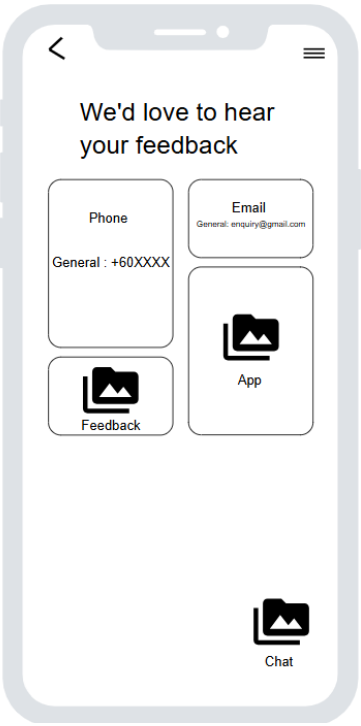

Figure 4.65: Lo-fi - Menu Page after clicking on phone and email

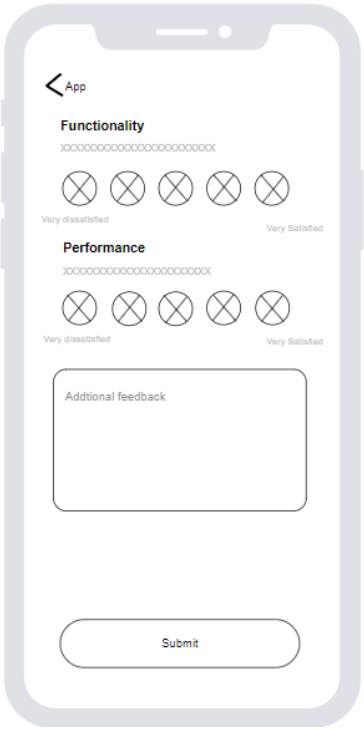

Figure 4.66: Lo-fi - Feedback Page after clicking "App"

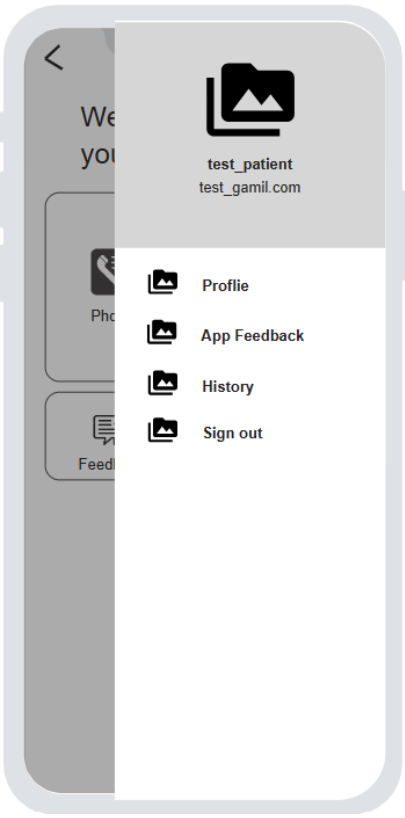

Figure 4.67: Lo-fi - Menu Page after clicking the menu icon

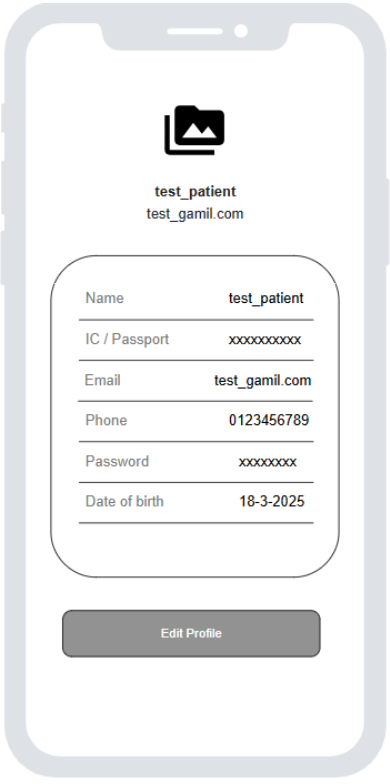

Figure 4.68: Lo-fi - Profile Page after clicking "Profile"

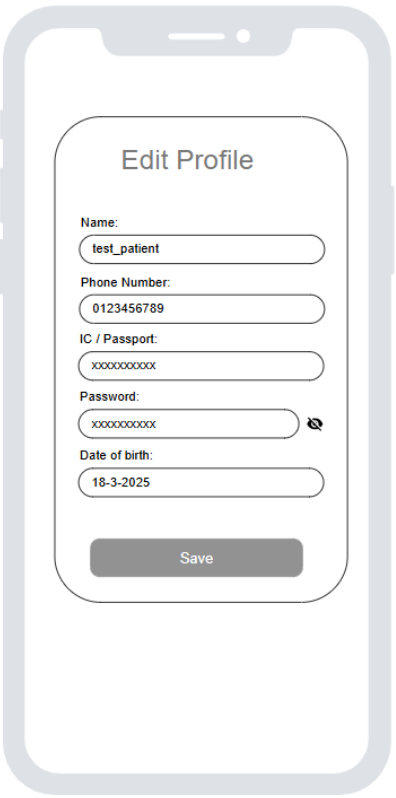

Figure 4.69: Lo-fi – Edit Profile form

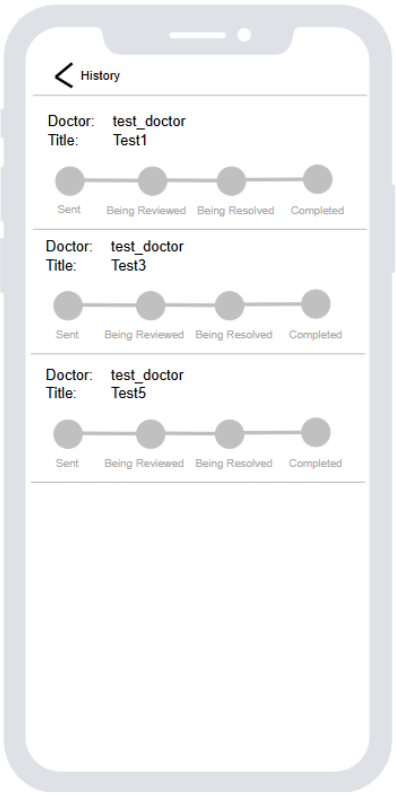

Figure 4.70: Lo-fi - History Page after clicking “History”

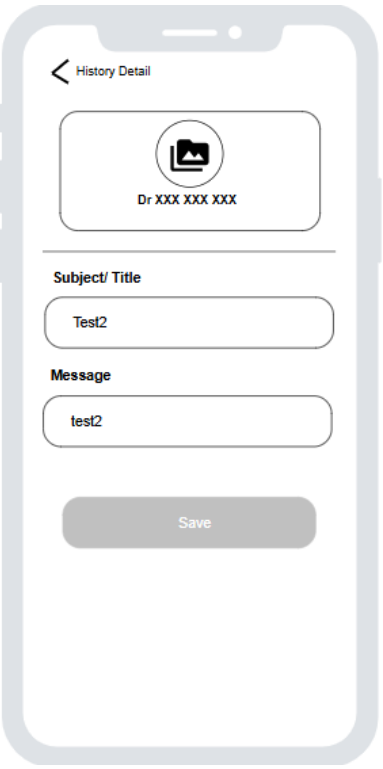

Figure 4.71: Lo-fi – History Detail after clicking the feedback entry

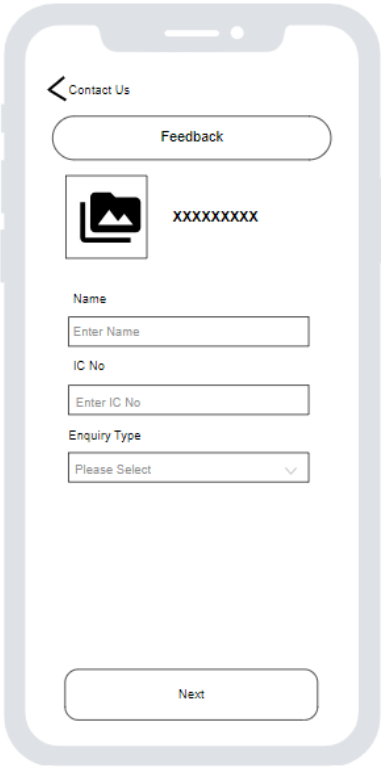

Figure 4.72: Lo-fi - Feedback Form after clicking “Feedback”

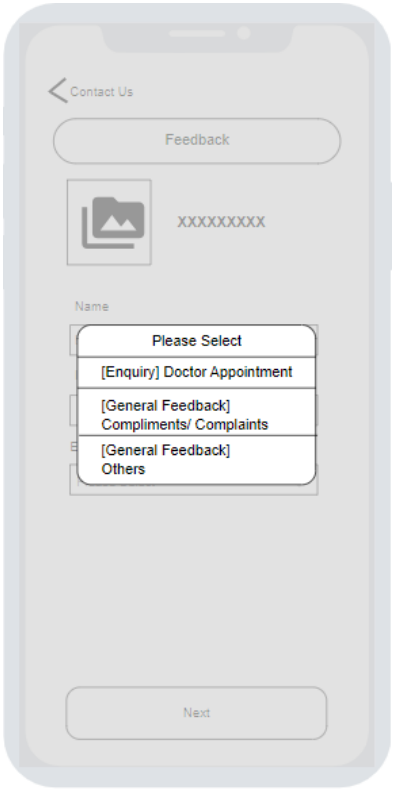

Figure 4.73: Lo-fi - Feedback Form after selecting "Enquiry Type"

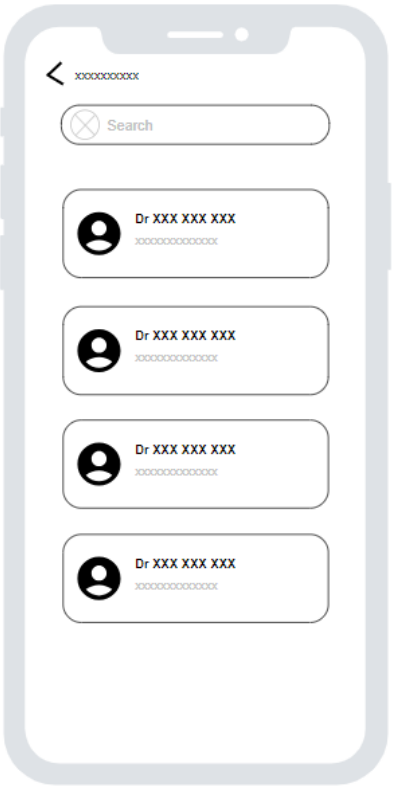

Figure 4.74: Lo-fi - Doctor list after selecting "Doctor Appointment"

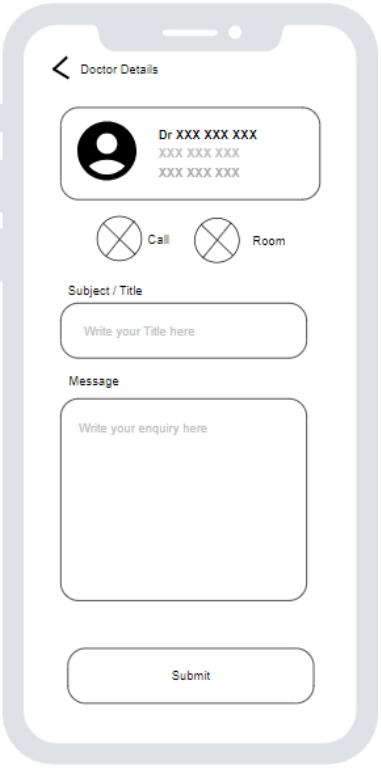

Figure 4.75: Lo-fi - Doctor Details after selecting specific doctor

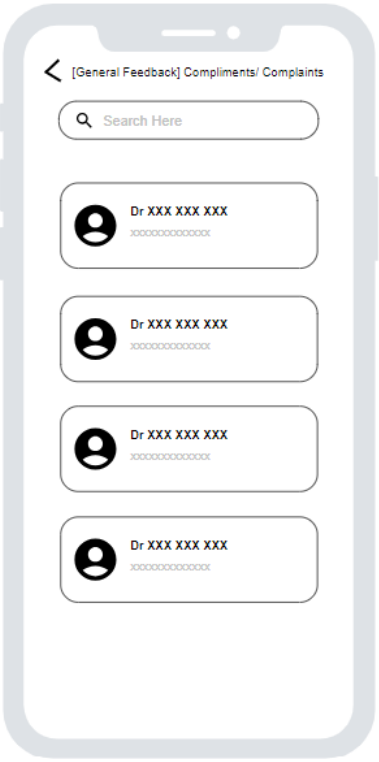

Figure 4.76: Lo-fi - Doctor list after selecting "Complements / Complaints"

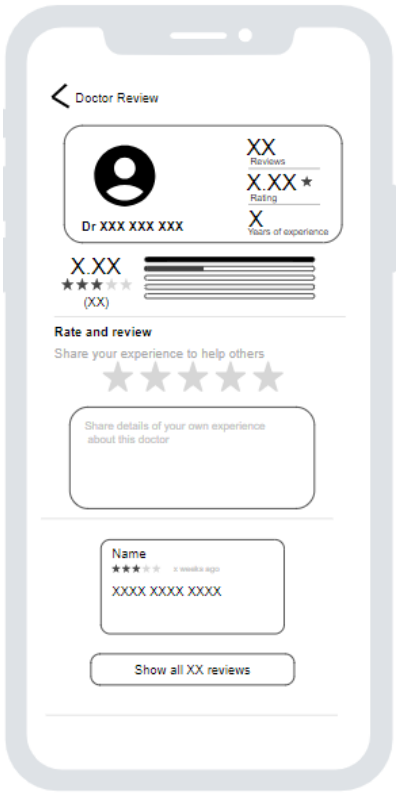

Figure 4.77: Lo-fi - Doctor Review after selecting specific doctor

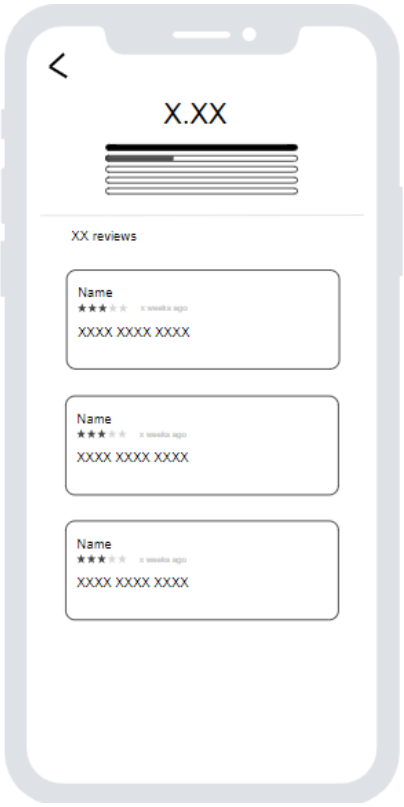

Figure 4.78: Lo-fi - All Review page

Figure 4.79: Lo-fi - Feedback form after selecting "Others"

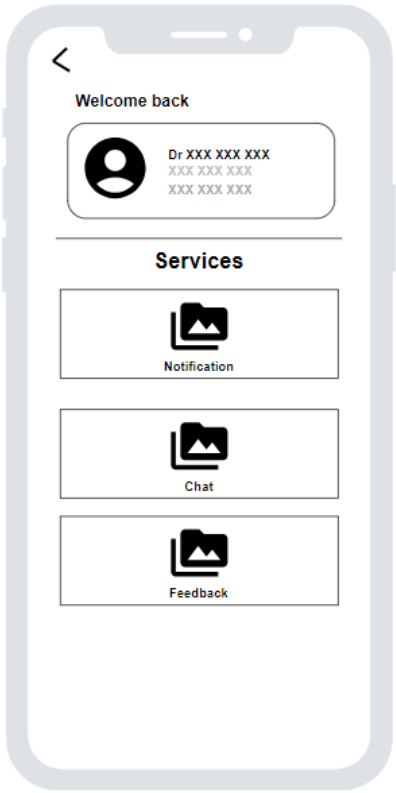

Figure 4.80: Lo-fi - Menu Page (Staff)

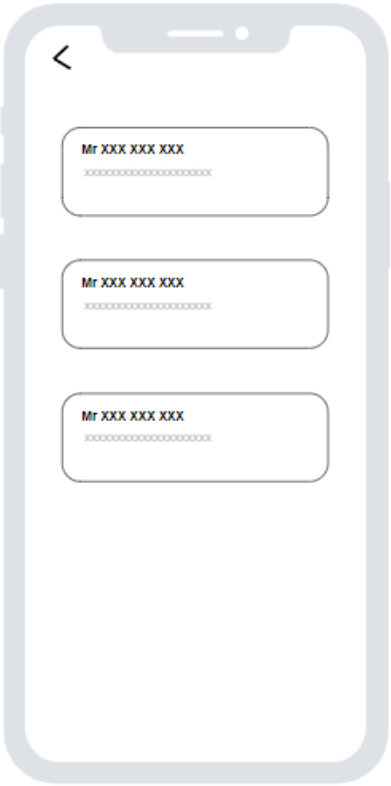

Figure 4.81: Lo-fi - Notification after clicking “Notification”

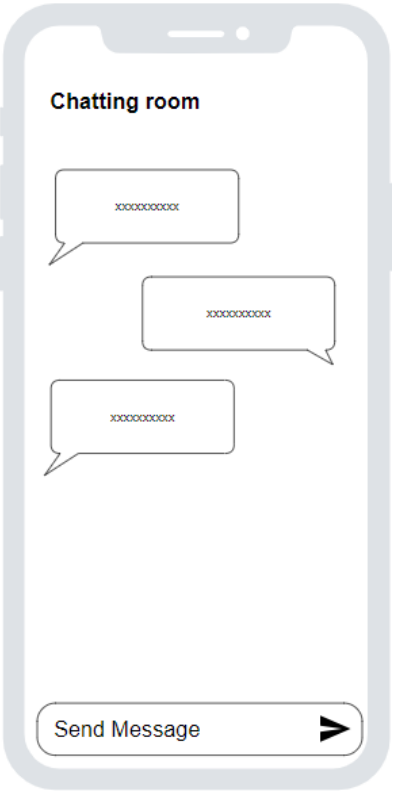

Figure 4.82: Lo-fi – Chatting room after clicking “Chat”

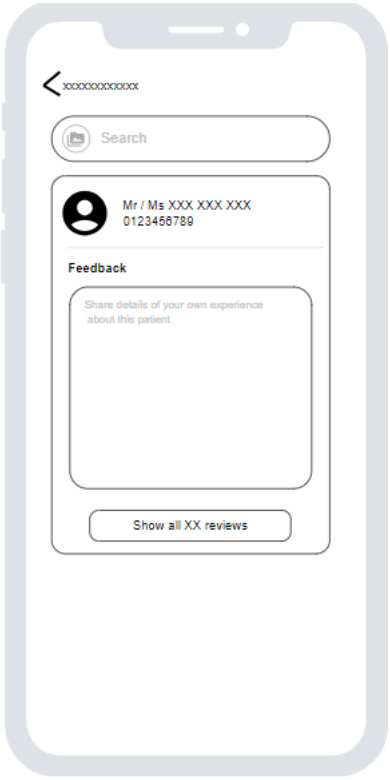

Figure 4.83: Lo-fi - Doctor Feedback Page after clicking “Feedback

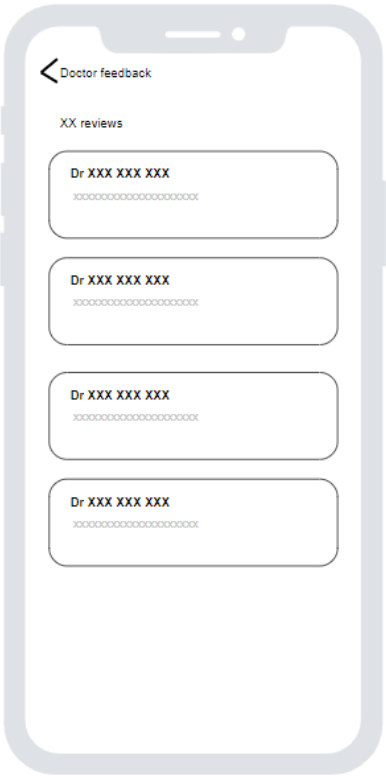

Figure 4.84: Lo-fi - Doctors Review Page

Figure 4.85: Lo-fi – Menu(Public)

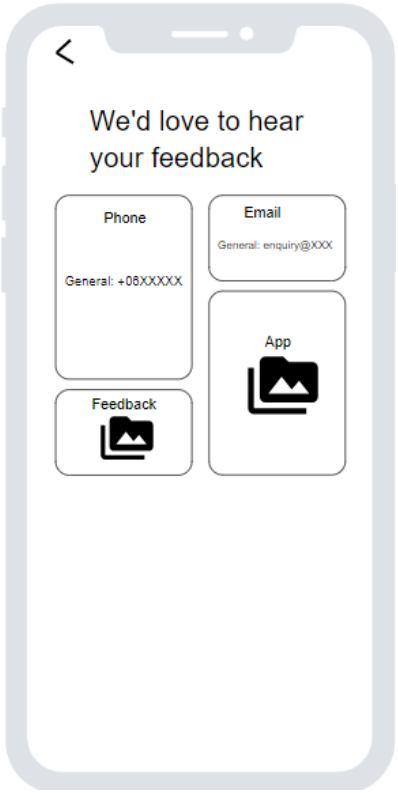

Figure 4.86: Lo-fi - Menu Page after clicking on phone and email (Public)

4.6 High-fidelity Prototype

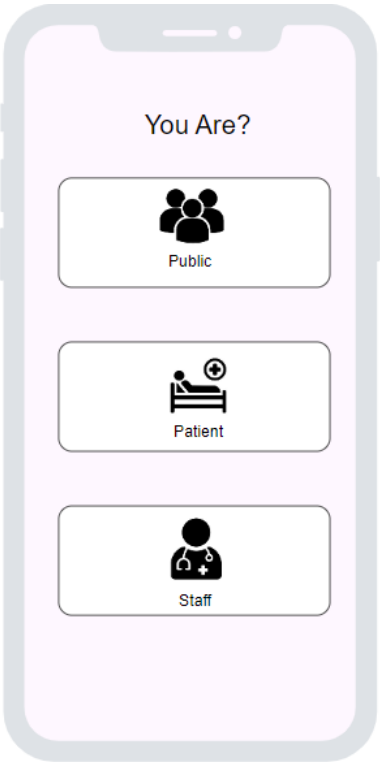

Figure 4.87: Hi-fi - User type Page

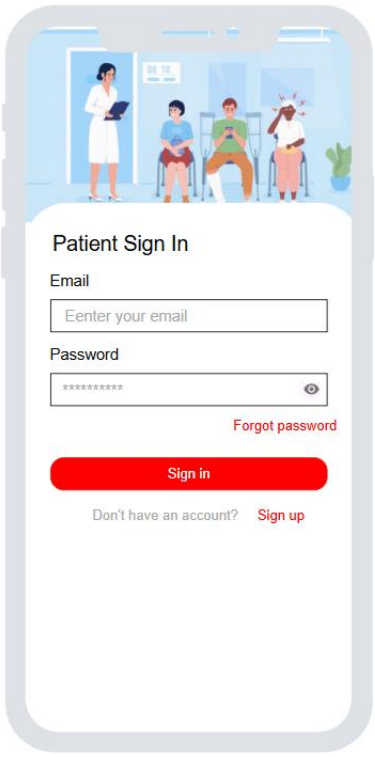

Figure 4.88 : Hi-fi - Login Page

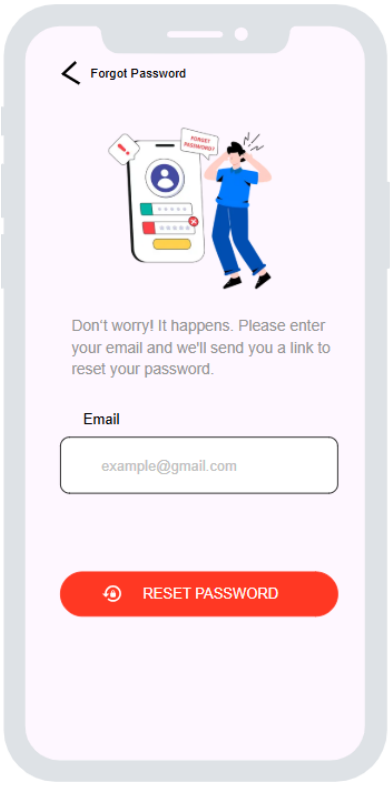

Figure 4.89: Hi-fi – Forgot Password Page

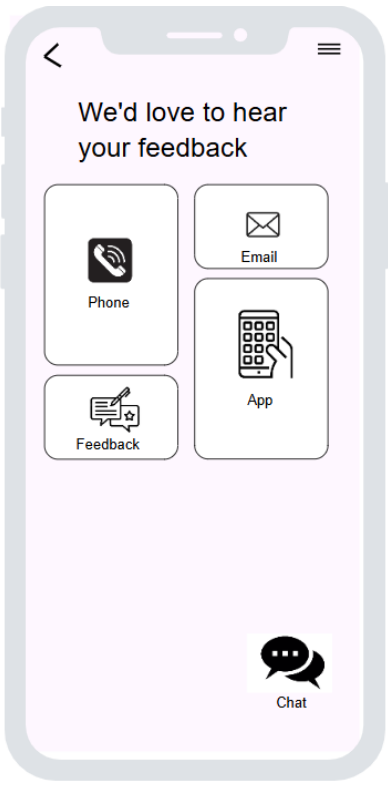

Figure 4.90 : Hi-fi - Menu Page(Patient)

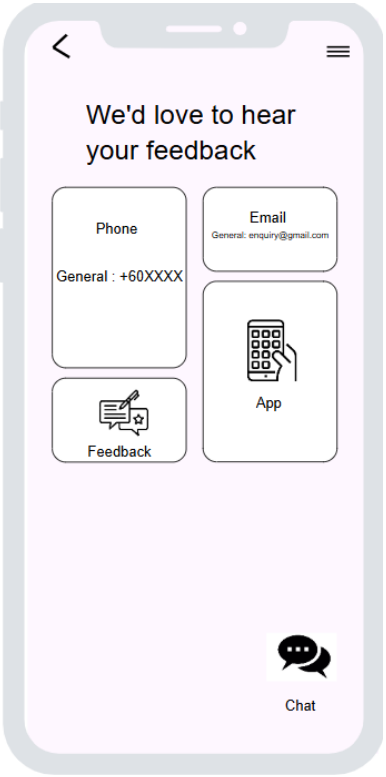

Figure 4.91 : Hi-fi - Menu Page after clicking on phone and email

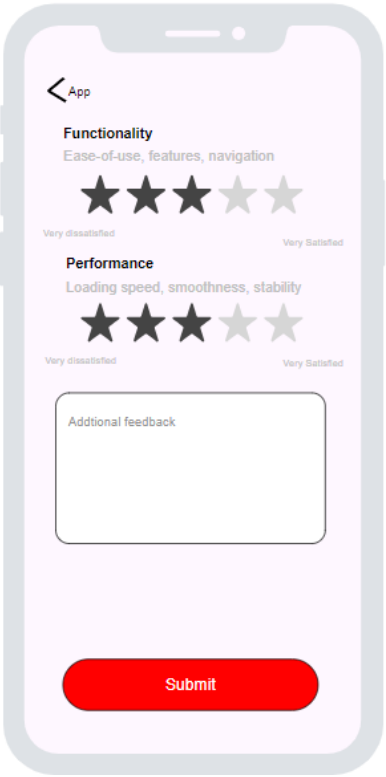

Figure 4.92: Hi-fi - Feedback Page after clicking “App

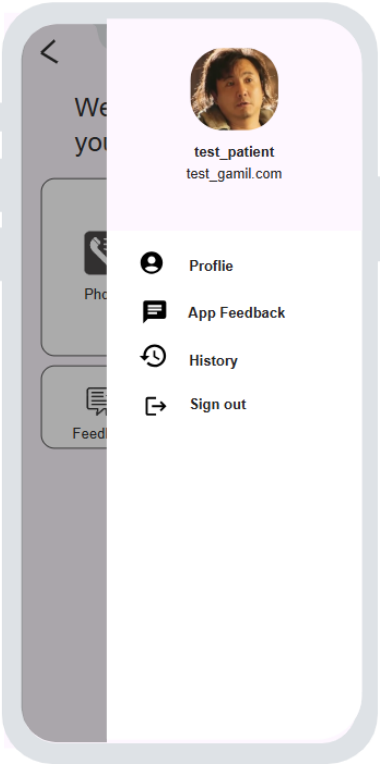

Figure 4.93 : Hi-fi - Menu Page after clicking the menu icon

Figure 4.94: Hi-fi - Profile Page after clicking “Profile”

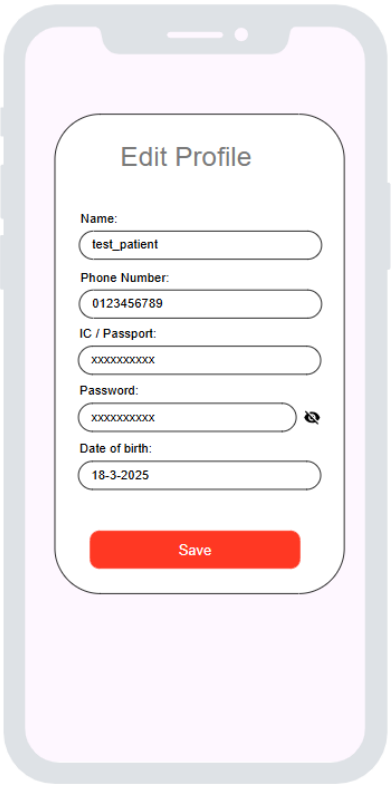

Figure 4.95 : Hi-fi – Edit Profile form

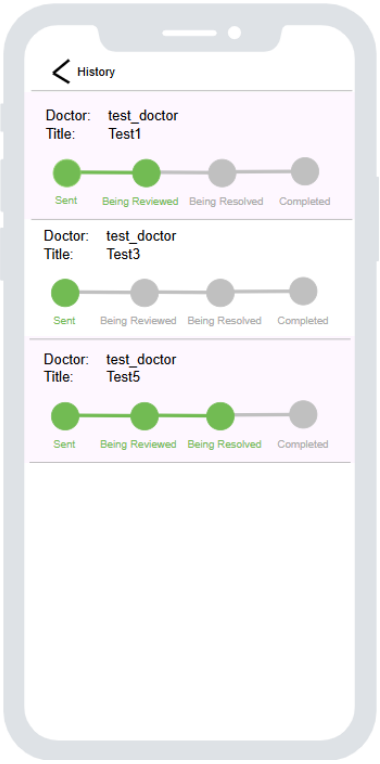

Figure 4.96: Hi-fi - History Page after clicking “History”

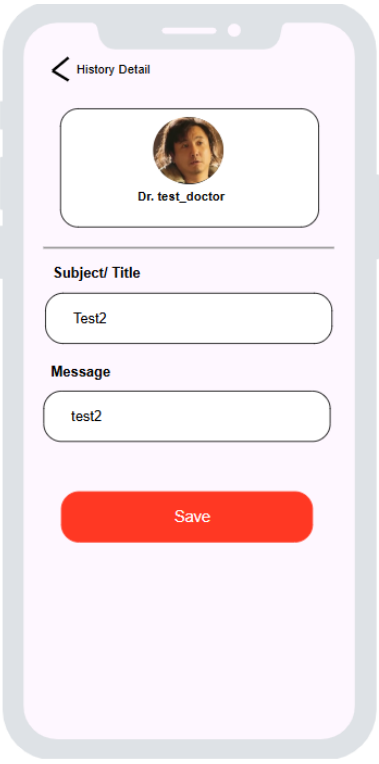

Figure 4.97 : Hi-fi – History Detail after clicking the feedback entry

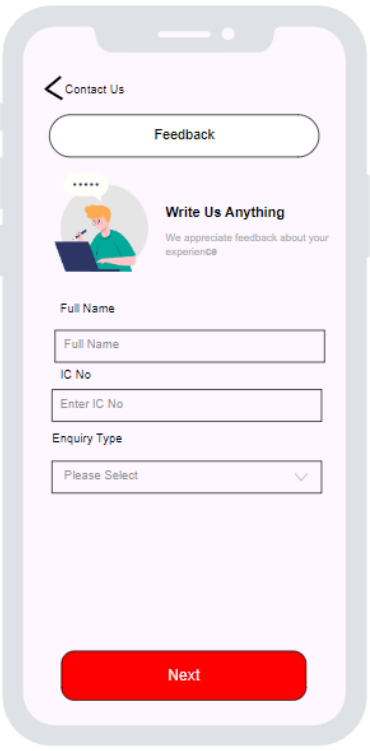

Figure 4.98: Hi-fi - Feedback Form after clicking “Feedback”

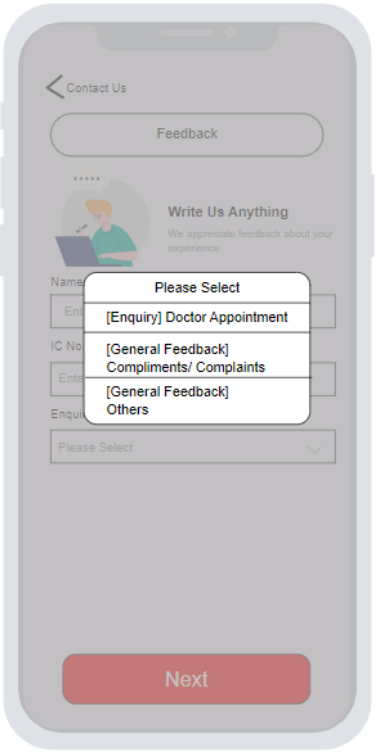

Figure 4.99 : Hi-fi - Feedback Form after selecting “Enquiry Type”

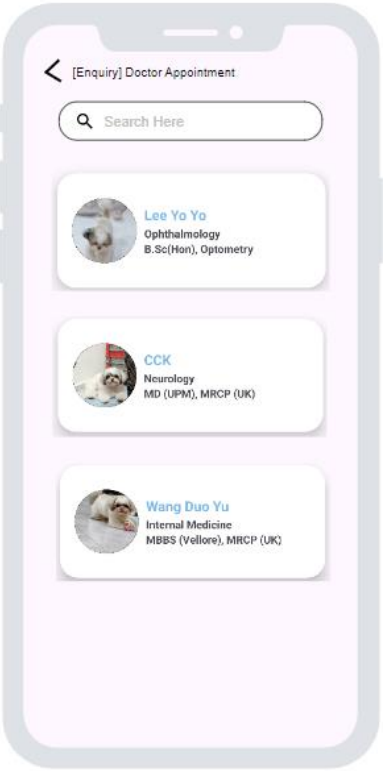

Figure 4.100: Hi-fi - Doctor list after selecting “Doctor Appointment”

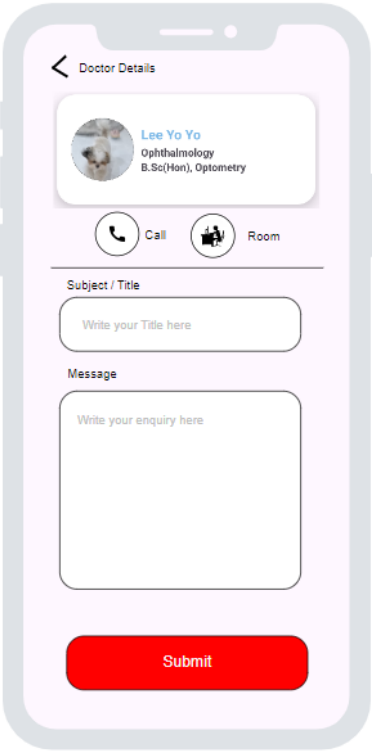

Figure 4.101: Hi-fi - Doctor Details after selecting specific doctor

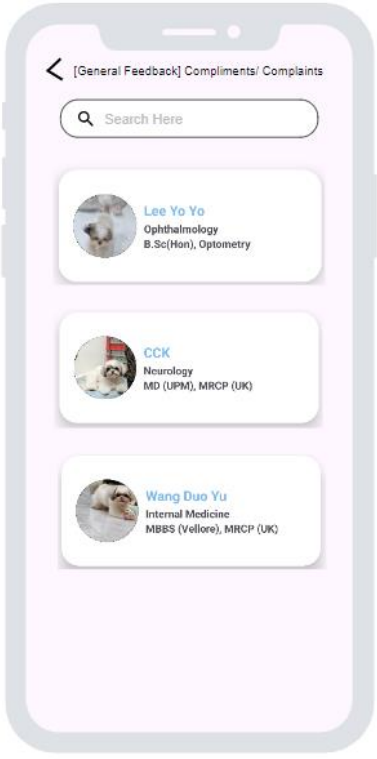

Figure 4.102: Hi-fi - Doctor list after selecting “Complements / Complaints”

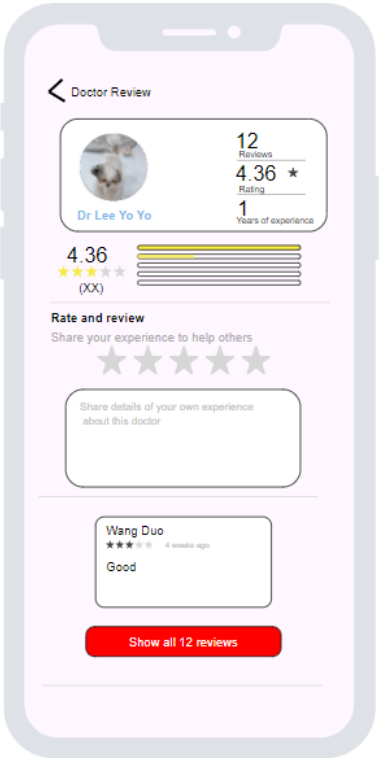

Figure 4.103: Hi-fi – Doctor Review after selecting specific doctor

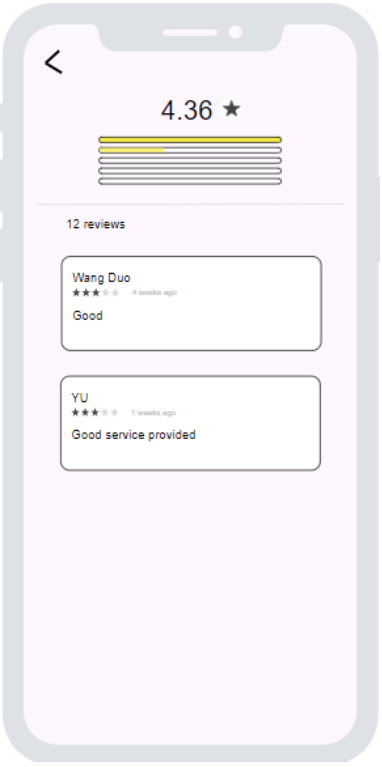

Figure 4.104: Hi-fi - All Review page

Figure 4.105: Hi-fi - Feedback Form after selecting "Others"

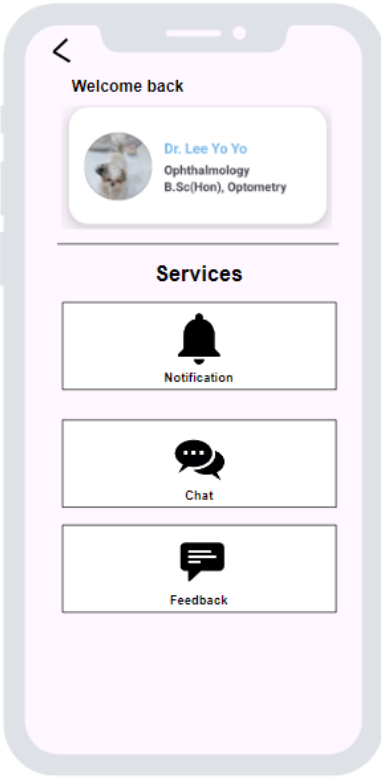

Figure 4.106: Hi-fi - Menu Page (Staff)

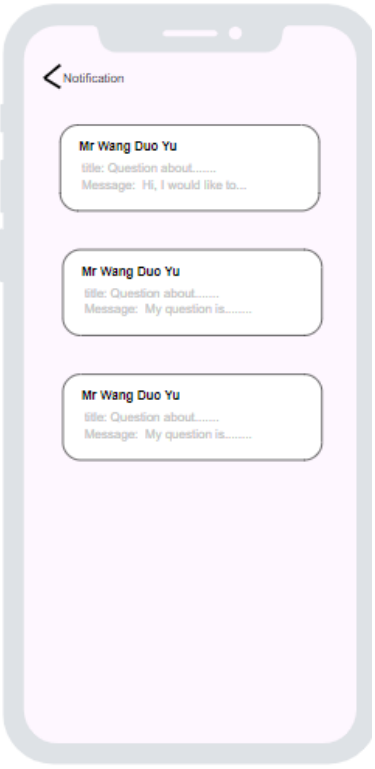

Figure 4.107: Hi-fi – Notification after clicking "Notification"

Figure 4.108: Hi-fi - Chatting room after clicking "Chat"

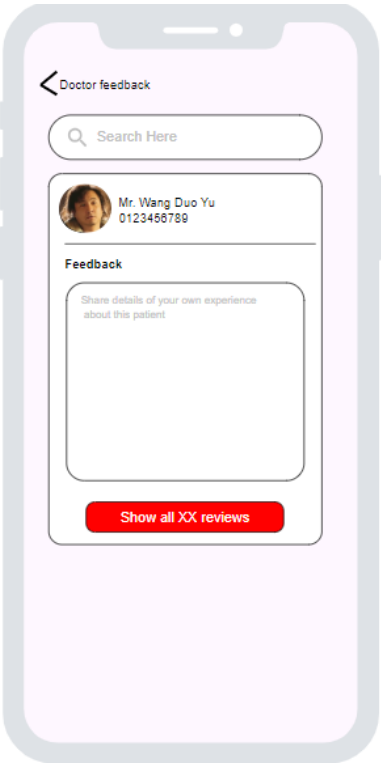

Figure 4.109: Hi-fi - Doctor Feedback Page after clicking "Feedback"

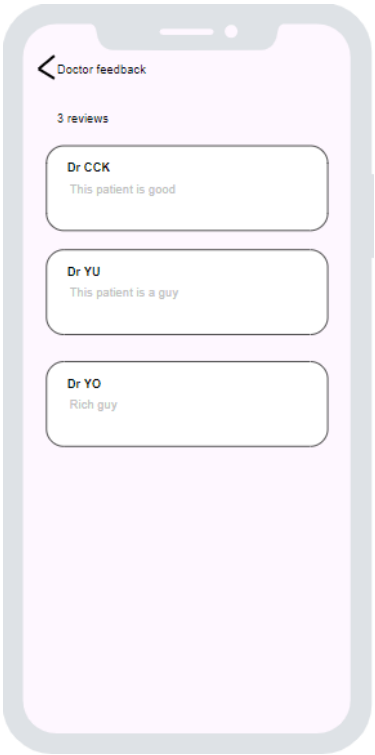

Figure 4.110: Hi-fi - Doctors Review Page

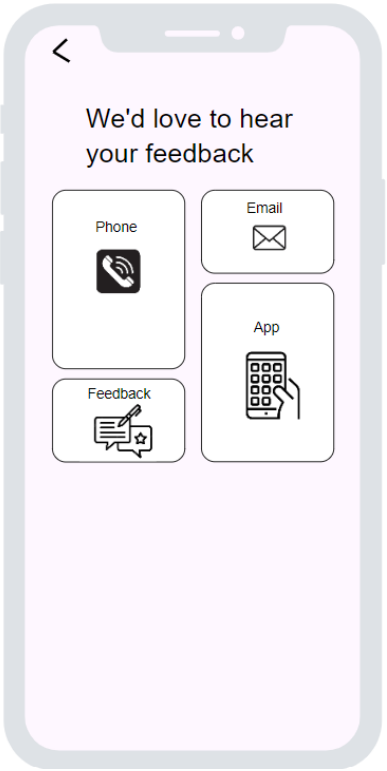

Figure 4.111: Hi-fi – Menu Page(Public)

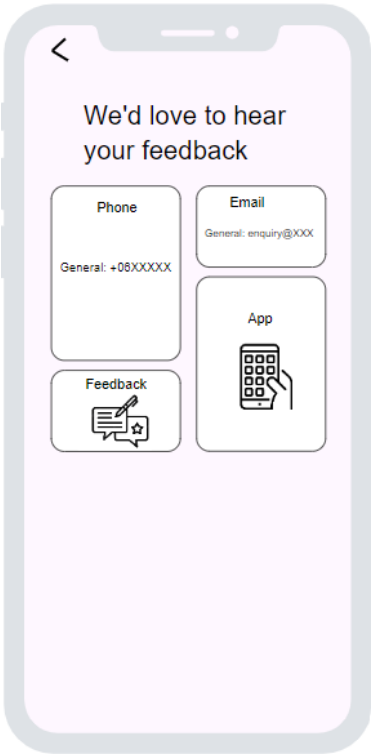

Figure 4.112: Hi-fi - Menu Page after clicking on phone and email (Public)

4.7 Timeline

4.9.1 FYP1 Timeline

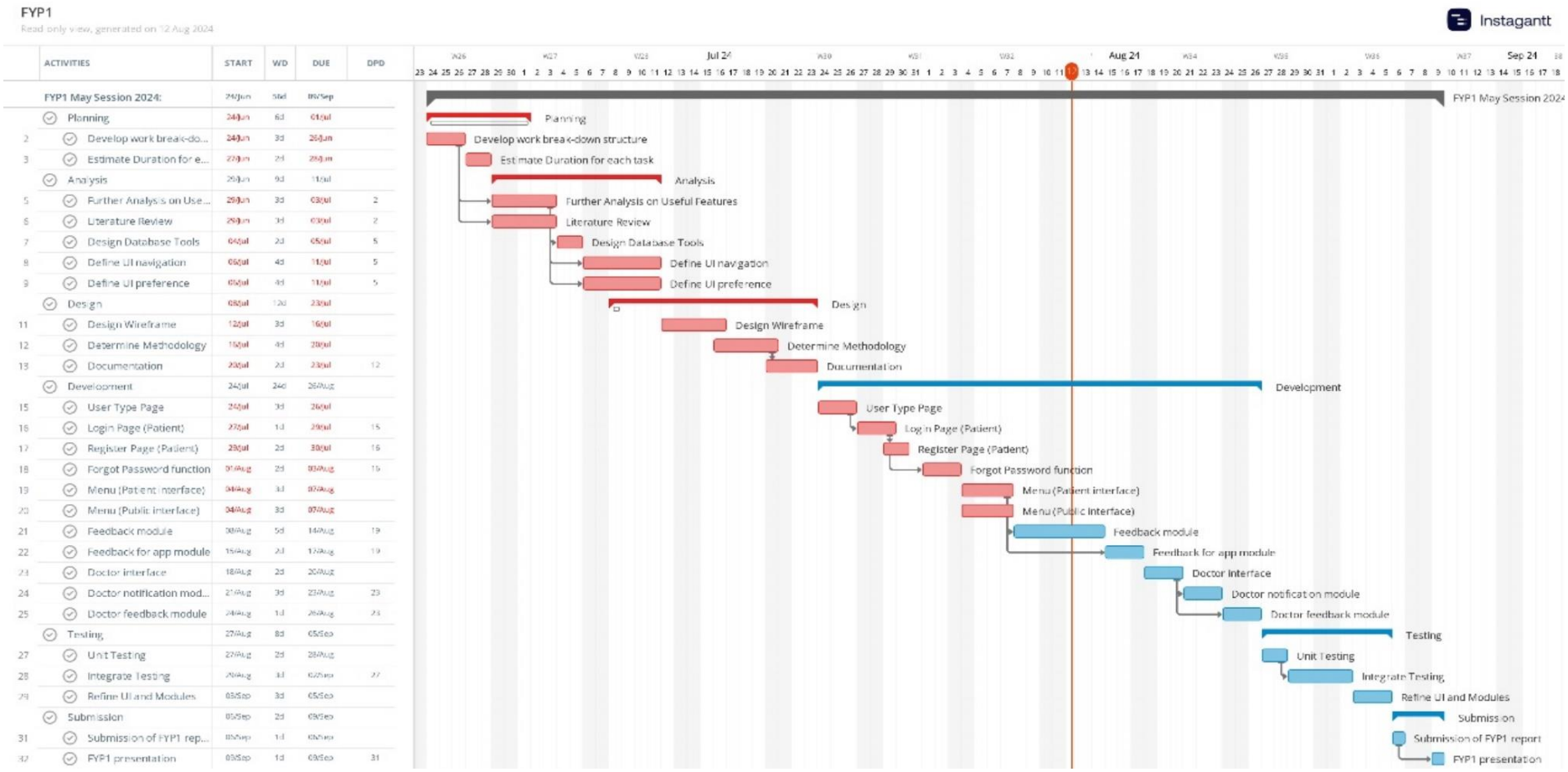

Figure 4.113 : FYP1 timeline

4.9.2 FYP2 Timeline

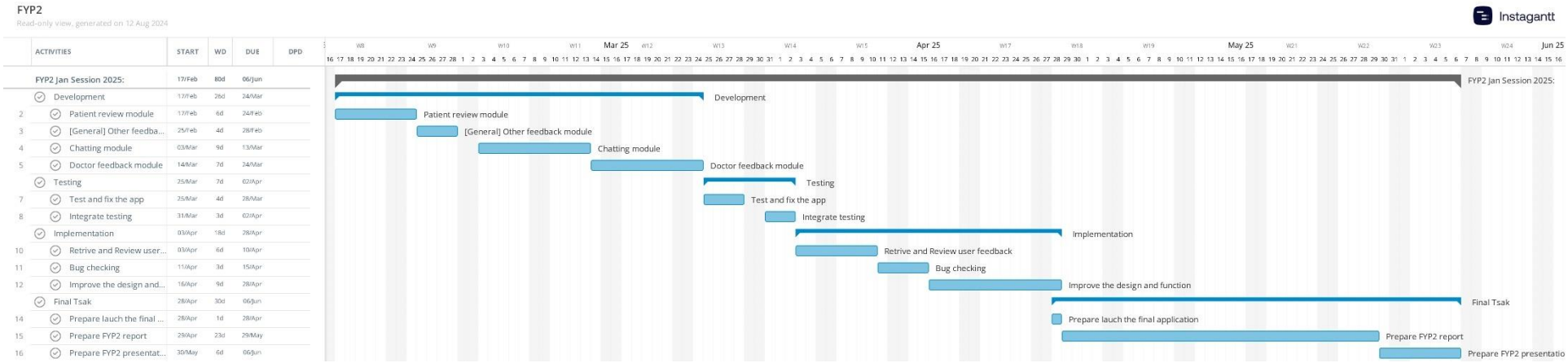

Figure 4.114: FYP2 timeline

Chapter 5

System Implementation

This chapter presents an overview of the hardware and software used in the development of this project. It outlines the setup and configuration procedures performed before the start of development phase. Additionally, the preliminary work also will be presented, including UI screenshots along with detailed descriptions. Lastly, the chapter highlights the implementation challenges and issues encountered during the implementation process.

5.1 Hardware used

The hardware involved in this project is laptop.

Table 5.1 Specifications of laptop

Description	Specifications
Model	Acer Nitro5 AN515-55-537A Gaming
Processor	Intel ® Core ™ i5-10300H CPU @ 8M Cache, 4.50GHz, 4 Cores
Operating System	Windows® 10
Graphic	NVIDIA® GeForce RTX3060 6GB GDDR6
Memory	8GB DDR4 RAM
Storage	512 GB PCIe NVMe M.2 ssD

5.2 Software Used

1. Android Studio

In this project, Android Studio will be used. It is a mobile application development software. All the UI designs and features will be created by using Android Studio. The language used in Android Studio is Java language. The minimum SDK is API 24, version is Android 7.0 which can run on approximately 96.3% of devices.

2. Firebase

In this project, Firebase will be used. Firebase is a Google-backed mobile app development platform with helpful APIs to assist developers in developing engaging and high-quality applications. Firebase is useful because it can manage large amounts of data in real-

time. Firebase synchronises the data to all related clients by implementing a cloud-hosted database. This makes it possible for patients and employees to communicate in real-time. In addition, Firebase provides effective back-end services, UI frameworks, and SDKs for user authentication within applications. Furthermore, Firebase offers cloud storage so that users may save videos and images on the cloud. This will allow consumers' device memory to be freed up. Additionally, Firebase has push notification abilities, which is useful in this project. [12].

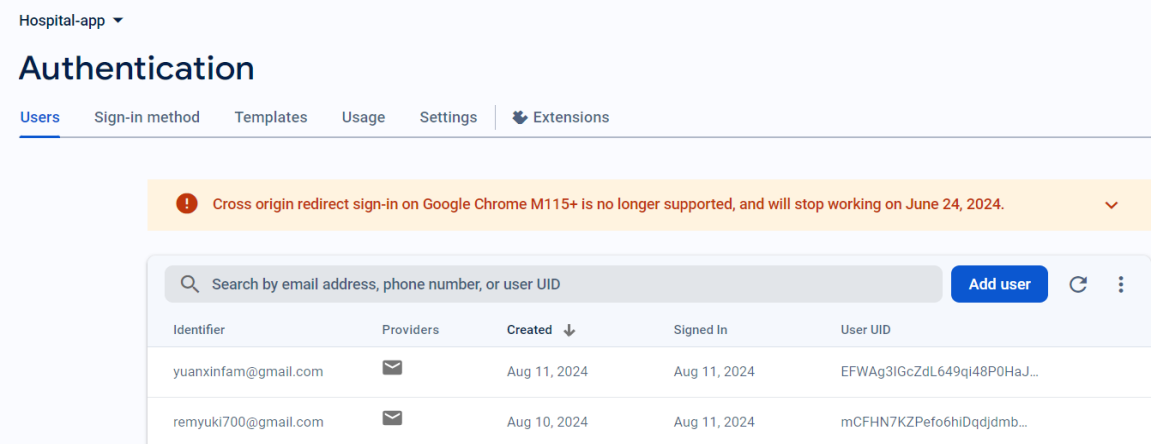

Figure 5.1 : Firebase authentication console

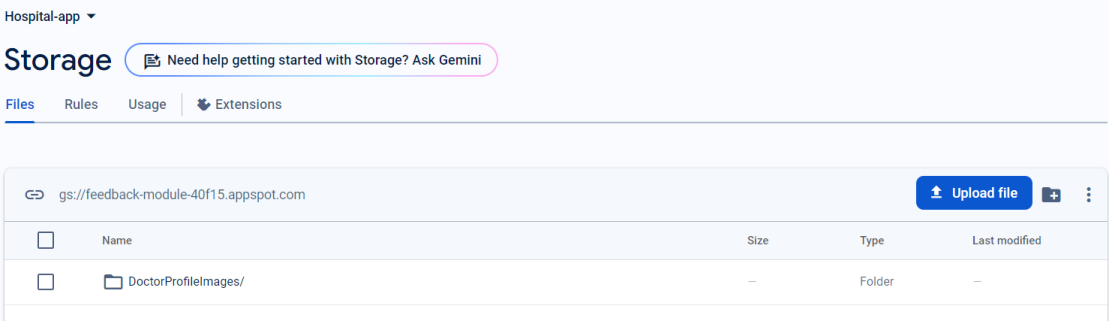

Figure 5.2 : Firebase storage console

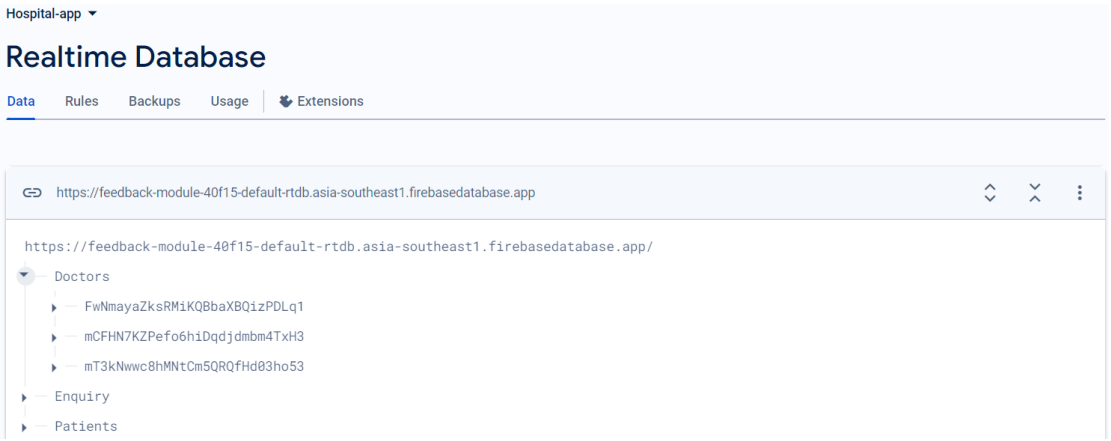

Figure 5.3 : Firebase real-time database console

3. Balsamiq

In this project, Balsamiq will be used to create a wireframe prototype. This tool facilitates the quick drafting of rough sketches that highlight the application's layout and functionality, focusing on overall structure and user flow. By passing detailed visual design, it allows one to focus on the interface's architecture and interactions, establishing a solid foundation before advancing to more detailed design work.

4. Moqups

In this project, Moqups will be used to create low-fidelity and high-fidelity wireframes. It is a visual collaboration tool that integrates whiteboarding, diagramming and design capabilities into a single platform. It combines wireframing, prototyping, and collaboration features to refine user interfaces and experiences before development.

5. Draw.io

In this project, Draw.io is used as a diagramming tool to create detailed flowcharts, entity relationship diagrams, use case diagrams and system architecture diagrams. It is an online diagramming tool that offers a wide range of shapes, templates, and customisation options. It's ideal for mapping complex workflows, system designs, and user journeys, ensuring clear communication among developers and stakeholders before development.

5.3 Software Setup and Configuration

5.3.1 Android Studio Setup

1. Download the Android Studio installer from the official website: (https://developer.android.com).
2. Run the installer and follow the on-screen instructions to complete the installation. Once installed, launch Android Studio and configure the development environment.
3. After completing the initial setup, create a new Android project to begin development. Navigate to **File > New > New Project**, then select a suitable template to get started.
4. Enter a project name and adjust the necessary parameters such as package name, save location, minimum SDK and language. Once done, click **Finish** to create the project and begin development.

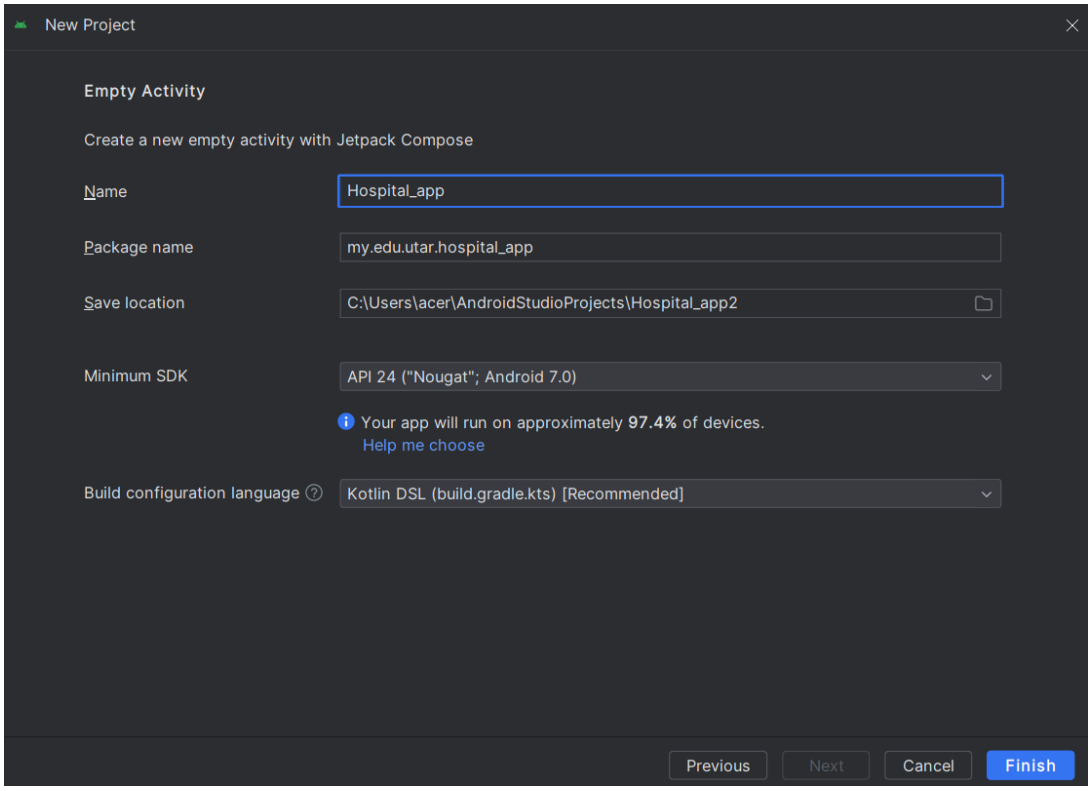

Figure 5.4: Android Studio Setup interface

5.3.2 Firebase Setup

Firebase are used to connect with Android Studio for storage purposes.

1. Visit the Firebase Console (https://console.firebase.google.com/) and click on "Add Project" to create a new Firebase project.
2. Follow the guided steps to set up your project, including naming the project, enabling Google Analytics (optional) and configuring the project settings.
3. Once the project is created, link it to the Android Studio project by selecting "Add App", choosing Android and providing the necessary package name and SHA-1 key.
4. Enable the necessary Firebase features you plan to use (e.g., Firestore, Realtime Database, Authentication, or Cloud Storage) from the Firebase Console.
5. Download the google-services.json file and add it to the app/ directory of your Android project.
6. Finally, follow the instructions to add the required Firebase dependencies to your build.gradle files to complete the integration.

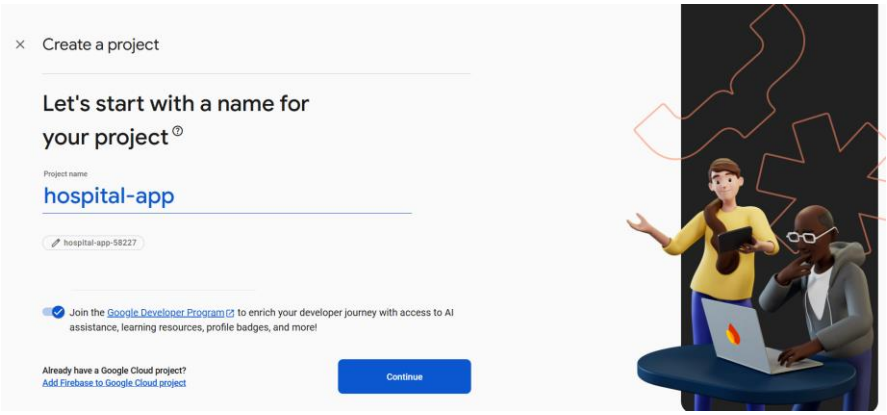

Figure 5.5: Firebase console – create a project

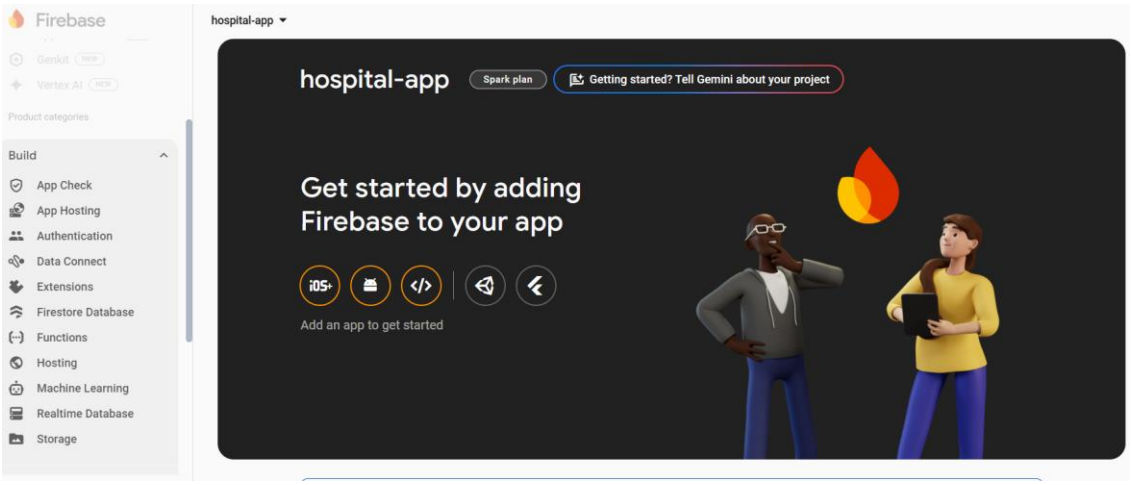

Figure 5.6: Firebase console – firebase features

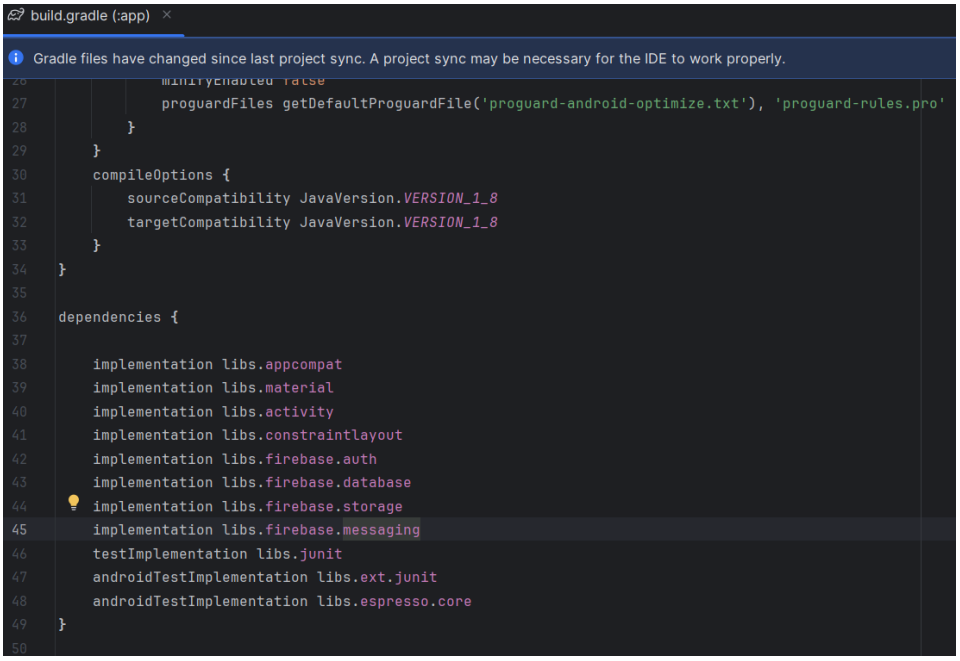

Figure 5.7: Android studio – build.gradle

5.3.3 Balsamiq Setup

Balsamiq is a user interface wireframing tool used during the design phase to create mockups and visualize the app layout before development.

1. Visit the official Balsamiq website (https://balsamiq.com) and download the Balsamiq Wireframes application suitable for your operating system.
2. Install the application by following the installation instructions provided on the website.
3. Launch Balsamiq Wireframes and create a new project to begin designing your wireframes.
4. Use the available UI components to design the screens and layout of your application.

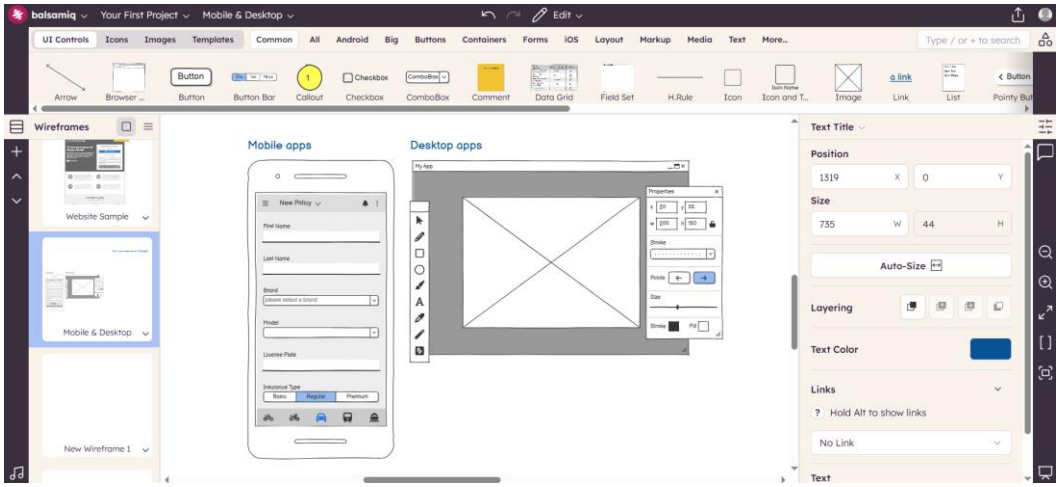

Figure 5.8: Balsamiq interface

5.3.4 Moqups Setup

Moqups is a web-based design tool used for creating low-fidelity and high-fidelity wireframes, mockups, diagrams, and prototypes. It helps in visualizing the app structure and user interface during the planning and design phase.

1. Visit the Moqups website (https://moqups.com).
2. Since Moqups is fully web-based, there is no need to download or install any software.
3. Once logged in, create a new project and choose a blank canvas or a template to start designing.
4. Use the built-in drag-and-drop elements to create wireframes, flowcharts, or UI mockups.
5. Save your project within the Moqups platform or export your designs as PDF, PNG, or HTML for documentation and sharing.

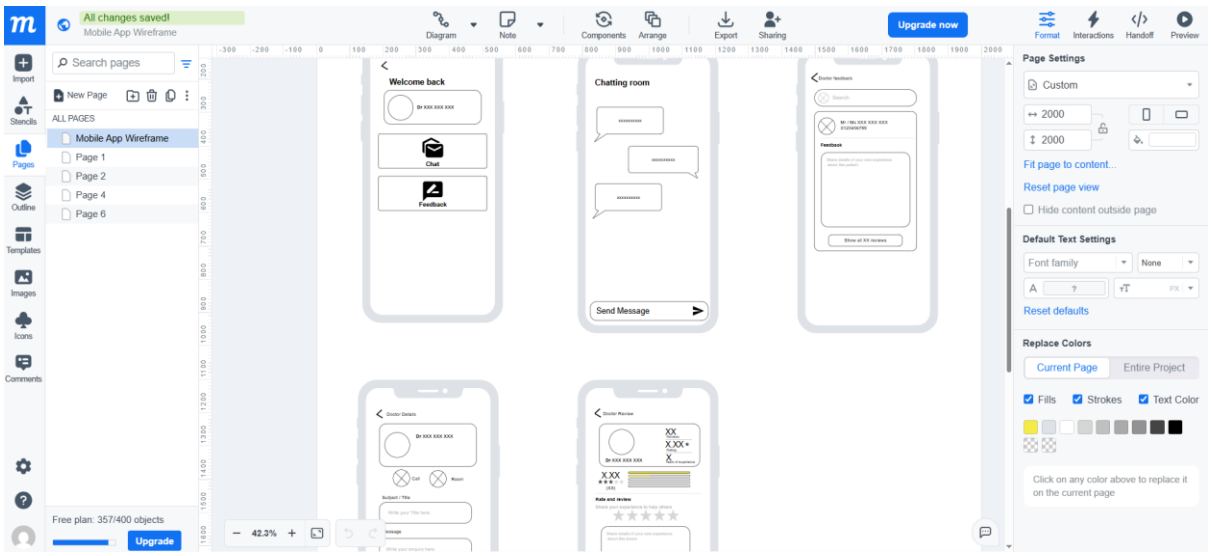

Figure 5.9: Moqups interface

5.3.4 Draw.io Setup

Web-based diagramming tools are commonly used to create flowcharts, system architectures, UML diagrams, and wireframes.

1. Visit the draw.io website (https://app.diagrams.net).
2. Choose where you would like to save your work (e.g., your device, Google Drive, OneDrive, etc.).
3. Start creating diagrams immediately without needing to download or install anything.
4. Click on "Create New Diagram", enter a name for your file, and select a blank template or from the available diagram types (flowchart, network, UML, etc.).
5. Use the drag-and-drop interface to build your diagrams with shapes, connectors, and text.
6. Save your diagrams to your selected location, or export them as PNG, JPG, PDF, or SVG files for documentation purposes.

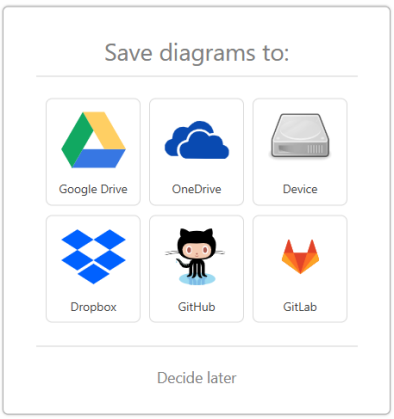

Figure 5.10: Draw.io – option to save work

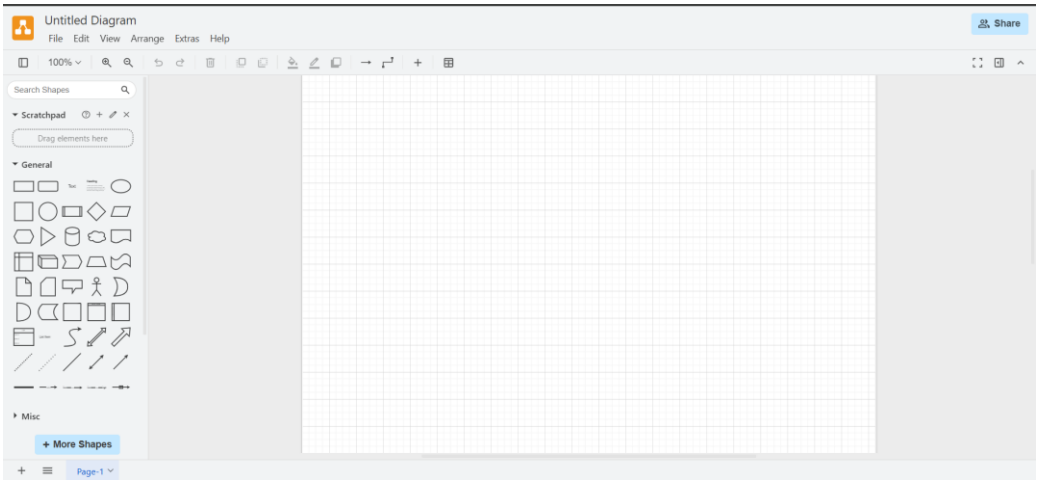

Figure 5.11: Draw.io interface

5.4 User Interface of the application

1. User Type Page

When users enter the application, users are first presented with a user type selection page, which distinguishes their role. If it is their first time using the app, they must choose their role such as public, patient or doctor. Each user type will have a tailored interface designed to allow them to perform functions specific to their role. After users have registered and logged into their account, they will be automatically directed to their designated interface upon entering the application.

Figure 5.12: User Type Page

2. Public users

2.1 Menu page

Public users are not required to register or log in. After selecting their user type, they are directed to a menu page with various functions to provide feedback. This menu includes options such as submitting feedback via phone, email or a feedback form.

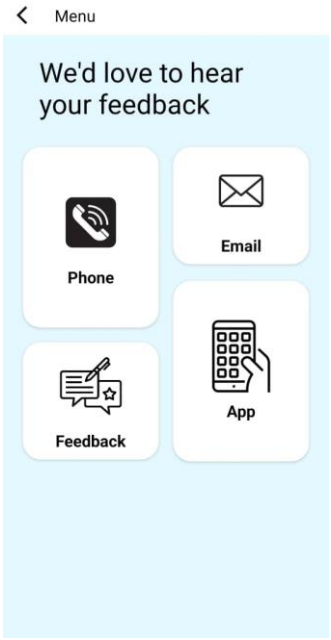

Figure 5.13: Menu Page (Public)

Users have the option to select the "Phone" feature, which allows them to provide feedback directly by making a call to the relevant hospital department.

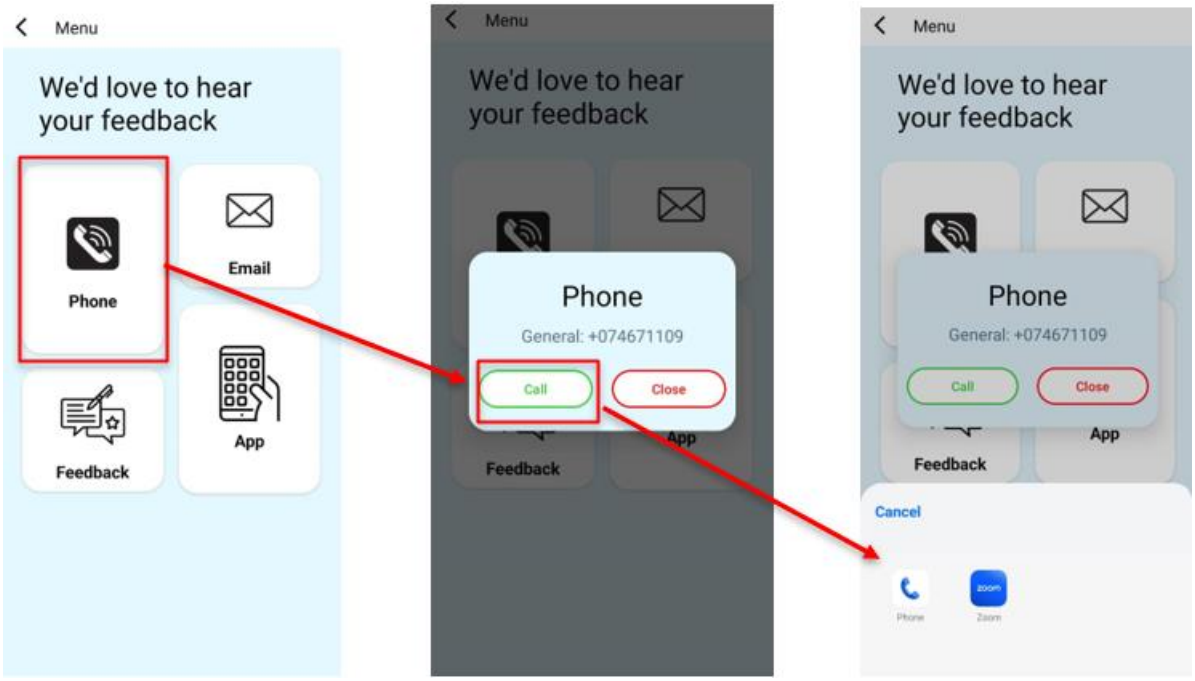

Figure 5.14: Phone call feature

Users can choose the "Email" option to provide feedback, which enables them to send their comments or concerns directly to the relevant hospital department.

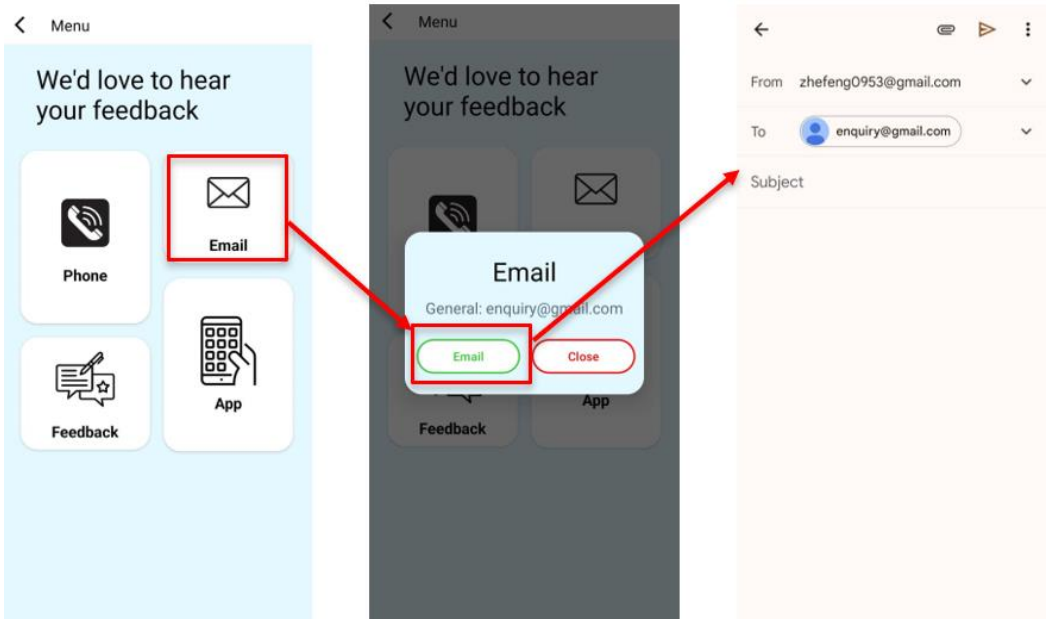

Figure 5.15: Email feature

Users can also choose the "Text-Based Form" under the "Feedback" menu to submit their comments or concerns via a form. The form requires users to enter their full name and IC number. Since public users are not permitted to provide feedback about doctors, the available enquiry type will be limited to "[General Feedback] Others." Additionally, users have the option to upload an image as supporting evidence.

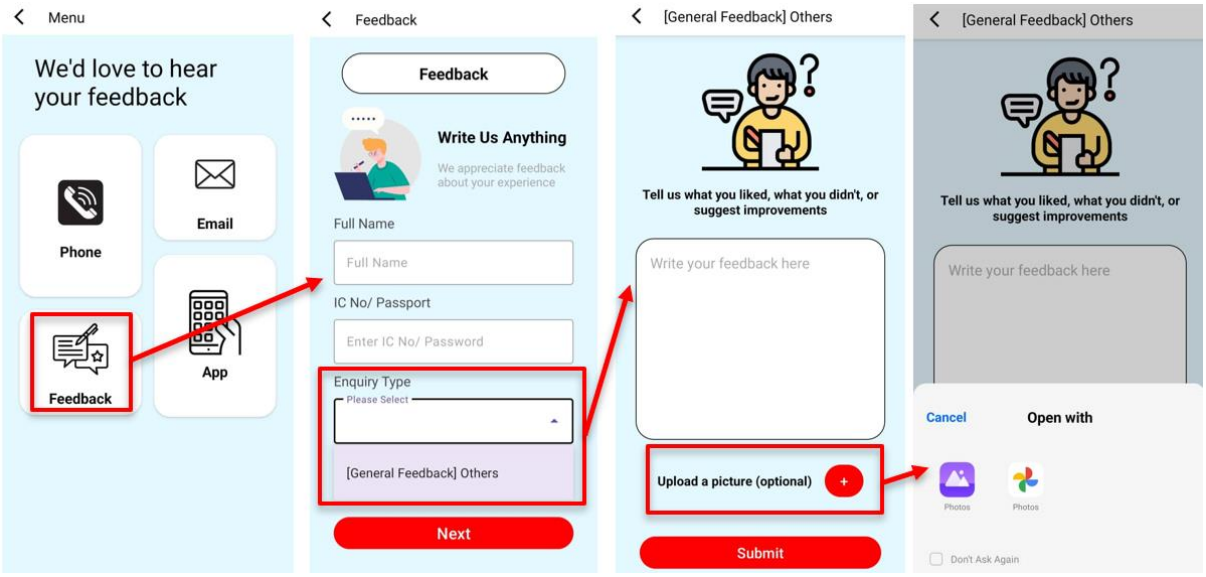

Figure 5.16: Feedback form ([General Feedback] Others)

Additionally, users can provide feedback on the application's functionality and performance, such as its smoothness, ease of use etc., ensuring that every aspect of their experience is thoroughly addressed.

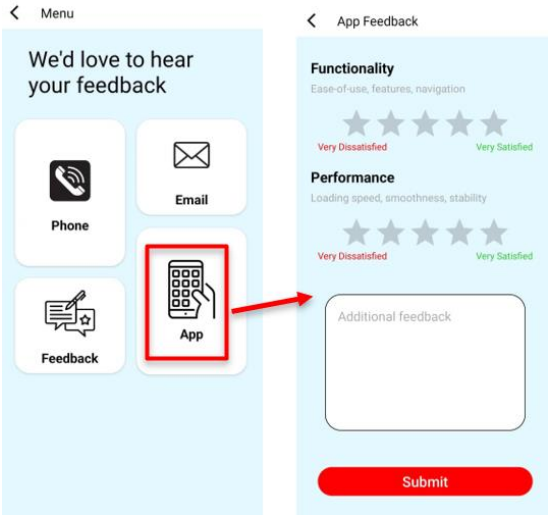

Figure 5.17: Feedback for application

3. Patient users

3.1 Login page

Users must enter their registered email and password. If they don’t have an account, they can click the "Sign Up" button to create one. If a user forgets their password, they can click on "Forgot Password" to start the password reset process. Additionally, if users haven’t verified their email, they will not be granted access to the application.

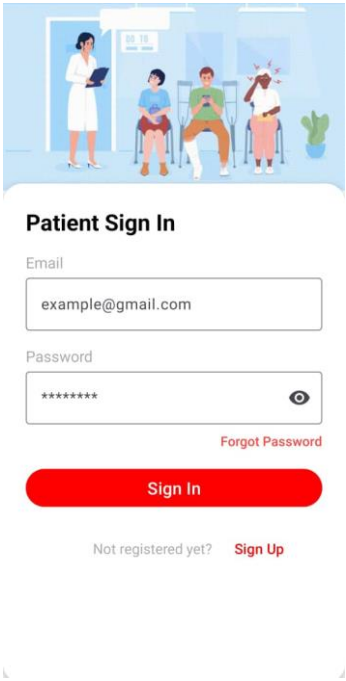

Figure 5.18: Login Page (Patients)

3.2 Forgot Password Page

After the user clicks "Forgot Password", they will be redirected to a page where they are prompted to enter their registered email address. Once they provide the email address and submit the request, an email will be sent to them with instructions on how to reset their password.

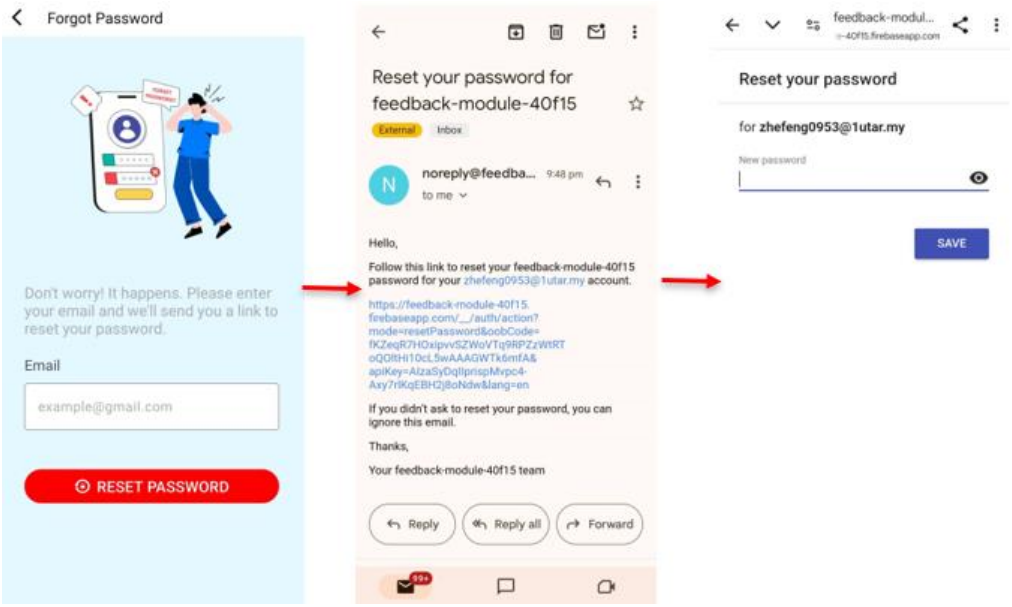

Figure 5.19: Password Reset Process (Patients)

3.3 Menu Page

This menu page is similar to a public menu page, offering options for submitting feedback via phone, email or feedback form. However, it includes additional features for patients, such as a chat function that enables direct communication with doctors. Additionally, a drawer function provides additional functions for patients to access and edit their profile information.

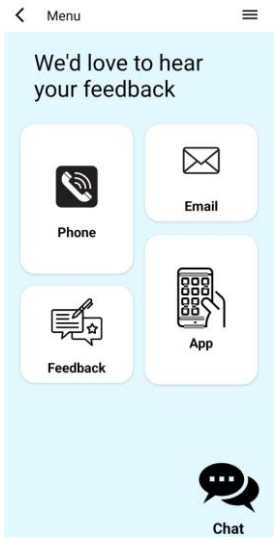

Figure 5.20: Menu Page (Patients)

Patients can access additional functions by either clicking the top right menu icon or swiping left on their phone. After that, they can upload their profile picture by clicking on the default placeholder image, which can be replaced with their own photo. The additional functions include options to edit their profile, provide feedback on the app's performance, and log out of their account.

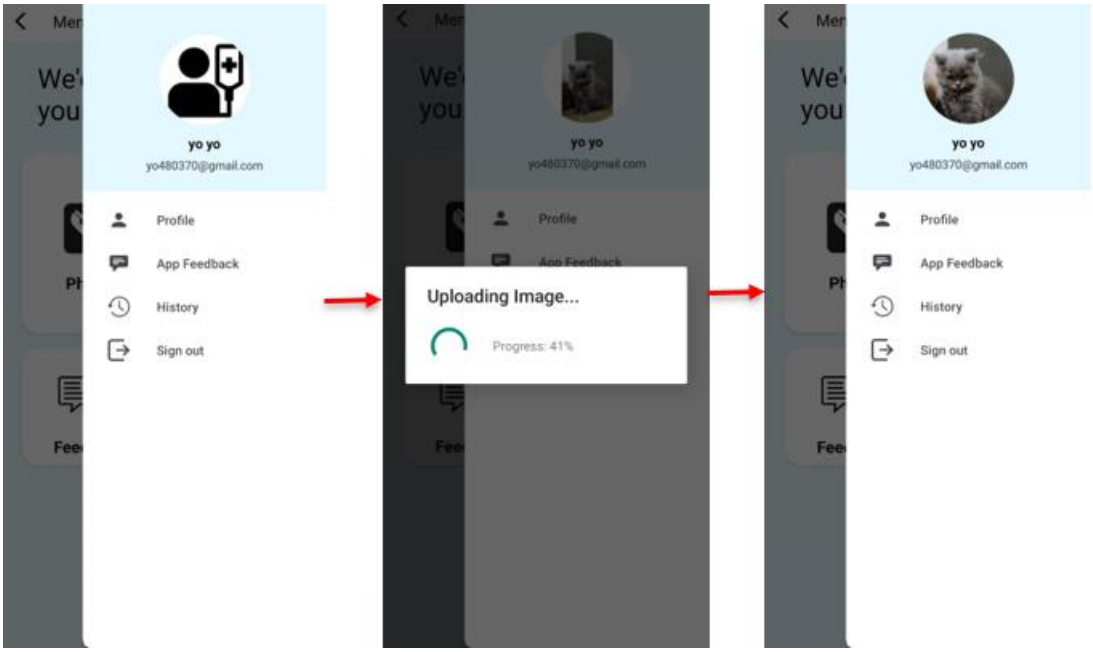

Figure 5.21: Uploading the image (Patients)

After users click the "Profile" option, they will be redirected to a page displaying their account details as entered during registration. If they notice any inaccuracies or wish to update their information, they can click the "Edit Profile" button to make the necessary changes.

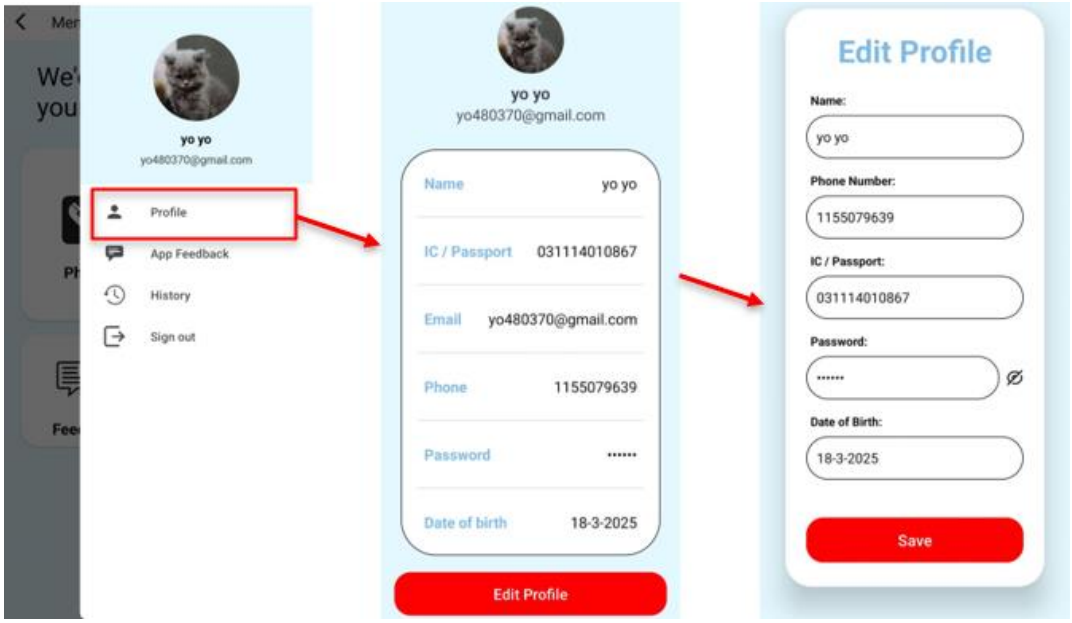

Figure 5.22: Edit Profile Process

When users click the “Feedback” option, they will be redirected to the “App” page, where they can provide their comments and ratings based on their experience with the application’s performance.

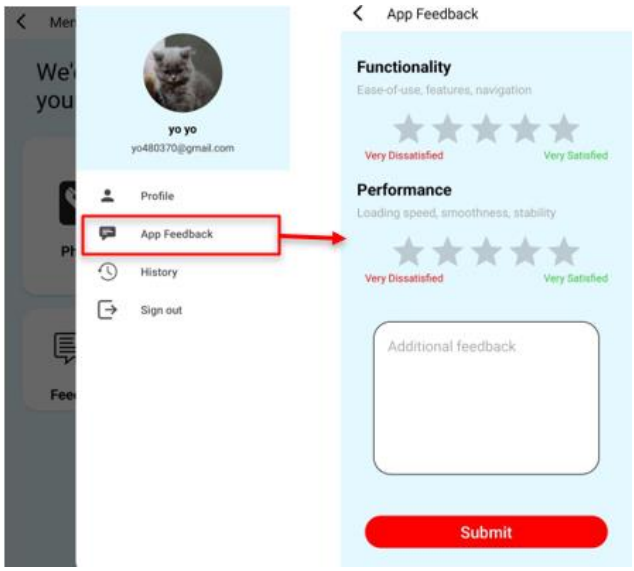

Figure 5.23: “Feedback” function

When users click the “History” option, they will be redirected to the History page, where they can view the feedback they have previously submitted to the doctor. Each feedback entry is displayed with its current status such as Sent, Being Reviewed, Being Resolve and Completed, allowing users to track the progress of their feedback. Only feedback marked as “Sent” will remain editable, enabling users to update or add more details if needed. Feedback that has been addressed will appear with a gray background, indicating it is completed and read-only.

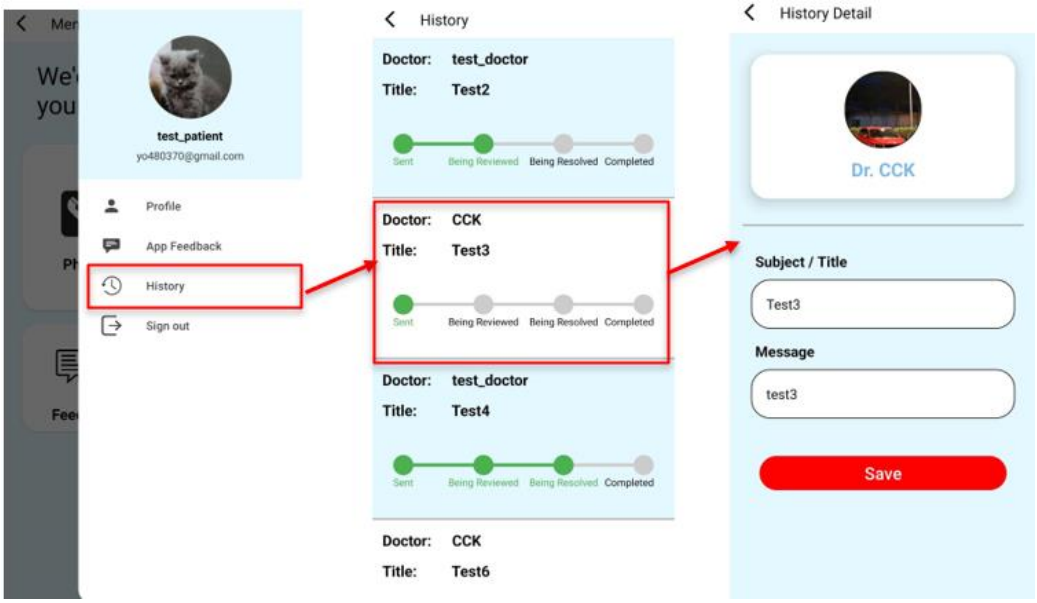

Figure 5.24: “History” function

When users click the “Logout” option, they will be redirected to the “Login” page, confirming that they have successfully logged out of their account.

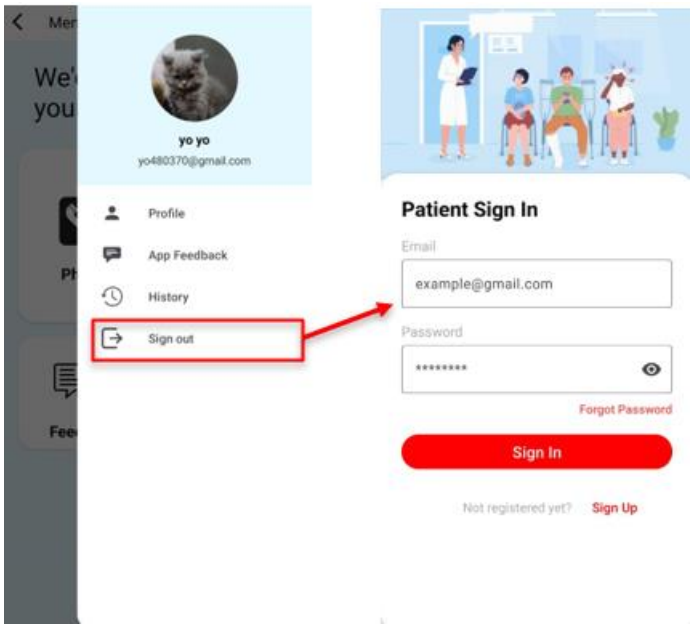

Figure 5.25: “Logout” function

3.4 Feedback Page

Similar to the Public, patients can also choose the "Text-Based Form" under the "Feedback" menu to submit their comments or concerns. The form requires users to enter their full name and IC number, but since patients have already provided these details during registration, the fields are automatically filled in. Patients only need to select the appropriate enquiry type, such as “[Enquiry] Doctor Appointment”, “[General Feedback] Compliments/Complaints”, or “[General Feedback] Others” based on their needs.

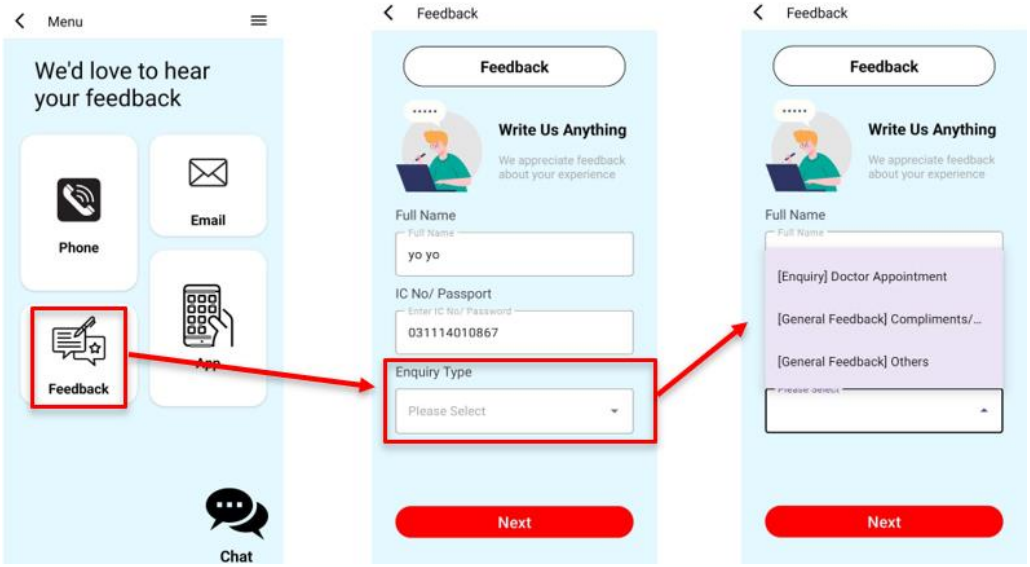

Figure 5.26: “Feedback” process

3.5 [Enquiry] Doctor Appointment

After selecting "[Enquiry] Doctor Appointment," users will first see a list of registered doctors, including each doctor's name, specialty, and qualifications. Users can choose the doctor they wish to provide feedback on or make an inquiry about. Additionally, users can search for a doctor by name for quicker access. Once a doctor is selected, users are redirected to a detailed page that displays the doctor's information, where they can proceed with providing their feedback or inquiry.

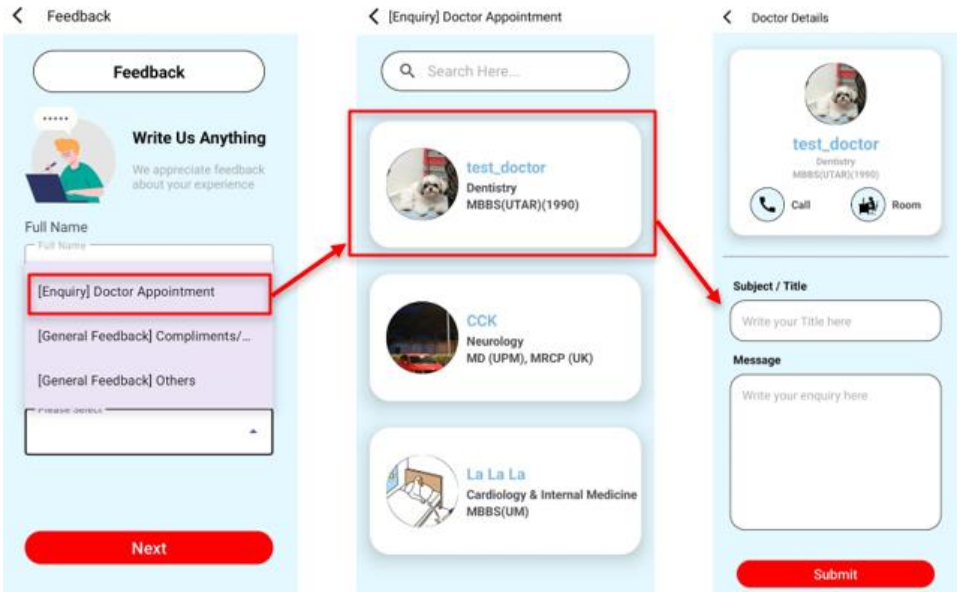

Figure 5.27: [Enquiry] Doctor Appointment

Users can also search for a doctor by name to quickly access the desired doctor's details, shorter the process of finding the doctor.

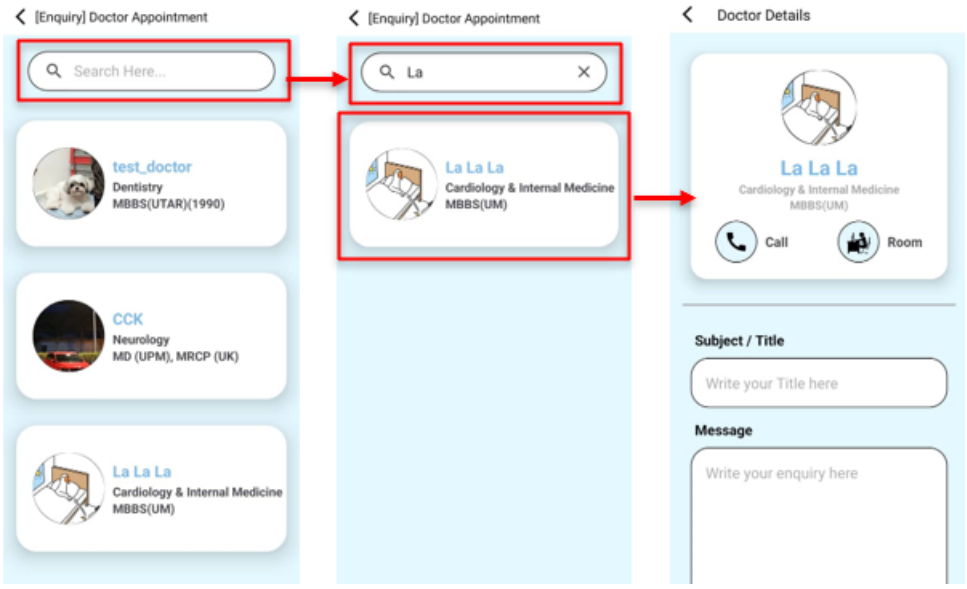

Figure 5.28: Search function ([Enquiry] Doctor Appointment)

Users have the option to initiate a direct phone call to the doctor by clicking the phone call icon displayed on the doctor's detail page. This feature allows users to quickly connect with their chosen doctor for urgent inquiries or real-time communication.

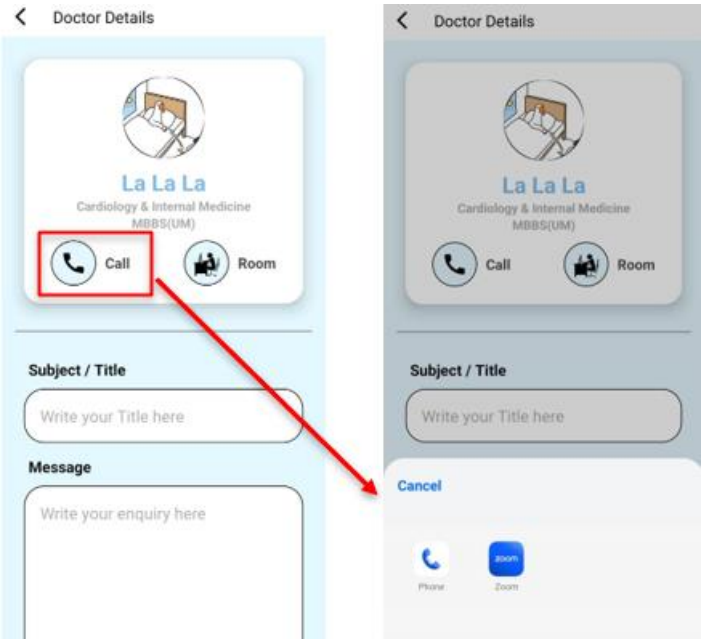

Figure 5.29: Call function ([Enquiry] Doctor Appointment)

Users can also go to the doctor's room by clicking the room icon on the doctor's detail page. This feature provides users with the precise room number, ensuring they can easily find the doctor's location for in-person consultations or feedback.

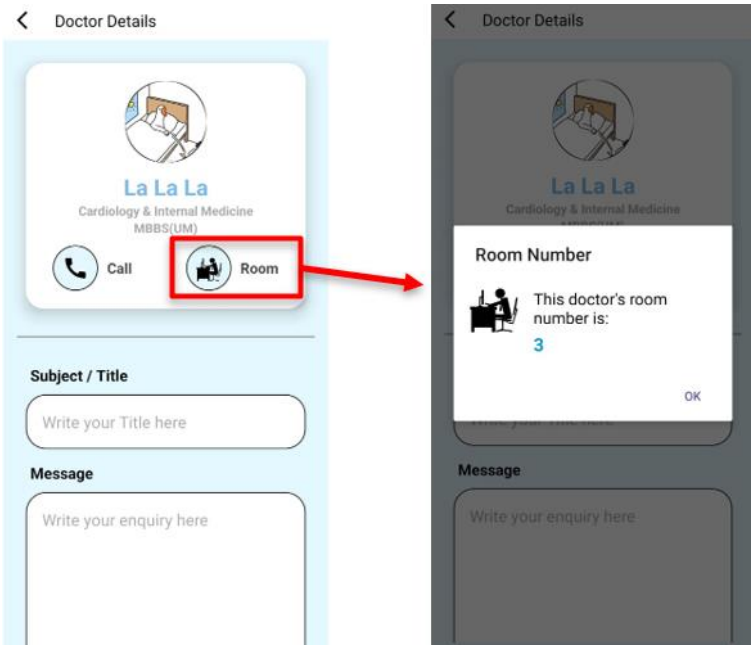

Figure 5.30: "Room" feature ([Enquiry] Doctor Appointment)

3.6 [General Feedback] Compliments/ Complaints

After selecting "[General Feedback] Compliments/ Complaints," users will first see a list of registered doctors, including each doctor's name, specialty, and qualifications. Users can select a doctor to rate or search for one by name for quicker access. Once a doctor is chosen, users will be redirected to a detailed page displaying the doctor's information, where they can submit their rating.

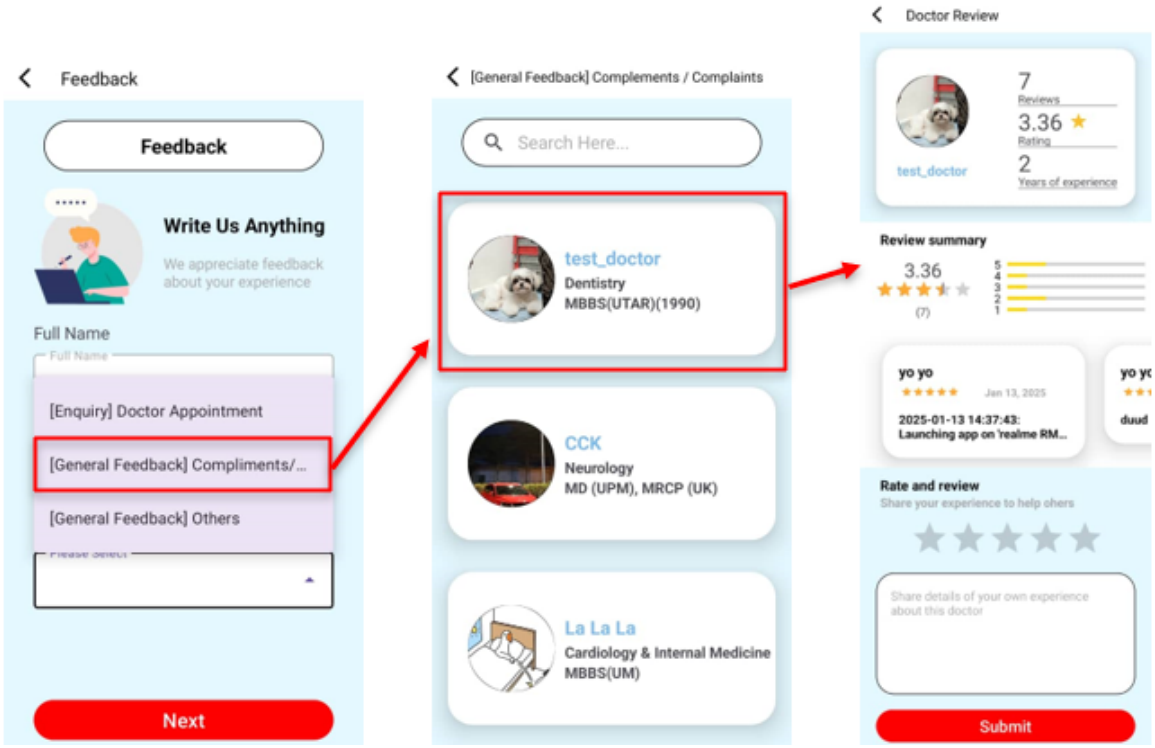

Figure 5.31: [General Feedback] Compliments/ Complaints

Users can submit their rating and review at the bottom of the application. After submitting, they will be redirected to a new page where they can view all the reviews left by other patients for that doctor.

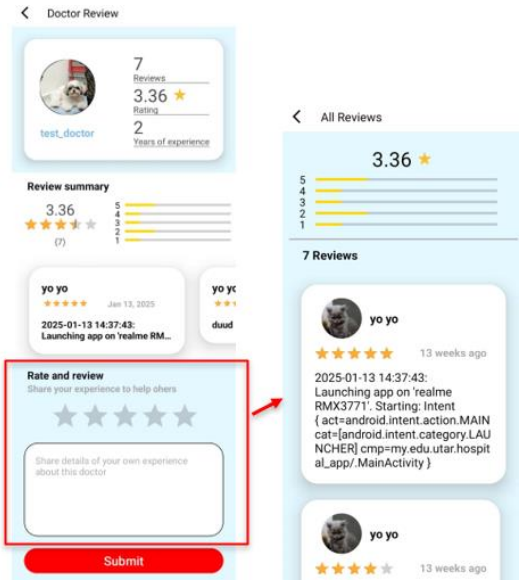

Figure 5.32 : [General Feedback] Compliments/ Complaints – submit rating and review

Additionally, users can view all reviews without submitting their own by clicking on the “See All Reviews” option.

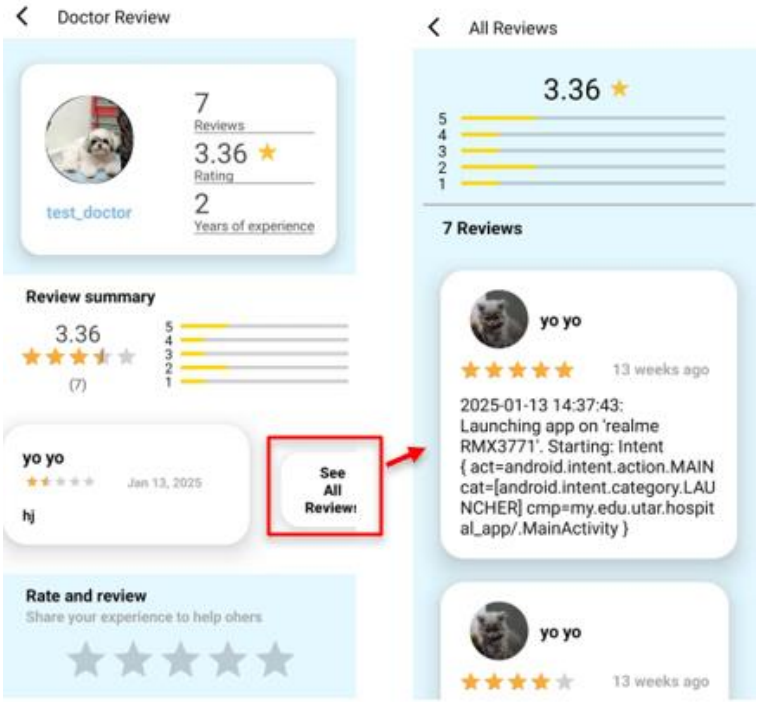

Figure 5.33 : [General Feedback] Compliments/ Complaints – see all review

Users can also choose the "Text-Based Form" under the "Feedback" menu to submit their comments or concerns via a form. Additionally, users have the option to upload an image as supporting evidence.

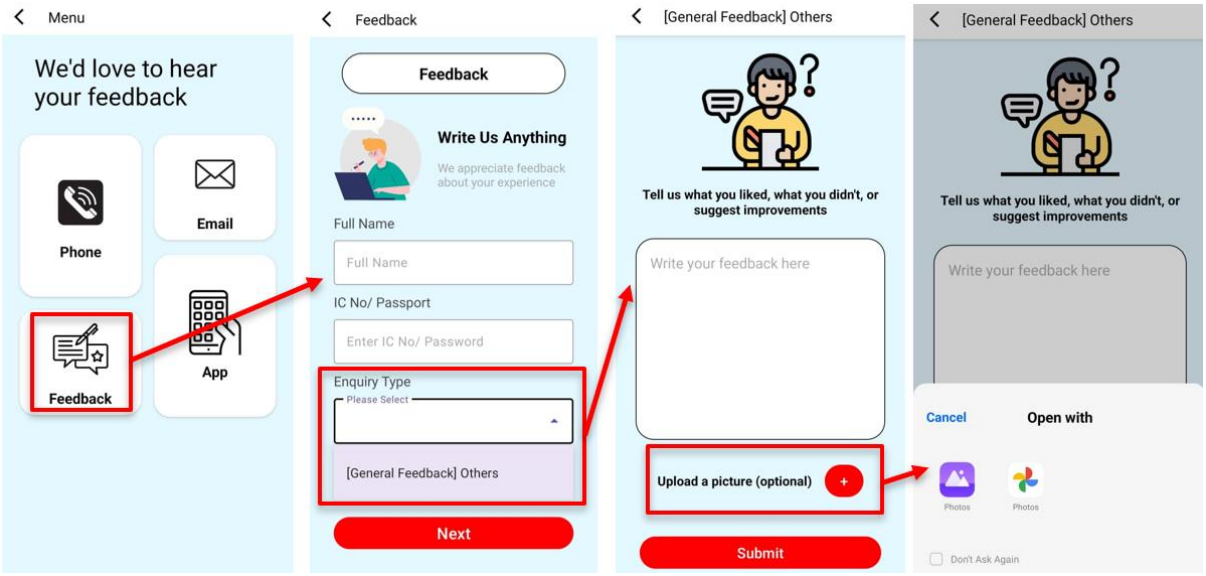

Figure 5.34: Feedback form ([General Feedback] Others)

4. Doctor users

4.1 Login page

Same as the patients, doctors must enter their registered email and password. If they don't have an account, they can click the "Sign Up" button to create one. If a user forgets their password, they can click on "Forgot Password" to start the password reset process. Additionally, if users haven't verified their email, they will not be granted access to the application.

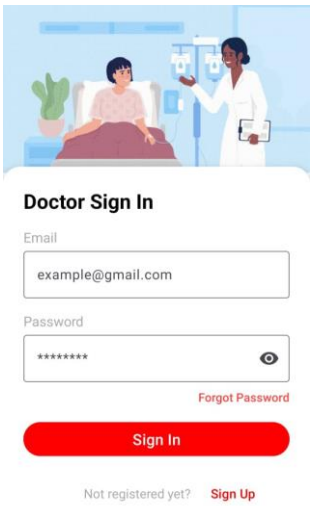

Figure 5.35: Login Page(Doctor)

4.2 Forgot Password Page

Similar to patients, when a user clicks "Forgot Password," they will be redirected to a page where they are prompted to enter their registered email address. After submitting their email address, they will receive an email with instructions on how to reset their password.

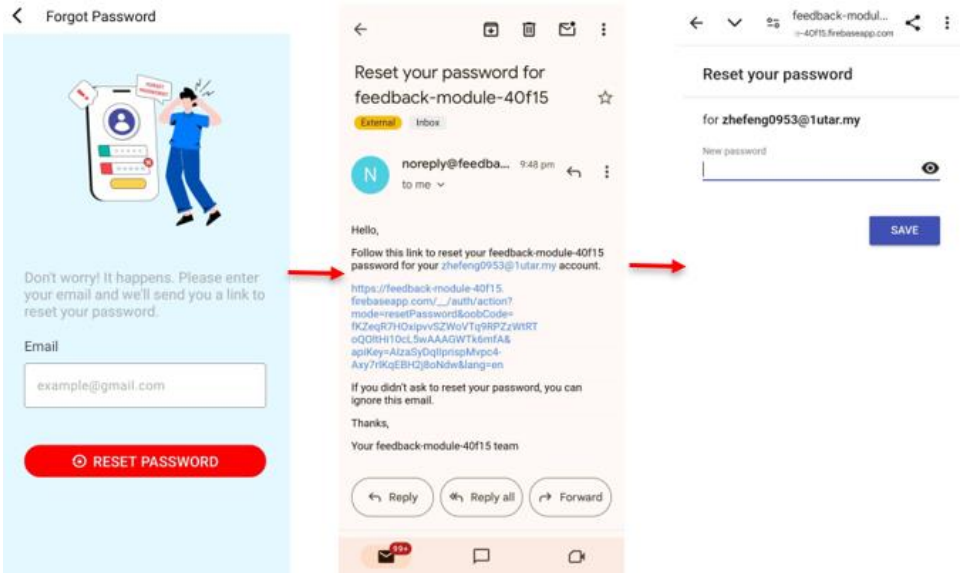

Figure 5.36: Password Reset Process (Doctors)

4.3 Menu Page (Doctors)

After successfully logging in, doctors are redirected to their interface. This interface displays their information and provides access to services such as notifications, chat and feedback features, allowing them to manage their interactions and tasks efficiently.

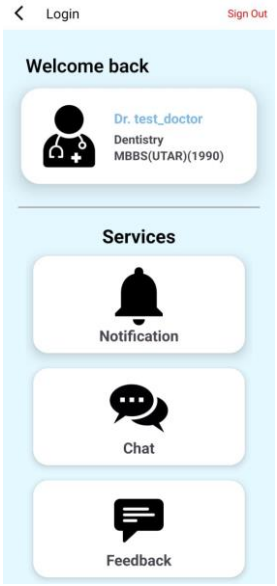

Figure 5.37: Doctor interface

Doctors can easily personalise their profile picture by clicking on the default placeholder image, which opens an option to upload a photo. This feature allows them to replace the placeholder with their own image, enhancing the doctor-patient connection by making it easier for patients to recognise their doctor.

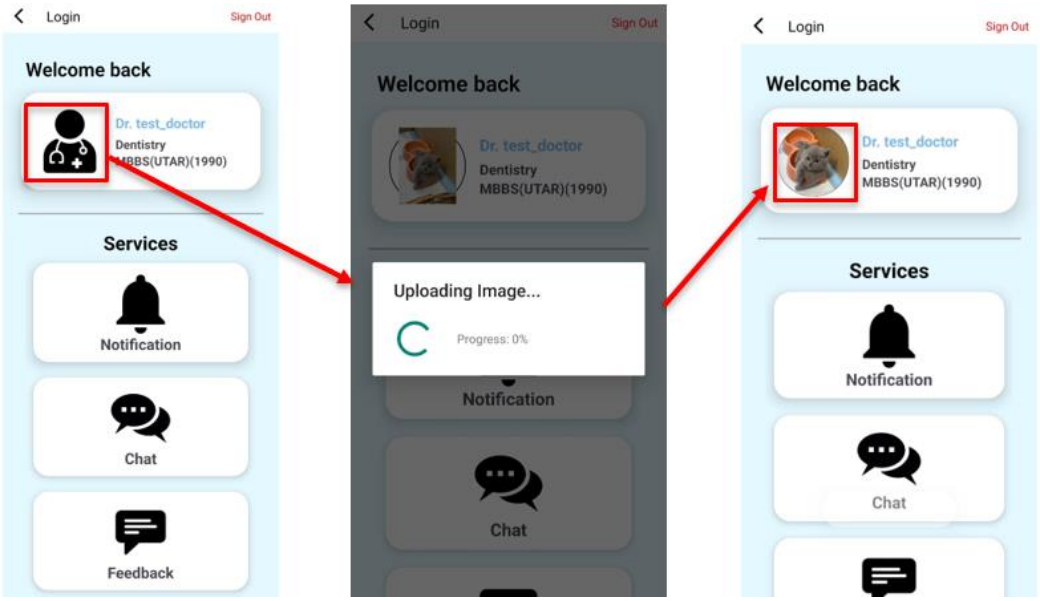

Figure 5.38: Uploading the image (Doctors)

Doctors can sign out their accounts by clicking the "Sign Out" text at the top right corner of the page.

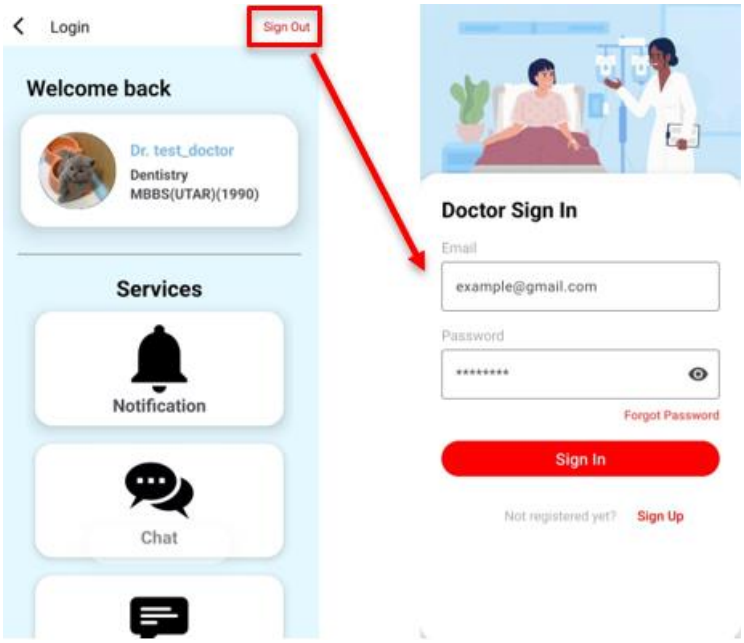

Figure 5.39: Sign Out process

4.4 Notification feature

Doctors can use the Notification service to view feedback messages from patients. If no feedback has been received, the list will be empty, indicating that no patients have sent messages to them.

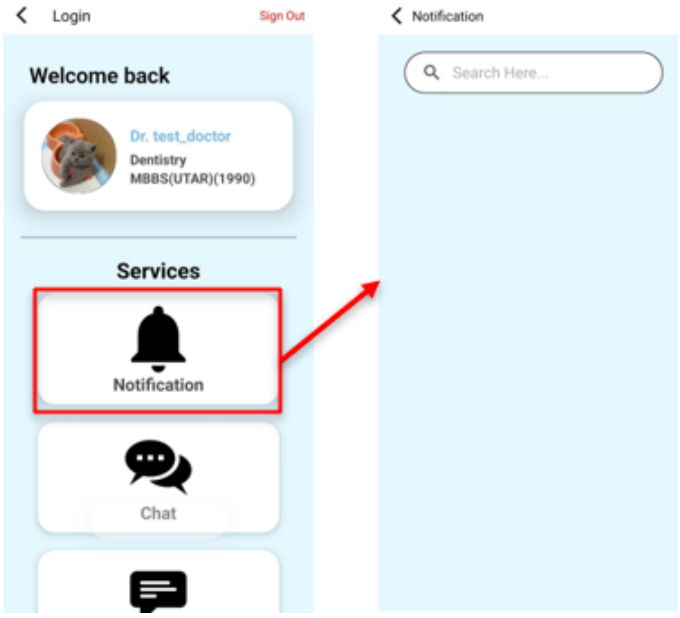

Figure 5.40: Demonstrate of “Notification” feature

When patients write a feedback message to doctors, they must provide a title and message. After submitting the feedback, they are redirected to the previous page and the page will prompt "Feedback sent successfully!".

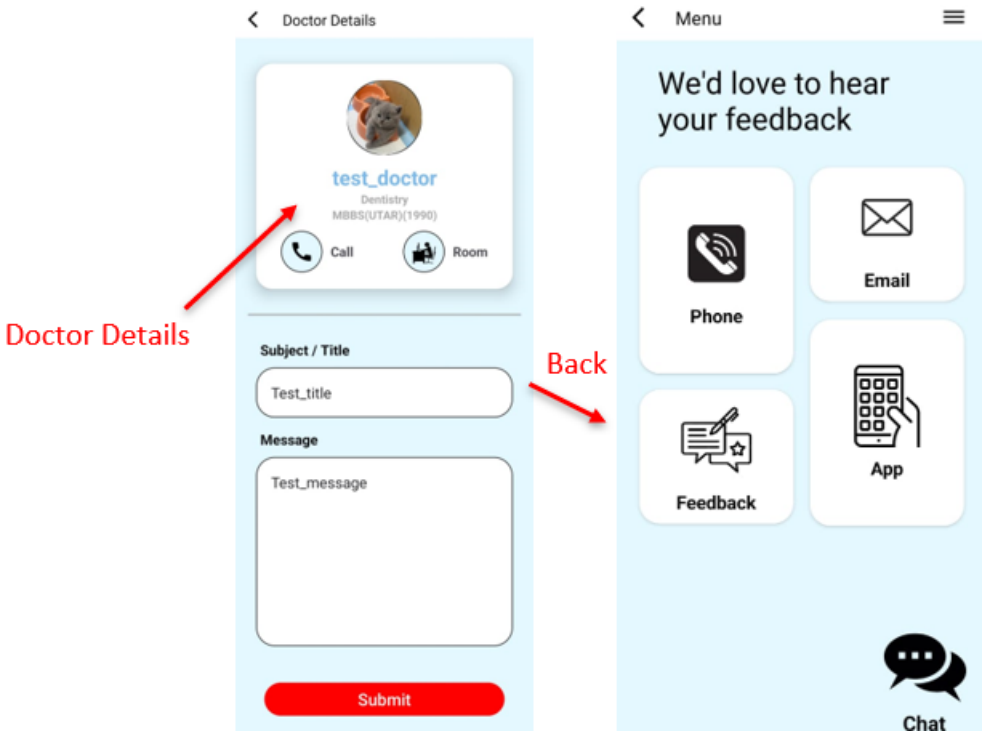

Figure 5.41: Patients submitting feedback (Patient view)

At the same time, the doctor's device will receive a notification when the patient submits feedback.

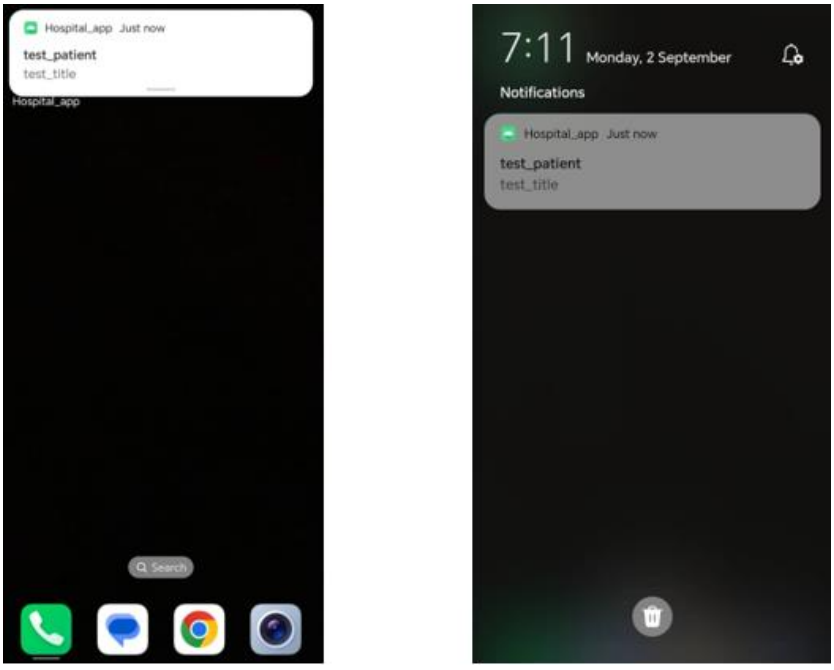

Figure 5.42: Notification (Doctor view)

When the doctor clicks the notification, they will enter the application and be directed to the notification page, which displays the patient who provided feedback. The doctor can then select the patient's feedback to view, which will take them to a detailed page showing the patient's name, feedback title and message. After reading the message, the doctor can click the "Chat" button below to communicate with the patient to solve the problem.

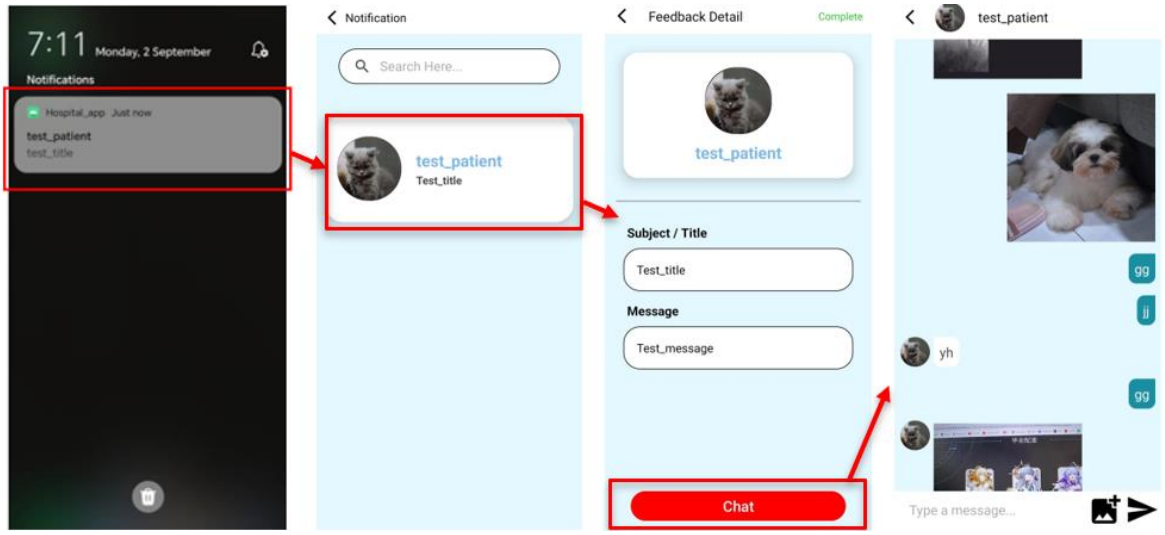

Figure 5.43: Feedback message

Once the issue is resolved, the doctor can click the "Complete" button at the top right to close the case. The entry will disappear from the list, indicating that the problem has been solved.

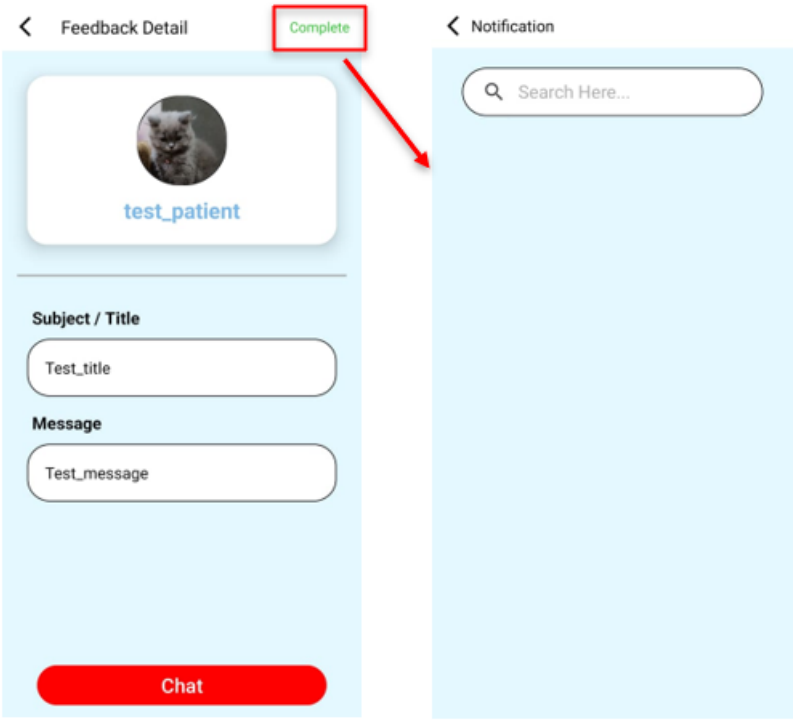

Figure 5.44: Complete action

4.5 Chat feature

Doctors can use the chat service to respond to feedback messages from patients. They can choose from recent conversations in the Users fragment. If the doctor has never chatted with a patient before, they can find for the patient in the Users fragment.

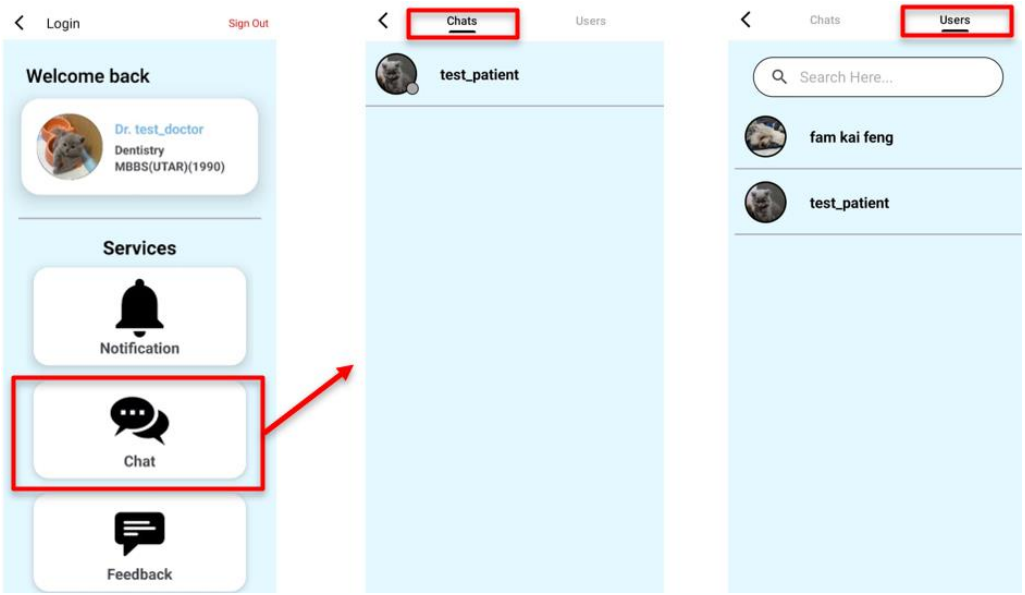

Figure 5.45: Demonstrate of "Chat" feature

Doctors can also search for a patient by name to quickly find and approach the desired patient, streamlining the process.

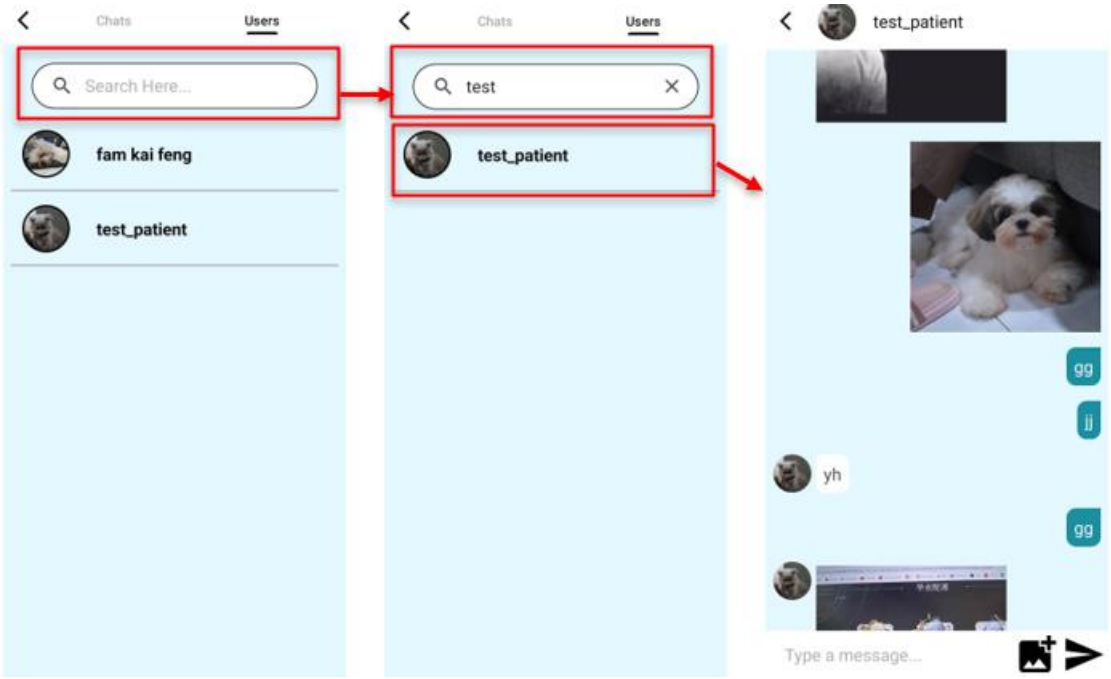

Figure 5.46: Chat - Search function

Doctor can select a patient to start a conversation and send either text messages or images to explain or resolve the feedback issue.

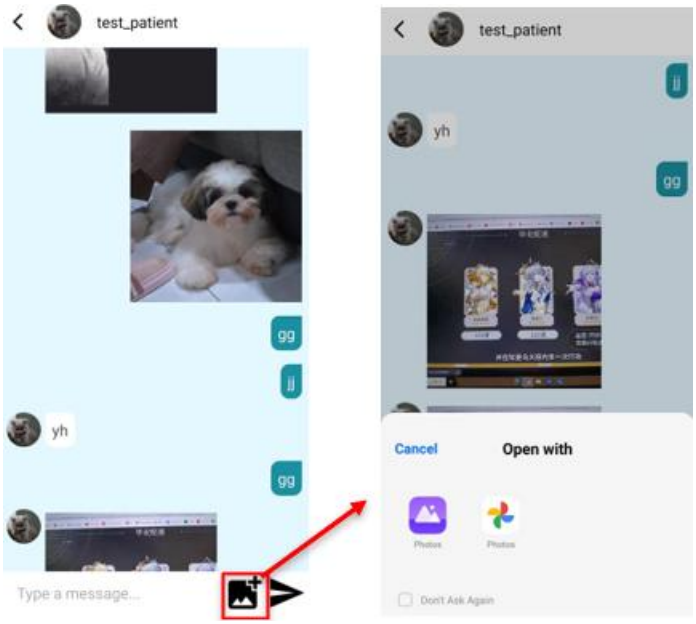

Figure 5.47: Send messages

4.6 Feedback feature

Doctors can use the feedback service to provide feedback on a patient's behavior and attitude.

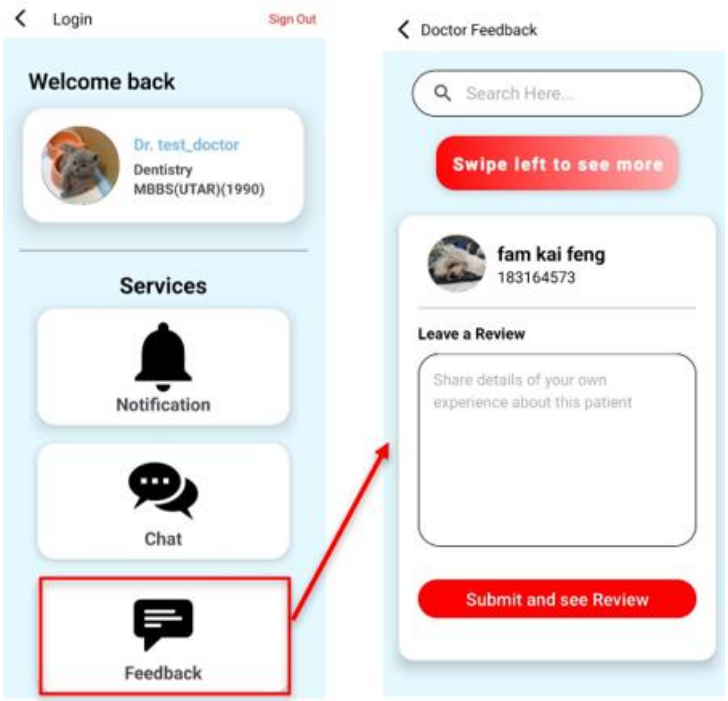

Figure 5.48: Demonstrate of "Feedback" feature

Doctors can also search for a patient by name to quickly find and approach the desired patient, streamlining the process.

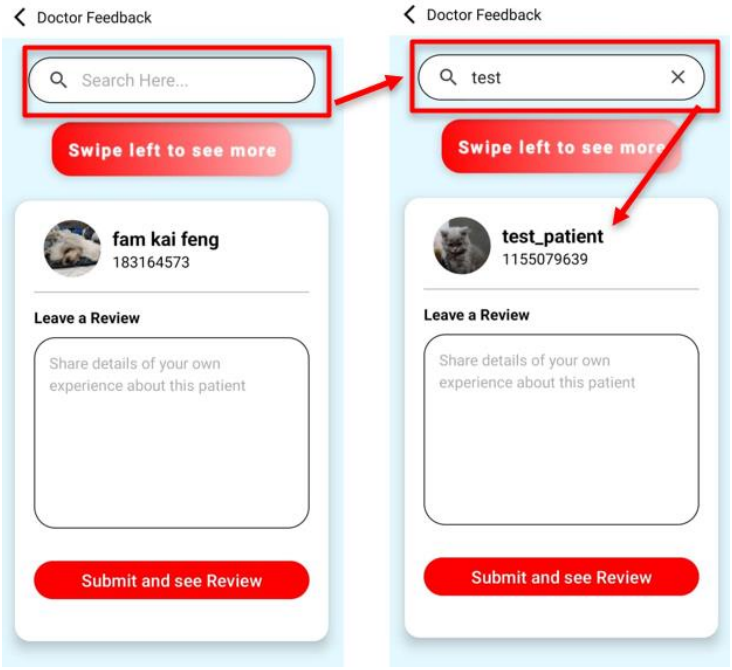

Figure 5.49: Feedback - Search function

Doctors can submit feedback regarding a patient by clicking the Submit button. After submitting, they will be redirected to a new page where they can view all the reviews left for that patient.

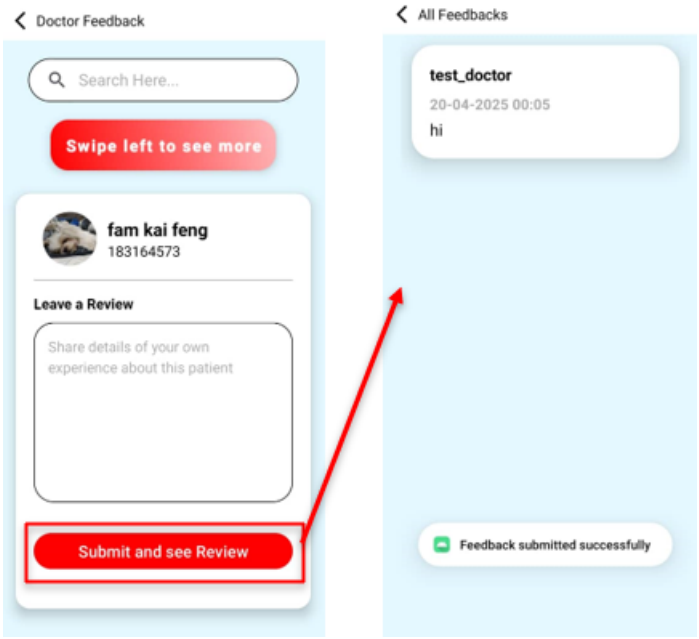

Figure 5.50: Sending feedback messages

5.5 Implementation Issues and Challenges

The development of this application presented some challenges that needed to be overcome. For example, one of the major challenges was the steep learning curve associated with Firebase. It requires significant time and effort to fully understand the Firebase, because firebase offers a wide range of features and services such as Authentication, Firebase Cloud Messaging, Realtime Database and etc. To use these features effectively, it was necessary to rely heavily on Firebase's official documentation and tutorials available on platforms like YouTube. Additionally, another challenge encountered during the development was the slow response time of the Android Studio emulator. For example, after implementing a new function in the code and trying to run the app, the emulator could take more than five minutes to launch. This significantly slowed down the development process due to the long waiting times. To solve this issue, a physical Android phone was used for testing instead of the emulator. This required enabling USB Debugging in the phone's developer settings.

Besides that, there were challenges in implementing the chat messaging feature due to the complexity of Firebase Messaging. As a beginner in using Firebase, understanding how to set up and manage real-time message synchronisation between users was initially overwhelming. Implementing features such as sending and receiving messages, updating message status such as seen or unseen and ensuring real-time data updates require a large understanding of Firebase Realtime Database and Firebase Cloud Messaging (FCM). Additionally, handling user authentication and securing data access added another layer of difficulty.

One particular challenge was ensuring that messages were delivered instantly and displayed correctly in the user interface without delays or duplication. This involved managing RecyclerViews efficiently, integrating Firebase listeners and testing different scenarios, such as sending images along with text. Debugging these issues was time-consuming because it was tough to pinpoint whether the problem was in the app logic, Firebase rules or network latency. To tackle these challenges, it is essential to conduct testing, dive into the official documentation and look for solutions in community resources, such as YouTube tutorials.

5.6 Concluding Remark

In conclusion, this application is designed to provide users with a platform for real-time feedback and enhance their overall care experience. The successful development of the application involved multiple stages, including the setup and configuration of both hardware and software, as well as the integration of key features such as Authentication, Realtime Database and Firebase Cloud Messaging. Each module was implemented smoothly, ensuring the application's robustness. Although there are a series of challenges during development such as database synchronisation issues, cloud messaging issues, issues with integrating Firebase in Android Studio and etc., but these obstacles were effectively addressed and resolved. Ultimately, this application empowers users to improve their care experience by offering a seamless platform for immediate feedback and communication. As a result, the application enhances user engagement, fosters better communication, and contributes to overall satisfaction in the care experience.

Chapter 6

System Evaluation and Discussion

6.1 System Testing and Performance Metrics

System testing was conducted using black box testing, which focuses on evaluating the application's functionality based on its inputs, actual outputs and expected outputs, without looking at its internal structure such as code. The goal of this testing method was to ensure that the system behaves as expected according to the defined requirements. To implement this, one of the types of black box testing which is use case testing was employed. Each use case outlines a sequence of actions or flows that users follow while interacting with the application. By defining these use cases, we were able to assess both the main flow and alternatives flows of user interactions. This enabled a comprehensive evaluation of the system's responses to different inputs, ensuring that all potential user interactions with the system were thoroughly tested. In doing so, we were able to validate the application's behavior across various scenarios and confirm that it meets the expected performance standards.

6.2 Testing Setup and Result

6.2.1 Choose User Type Testing

Table 6.1: Choose User Type Testing

Test Case Name: Choose User Type						
ID: TC001						
Test Condition ID	**Test Condition**	**Test Coverage ID**	**Description**	**Expected Output**	**Actual Output**	**Result Status**
TCON-01-001	Main Flow	TCOV-01-001	User selects one of the user types	System redirects the user to the respective page based on the chosen user type	System redirects the user to the respective page based on the chosen user type	Pass
TCON-01-002	Alternative Flow – User Cancels to Choose User Type	TCOV-01-002	User exits the application without selecting a user type	System terminates the application	System terminates the application	Pass

6.2.2 Login Account Testing

Table 6.2: Login Account Testing

Test Case Name: Login Account						
ID: TC002						
Test Condition ID	**Test Cases**	**Test Coverage ID**	**Description**	**Expected Output**	**Actual Output**	**Result Status**
TCON-02-001	Main Flow	TCOV-02-001	User provides correct email and password	System redirects the user to respective menu page.	System redirects the user to respective menu page.	Pass
TCON-02-002	Alternative Flow – Invalid Username and Password	TCOV-02-002	User provides incorrect email or password	System displays an error message	System displays an error message	Pass

6.2.3 Sign Out Account Testing

Table 6.3: Sign Out Account Testing

Test Case Name: Sign Out Account						
ID: TC003						
Test Condition ID	**Test Cases**	**Test Coverage ID**	**Description**	**Expected Output**	**Actual Output**	**Result Status**

TCON-03-001	Main Flow	TCOV-03-001	User logs out of their account	System successfully logs the user out and redirects to the login page	System successfully logs the user out and redirects to the login page	Pass

6.2.4 Profile Testing

Table 6.4: Profile Testing

Test Case Name: Profile						
ID: TC004						
Test Condition ID	**Test Cases**	**Test Coverage ID**	**Description**	**Expected Output**	**Actual Output**	**Result Status**
TCON-04-001	Main Flow	TCOV-04-001	User views and updates profile information	System redirects the user to the profile page and displays the editable profile form	System redirects the user to the profile page and displays the editable profile form	Pass
TCON-04-002	Alternative Flow – Missing or Incorrect Information	TCOV-04-002	User submits the form with missing or invalid data	System displays an error message	System displays an error message	Pass
TCON-04-003	Alternative Flow – User Cancels the Edit Process	TCOV-04-003	User cancels or exits the edit profile process	System redirects the user back to the profile view page without saving changes	System redirects the user back to the profile view page without saving changes	Pass

6.2.5 History Testing

Table 6.5: History Testing

Test Case Name: History						
ID: TC005						
Test Condition ID	**Test Cases**	**Test Coverage ID**	**Description**	**Expected Output**	**Actual Output**	**Result Status**
TCON-05-001	Main Flow	TCOV-05-001	User views and updates their feedback history	System redirects the user to the history page and displays the editable feedback form	System redirects the user to the history page and displays the editable feedback form	Pass
TCON-05-002	Alternative Flow – Missing or Incorrect Information	TCOV-05-002	User submits the form with missing or invalid data	System displays an error message	System displays an error message	Pass
TCON-05-003	Alternative Flow – User Cancels the Edit Process	TCOV-05-003	User cancels or exits the edit profile process	System redirects the user back to the profile view page without saving changes	System redirects the user back to the profile view page without saving changes	Pass

6.2.6 Phone call Testing

Table 6.6: Phone call Testing

Test Case Name: Phone call						
ID: TC006						
Test Condition ID	**Test Cases**	**Test Coverage ID**	**Description**	**Expected Output**	**Actual Output**	**Result Status**
TCON-06-001	Main Flow	TCOV-06-001	User selects the "Phone" option	System launches the phone call interface and redirects the user to initiate the call	System launches the phone call interface and redirects the user to initiate the call	Pass
TCON-06-002	Alternative Flow – Close Option Selected	TCOV-06-002	User selects the "Close" option	System redirects the user back to the main menu page	System redirects the user back to the main menu page.	Pass

6.2.6 Email Testing

Table 6.7: Email Testing

Test Case Name: Email						
ID: TC007						
Test Condition ID	**Test Cases**	**Test Coverage ID**	**Description**	**Expected Output**	**Actual Output**	**Result Status**

TCON-07-001	Main Flow	TCOV-07-001	User selects the "Email" option	System launches the email interface and redirects the user to compose an email.	System launches the email interface and redirects the user to compose an email.	Pass
TCON-07-002	Alternative Flow – Close Option Selected	TCOV-07-002	User selects the "Close" option	System redirects the user back to the main menu page	System redirects the user back to the main menu page.	Pass

6.2.8 Give General Feedback Testing

Table 6.8: Give General Feedback Testing

Test Case Name: Give General Feedback						
ID: TC008						
Test Condition ID	**Test Cases**	**Test Coverage ID**	**Description**	**Expected Output**	**Actual Output**	**Result Status**
TCON-08-001	Main Flow	TCOV-08-001	User selects the “[General Feedback] Others” option and enters a valid full name	System redirects the user to the “"[General Feedback] Others” page, allowing submission of feedback and optional image upload	System redirects the user to the “"[General Feedback] Others” page, allowing submission of feedback and optional image upload	Pass

			and IC/passport number			
TCON-08-002	Alternative Flow – Missing and Invalid IC number/passport	TCOV-08-002	User inputs an invalid or missing IC/passport number	System displays an error message	System displays an error message	Pass
TCON-08-003	Alternative Flow – Missing and Invalid Feedback Message	TCOV-08-003	User submits the form without entering a feedback message	System displays an error message	System displays an error message	Pass

6.2.9 Give App Feedback Testing

Table 6.9: Give App Feedback Testing

Test Case Name: Give App Feedback						
ID: TC009						
Test Condition ID	**Test Cases**	**Test Coverage ID**	**Description**	**Expected Output**	**Actual Output**	**Result Status**
TCON-09-001	Main Flow	TCOV-09-001	User selects the "App" option which enabling ratings for functionality and performance and allowing additional comments	System redirects to the "App Feedback" page, allowing the user to rate functionality and performance and add comments.	System redirects to the "App Feedback" page, allowing the user to rate functionality and performance and add comments.	Pass
TCON-09-002	Alternative Flow – Missing and Invalid Rating Validation	TCOV-09-002	User submits the feedback form with missing or invalid rating values.	System displays an error message	System displays an error message	Pass

6.2.10 Give Doctor Appointment Feedback Testing

Table 6.10: Give Doctor Appointment Feedback Testing

Test Case Name: Give Doctor Appointment Feedback						
ID: TC0010						
Test Condition ID	**Test Cases**	**Test Coverage ID**	**Description**	**Expected Output**	**Actual Output**	**Result Status**
TCON-10-001	Main Flow	TCOV-10-001	User selects the "[Enquiry] Doctor Appointment" option where the user can search/select a doctor and choose to call, visit the doctor's room, or submit feedback	System redirects the user to the "[Enquiry] Doctor Appointment" page and user can search or select a doctor to either call, visit the doctor's room, or submit feedback	System redirects the user to the "[Enquiry] Doctor Appointment" page and user can search or select a doctor to either call, visit the doctor's room, or submit feedback	Pass
TCON-10-002	Alternative Flow – Invalid or Missing Feedback Message or Title	TCOV-10-002	User submits the form without entering a valid feedback message or title	System displays an error message	System displays an error message	Pass

	Alternative Flow – User cancels feedback submission		User clicks the "Back" button to exit the feedback form	System redirects the user to "[Enquiry] Doctor Appointment" page	System redirects the user to "[Enquiry] Doctor Appointment" page	Pass
TCON-10-003	Alternative Flow – Doctor Not Found	TCOV-10-003	User searches for a doctor by name and no match is found	System displays an error message	System displays an error message	Pass

6.2.11 Give Compliments/ Complaints Testing

Table 6.11: Give Compliments/ Complaints Testing

Test Case Name: Give Compliments/ Complaints						
ID: TC011						
Test Condition ID	**Test Cases**	**Test Coverage ID**	**Description**	**Expected Output**	**Actual Output**	**Result Status**
TCON-11-001	Main Flow	TCOV-11-001	User selects the "[General Feedback] Compliments/ Complaints" option which allows the	System redirects the user to the "[General Feedback] Compliments/ Complaints" page where the user can select or	System redirects the user to the "[General Feedback] Compliments/ Complaints" page where the user can select or	Pass

			user to search/select a doctor, give a rating, and submit a review.	search for a doctor for providing rating and review.	search for a doctor for providing rating and review.	
TCON-11-002	Alternative Flow – Invalid or Missing Rating or Details	TCOV-11-002	User submits a form with missing or invalid rating or review details	System displays an error message	System displays an error message	Pass
TCON-11-003	Alternative Flow – User Cancels Feedback Submission	TCOV-11-003	User clicks the “Back” button to exit the rating page	System cancels the feedback submission and redirects the user back to the “[General Feedback] Compliments/ Complaints” page	System cancels the feedback submission and redirects the user back to the “[General Feedback] Compliments/ Complaints” page	Pass
TCON-11-004	Alternative Flow – Doctor Not Found	TCOV-11-004	User searches for a doctor by name and no match is found	System displays an error message	System displays an error message	Pass

6.2.12 Chat Testing

Table 6.12: Chat Testing

Test Case Name: Chat						
ID: TC012						
Test Condition ID	**Test Cases**	**Test Coverage ID**	**Description**	**Expected Output**	**Actual Output**	**Result Status**
TCON-12-001	Main Flow	TCOV-12-001	User selects the "Chat" option, which allows them to search or select a doctor and initiate a chat to provide feedback	User can successfully search/select a doctor and initiate a chat to give feedback	User can successfully search/select a doctor and initiate a chat to give feedback	Pass
TCON-12-002	Alternative Flow – Invalid Message	TCOV-12-002	User attempts to send an empty or invalid message in chat	System displays an error message	System displays an error message	Pass
TCON-12-003	Alternative Flow – User Cancels Chat	TCOV-12-003	User clicks the "Back" button to exit the chat room page	System redirects the user back to the "Chat" page where they can select a	System redirects the user back to the "Chat" page where they can select a	Pass

				doctor to initiate a new chat	doctor to initiate a new chat	
TCON-12-004	Alternative Flow – User Not Found	TCOV-12-004	User searches for a user by name and no match is found	System displays an error message	System displays an error message	Pass

6.2.13 Check Notification Testing

Table 6.13: Check Notification Testing

Test Case Name: Check Notification						
ID: TC013						
Test Condition ID	**Test Cases**	**Test Coverage ID**	**Description**	**Expected Output**	**Actual Output**	**Result Status**
TCON-13-001	Main Flow	TCOV-13-001	User selects the "Notification" option to view details	System redirects the user to the "Notification" page. After selecting a notification, system redirects the user to the "Feedback Detail" page to view the notification details	System redirects the user to the "Notification" page. After selecting a notification, system redirects the user to the "Feedback Detail" page to view the notification details	Pass

TCON-13-002	Alternative Flow – User Cancels View of Feedback Details	TCOV-13-002	User clicks the "Back" button to exit the "Feedback Detail" page	System redirects the user back to the "Notification" page	System redirects the user back to the "Notification" page	Pass
TCON-13-003	Alternative Flow – User Not Found	TCOV-13-003	User searches for a user by name and no match is found	System displays an error message	System displays an error message	Pass

6.2.14 Give Feedback Testing

Table 6.14: Give Feedback Testing

Test Case Name: Give Feedback Testing						
ID: TC014						
Test Condition ID	**Test Cases**	**Test Coverage ID**	**Description**	**Expected Output**	**Actual Output**	**Result Status**
TCON-14-001	Main Flow	TCOV-14-001	User selects the "Feedback" option and chooses a patient to provide feedback.	System redirects the user to the "Feedback" page, displays a list of patients, and upon feedback	System redirects the user to the "Feedback" page, displays a list of patients, and upon feedback	Pass

				submission, redirects to "All Feedback" page.	submission, redirects to "All Feedback" page.	
TCON-14-002	Alternative Flow – User Cancels Giving Feedback	TCOV-14-002	User clicks the "Back" button to exit the "Doctor Feedback" page before submitting any feedback.	System redirects the user back to the menu page	System redirects the user back to the menu page	Pass
TCON-14-003	Alternative Flow – User Not Found	TCOV-14-003	User searches for a user by name and no match is found	System displays an error message	System displays an error message	Pass

6.3 Project Challenges

A major challenge of this project was developing the application entirely from scratch which I had never experienced before. To ensure that the final product met the needs of all users, a lot of research was conducted to identify the features needed from each user type's perspectives. In addition, understanding and deciding on the appropriate tools, technologies and design approaches without prior experience made the process of development more demanding.

Another challenge in the development process was ensuring real-time communication between doctors and patients. This was particularly difficult because messages needed to be synchronized and displayed accurately in the chat room and issues such as message delays, incorrect ordering and data inconsistency between users made this aspect of development challenging.

Moreover, another major challenge was managing data consistency and performance while using a real-time database. Handling large volumes of real-time updates without causing delays, data duplication or synchronization errors required careful database structuring. In addition, optimising data retrieval and ensuring smooth scalability as the number of users grew added further complexity to the project.

6.4 Objective Evaluation

1. **To develop a mobile application to enhance patient-centered care through dynamic feedback and quality assessment in hospital.**

   This objective has been successfully achieved by creating a platform that allows patients to provide real-time feedback on their experiences. The application includes both a feedback channel and a chat channel, enabling direct communication between patients and doctors regarding the care received. Additionally, a feature has been implemented that allows patients to select a desired doctor, rate their performance, and view reviews from other patients, promoting greater transparency. The platform also enables hospital employees to provide feedback on patient behaviour and care delivery preferences, supporting better communication and continuous improvements in service delivery.

2 **To facilitate real-time communication channels for patients and hospital employees to provide dynamic feedback.**

This objective has been achieved through the implementation of the chat feature within the application, enabling patients to interact promptly with hospital staff. The application provides direct communication channels for patients, allowing instant feedback submission and real-time responses. Hospital staff will receive immediate feedback and can take a proactive approach by initiating live chats with patients to address concerns. This real-time interaction ensures timely resolution of issues, enhances user satisfaction, and promotes efficient communication between all parties involved.

3 **To develop a mobile application to enhance the user experience by distinguishing between different users within the application.**

The application effectively distinguishes between different user types, providing a personalized experience for each group. For example, public users have access to a limited set of features such as providing feedback on facilities and cleanliness. In contrast, patient users have access to a broader range of functionalities including rating and reviewing doctors, providing feedback to doctors and engaging in real-time chats with them. On the other hand, doctor users have a completely different interface and set of features tailored specifically to their professional needs. A clean and intuitive UI has been implemented to ensure seamless navigation, with interfaces customized to the specific requirements of public, patients and hospital employees. This approach prioritises ease of use and accessibility, enabling users to interact easily with the platform and efficiently provide feedback according to their respective roles.

4 **To assess the quality of care delivered through user feedback**

This objective has been achieved through the implementation of a star rating system within the application, allowing patients to assess doctors based on various aspects of their performance. Patients can select a doctor from a list and provide both a rating and a written review. This feature enables patients to view the overall ratings and feedback for each doctor, promoting greater transparency. Additionally, doctors can gain valuable insights into areas for improvement based on patient feedback, ultimately helping to enhance the quality of care provided.

6.5 Concluding Remark

In conclusion, this project successfully developed a patient-centered care mobile application that enhances the overall healthcare experience. By transforming from traditional survey forms to a digital, real-time feedback system, the application enables faster and more dynamic interactions between patients and doctors. Patients can now provide immediate feedback, communicate directly with hospital staff and contribute to a more transparent and responsive healthcare environment.

Despite facing challenges during development such as building a system from scratch, handling real-time communication and ensuring data consistency. The project had overcome these obstacles through continuous testing and refinement. The application was tested using black box testing techniques which is use case testing to ensure it met functionality, usability and performance standards. These experiments gave good results that matched what we expected. This shows that the application is strong and reliable, giving confidence that it can meet customer needs well. Ultimately, the project achieved its key objectives which are improving patient-centered care, establishing real-time communication channels, differentiating user experiences based on roles, and facilitating quality assessments through user feedback.

Chapter 7
Conclusion and Recommendation

7.1 Conclusion

The primary goal of this project was to enhance patient-centered care by enabling dynamic, real-time feedback through a mobile application. This objective has been successfully achieved by creating a platform where patients can easily share their experiences and feedback, and hospital staff can respond promptly to address any issues raised. The application introduces a more interactive and immediate feedback mechanism, replacing the traditional method which is slower paper-based methods with a streamlined digital platform. This transformation not only improves the convenience of providing feedback but also fosters a faster and more responsive healthcare environment, leading to higher patient satisfaction.

A major strength of the application is its ability to differentiate between various user types, offering customised features based on the user's role. Public users can provide feedback regarding hospital facilities, functionality and cleanliness, contributing to overall service improvement. On the other hand, patients are empowered to give real-time feedback, rate and review doctors, and communicate directly with their healthcare providers through an integrated chat system. Meanwhile, doctors can provide feedback on patient interactions, view feedback submitted by other doctors and engage in real-time communication to address patient concerns effectively.

By connecting patients and healthcare providers on a single, accessible platform, the application bridges communication gaps and enhances the feedback process. It enables both patients and doctors to collaborate more effectively, ensuring that issues are addressed quickly and efficiently. Furthermore, the mobile platform ensures that users can easily access the platform via their smartphones, making the feedback process more convenient and intuitive for all user groups.

Overall, the project has not only achieved its intended objectives but has also laid a strong foundation for future enhancements. By embracing real-time digital communication, the

application contributes to a more transparent, responsive, and patient-focused healthcare system. Moving forward, further improvements could be explored to expand the system's capabilities, such as incorporating AI-based feedback analysis, multilingual support, or personalized feedback suggestions to make the experience even more comprehensive and accessible for a broader audience.

7.2 Recommendation

The first recommendation is introducing AI-Based Feedback Analysis. To further enhance the functionality and responsiveness of the application, it is recommended to integrate AI-based feedback analysis tools. By leveraging machine learning, the system can automatically categorise, prioritise and analyse the feedback received from patients. This would enable hospital management to quickly detect the problems, common complaints or compliments without manually reading through every submission. Introducing AI would not only save time and resources but also ensure that critical feedback is addressed promptly, leading to continuous improvement in service quality and patient satisfaction.

The second recommendation is implementing multilanguage support. Currently, the application operates solely in English, which may limit accessibility for users who are not proficient in English. To make the platform more inclusive and user-friendly for a wider audience, it is recommended to integrate multilanguage support. By offering multiple language options, users from different linguistic backgrounds would be able to use the system more comfortably and confidently. This would significantly improve the user experience, reduce misunderstandings, and encourage more active participation in providing feedback.

The third recommendation is implementing cross-platform compatibility. Currently, the application is developed exclusively for the Android platform, which restricts access to users with only Android devices. To enhance accessibility and broaden the user base, the application should be developed to function seamlessly across multiple platforms, including Android, iOS and web browsers. By doing so, users can access the system regardless of the device they are using whether it is a smartphone, tablet or computer. This enhancement would significantly increase the application's accessibility, usability and overall impact.

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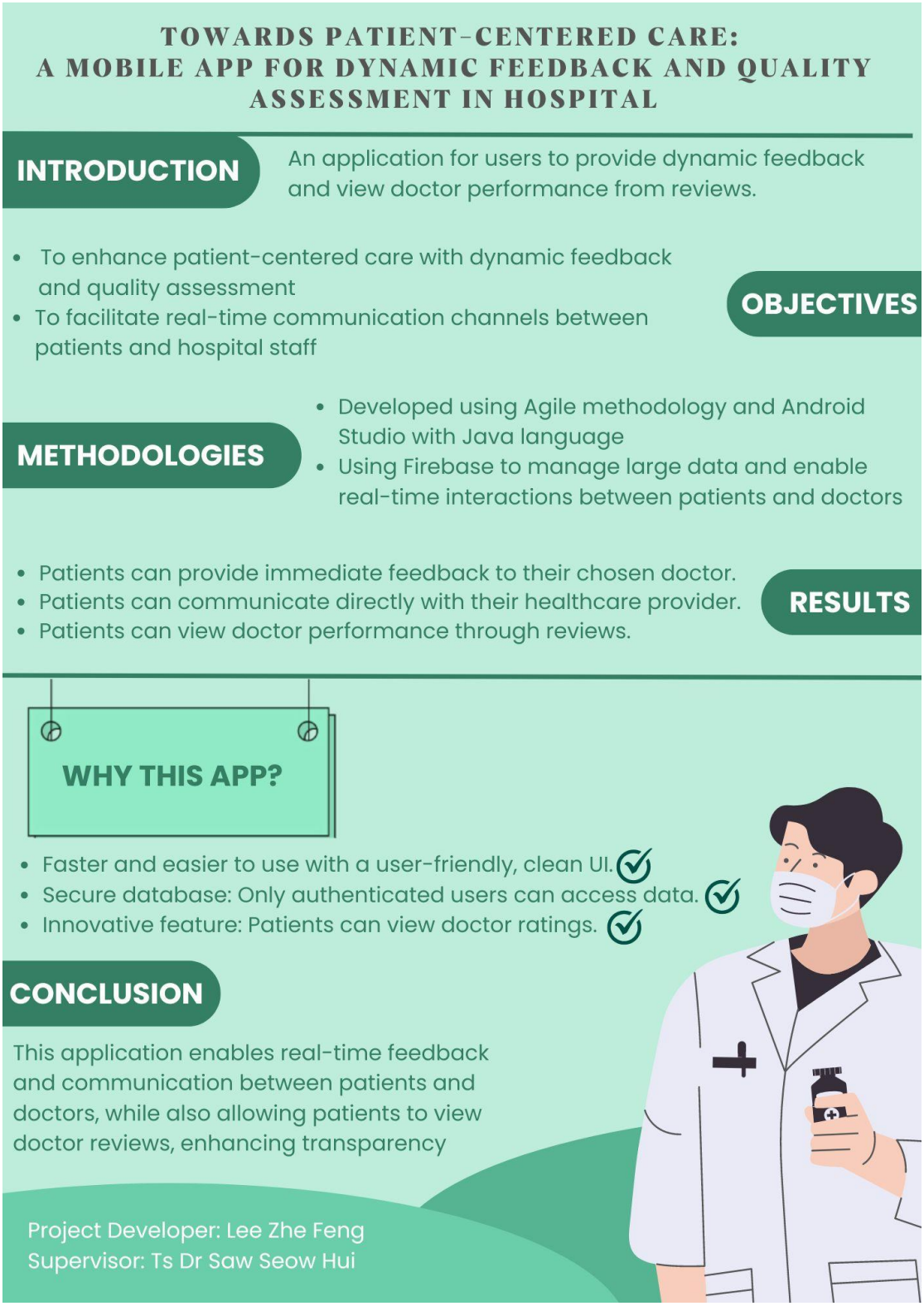
TOWARDS PATIENT-CENTERED CARE:
A MOBILE APP FOR DYNAMIC FEEDBACK AND QUALITY ASSESSMENT IN HOSPITAL
INTRODUCTION
An application for users to provide dynamic feedback and view doctor performance from reviews.
OBJECTIVES
To enhance patient-centered care with dynamic feedback and quality assessment
To facilitate real-time communication channels between patients and hospital staff
METHODOLOGIES
Developed using Agile methodology and Android Studio with Java language
Using Firebase to manage large data and enable real-time interactions between patients and doctors
RESULTS
Patients can provide immediate feedback to their chosen doctor.
Patients can communicate directly with their healthcare provider.
Patients can view doctor performance through reviews.
WHY THIS APP?
Faster and easier to use with a user-friendly, clean UI.
Secure database: Only authenticated users can access data.
Innovative feature: Patients can view doctor ratings.
CONCLUSION
This application enables real-time feedback and communication between patients and doctors, while also allowing patients to view doctor reviews, enhancing transparency
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