Software Engineering Project Report

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Abstract

This paper outlines the app "YourHealth", and describes the development process and design features. YourHealth was created to address the problem of a lack of doctor-patient connection outside of the doctor's office. It seeks to create a space where doctors and patients can communicate, refer to past appointments and health goals, and create appointments. This paper describes a detailed description of the flow of the application activities and features, as well as describing the app's backend and user interfaces.

1. Introduction

1.1 Purpose

The purpose of this paper is to provide a high-level overview of our app. We also delve into implementation details, for future reference regarding the motivations and reasoning behind our design decisions.

1.2 Intended Audience

YourHealth serves two audiences: consumers of Health Care services, who we will refer to as "patients", and encompasses the general population; and Health Care providers, specifically Doctors.

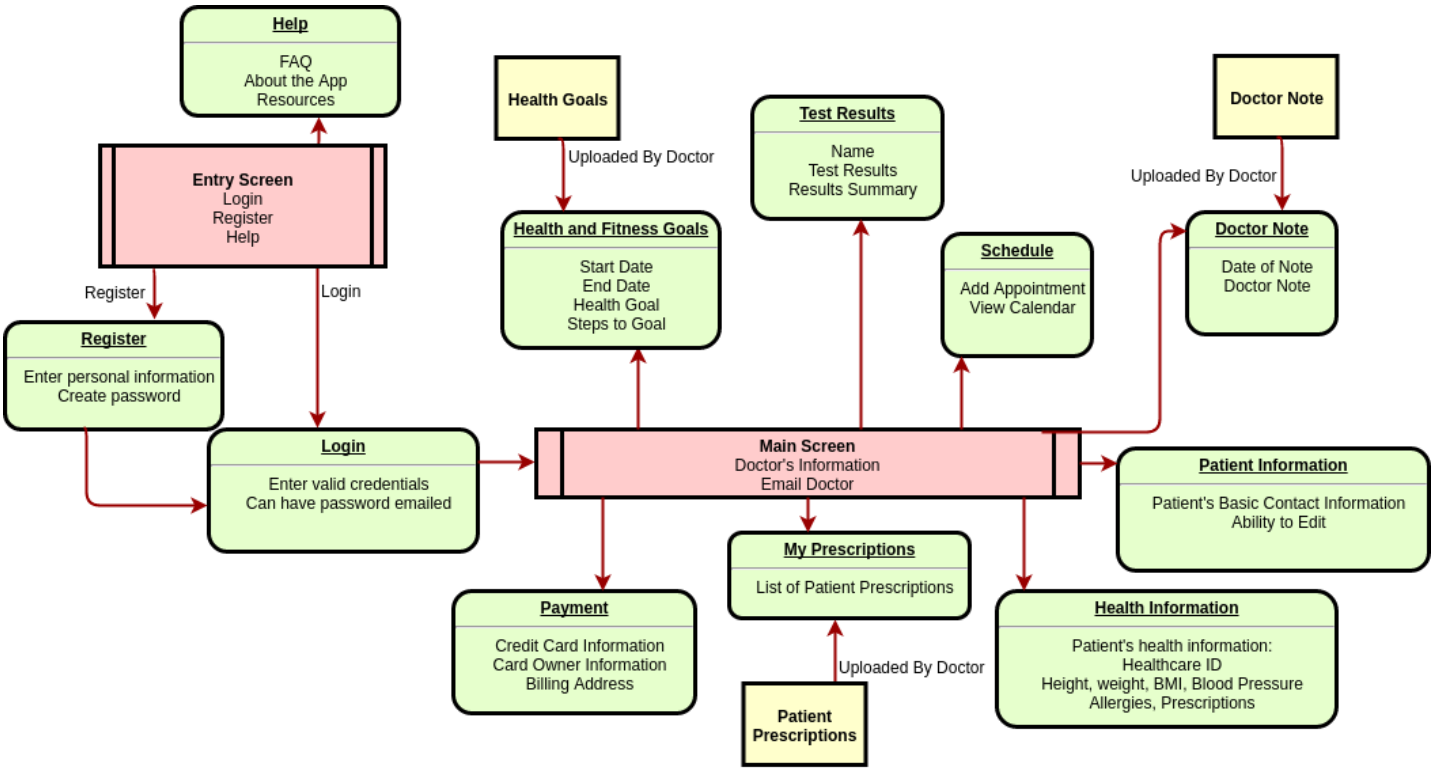
1.3 Product Scope

The YourHealth Android Application is a healthcare management app for doctors and their patients. The application is designed to make communication between doctors and patients easier, quicker, and more efficient. By using YourHealth, the communication will be instant, secure and convenient; health problems of patients will be easy to access by either the patient themself or their doctor. The goal of this product is to help hospitals, clinics or family doctors in organizing their patients, and to provide patients with quick feedback from their doctors. Patients can make appointments, view schedules, take a look at doctor notes and pay for their sessions without having to go to the doctor in person; this saves both time and energy for doctors and patients. This product simplifies process and brings the doctor-patient relationship into the 21th Century.

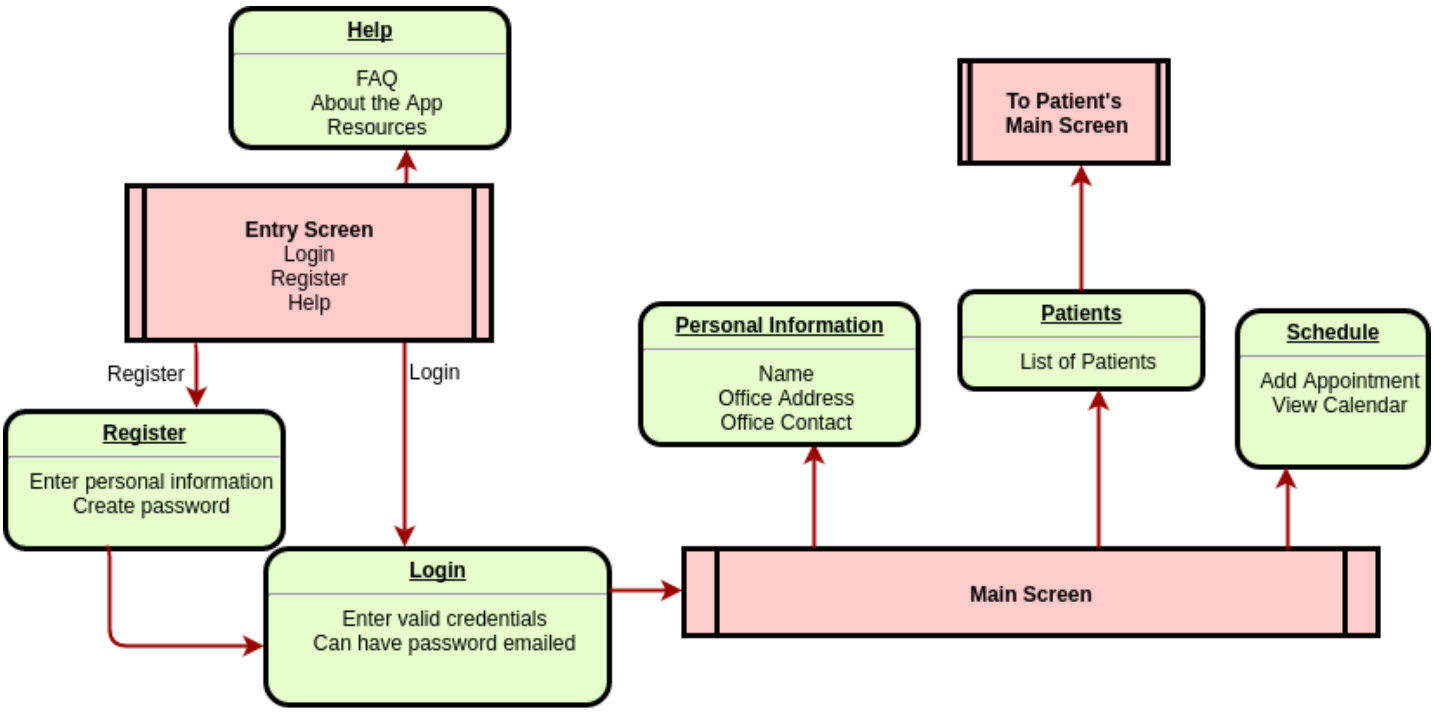
2. Product Description

2.1 Product Perspective

YourHealth is heavily inspired by applications such as DoctorOnDemand, MicrosoftHealthVault and AmWell. YourHeath is meant to be a support tool



YourHealth Activity Flow from Patient Perspective



YourHealth Activity Flow from Doctor Perspective

make transferring data such as prescriptions and test results more convenient.

2.2 Product Features

Scheduling appointments: Patients can request appointments by choosing the time slot and duration; doctors can accept appointments requests and add the appointment to their schedule for further viewing. Both doctors and patients can view their schedules. Patients will also be able to refer to their past appointments, and the app will send a reminder to book an appointment if the patient needs to come for regular checkups.

Mood update: Up on logging into the app, we will ask you to choose from “Great”, “alright”, “bad” to describe your current emotion. In the future, the backend will receive this information and store it for further usage.

Emergency: An emergency button is button that can assist you when you are having an health emergency such as nonstop bleeding, dizzy and so on, by choosing the emergent situation you are having right now from a drop-down list, a simple and easy-to-follow tip will show up and help you keep the situation under control until the 911 gets there; this button can also call 911 on one-click.

Medical Terms: This is a page that can explain to you well about the uncommon medical terms that are commonly used by the doctors to describe your condition or give you prescriptions. By clicking the term you do not know the meaning of from a drop-down list-view, you will see an explanation that uses simple and common words which are easy to understand for non-professional people.

Requisition form: This functionality provides a shared space within the app that is accessible by both doctors and patients. The doctor will be able to upload a requisition form, and the patient will be able to download it after logging in and maintain a copy for themselves. Either doctors or patients will be able to refer to the past records of requisitions in order to make better decisions for the future. Patients will have access to their latest test results after doctors upload into the app. This will allow for faster receiving of results by the patient, saves time and energy for both doctors and patients. This is also very convenient when either one of them wants to refer back to results in the future.

Color-Coding: Downloaded test results that are viewable by the user will be outputted in a table format. The data will be colour coordinated as Green, Yellow and Red to corresponded to good health values, borderline values, and unhealthy values respectfully. For standard tests such as blood tests, normal standard result ranges will also be displayed to give the Patient a better sense of the data.

Health and Fitness Goal: One of the most distinguishing and creative function of our product is Health and Fitness goal function. Upon logging in, patients can access their health and fitness goals that are set up by their doctors. Besides goals, doctors can also add specific steps under

the Steps section for patients to view and follow. In the future version of this product, patients will also be able to enter their current health state such as weight, blood sugar and so on to keep track of the fitness process and once they achieve their goals, their doctors can add new goals. This will provide motivation for the patient to continue to work towards their goals, and will provide doctors with a place to refer to how their patients are doing and where they may need additional support.

Payment form: Patients can pay for their sessions using our product's payment form function instead of going to the hospital or clinics in person.Patients will be asked to enter their payment information and our application will check whether is linked to a valid mastercard or visa card. Doctors will be able to invoice their patients and receive payments. For the current version of the application, secured payment has not been implemented yet, just a form that takes in and checks for valid visa/MasterCard information. The patient's sending of the payment and the doctor's receiving of the payment will be entered into each of their profiles into the firebase database that we are using.

Doctor Note: For doctor note functionality, doctors can create notes for himself for future appointments or he can also choose to put notes for the patient to see. After doctors input doctor notes for their patients, the notes will be sent to the patient's profile where the patient can access once they have logged into their account. All notes will be saved locally.

Prescription: Doctors will be able to upload their patient's prescriptions onto our product. The patients will be able to download and print it at their leisure or keeping as for further viewing. This comes to handy when either doctors or patients want to access past prescription.

Overview chart: This is a place where you can take a look at your health overview. Your weight, blood sugar, blood pressure and more over the past few weeks, months will be easy to access by simply click the button. The data will be presented in chart forms such as pie chart for nutrition intake, curve chart for weight. From here, you can see a trend of your condition and how far away you are from your goal. This functionality will give you great motivations for achieving your health goal.

OnClick-Communication: This will open up the default email app for the android application or you can choose the email applications you want to use that is on your phone. You can create an email sending to a name choosing from a listview of your doctors, by click it, the address of that doctor will show up in the receiver box. The patients can also choose to call the clinic/hospital/doctors as long as the numbers are provided. If the user clicks on the phone number provided, it will open up the phone call interface. This is just an added feature to make communication simpler for the patients, and make the communication between doctors and patients much convenient.

2.3 User Classes and Characteristics

We have 2 groups of users: patients and doctors. The characteristics of patients are that they have access to all the informations except doctor's own schedules, but do not have permission to edit informations. The characteristics of doctors are that they have permission to all the informations that the patients have access to, plus their own schedule; they also have permission to change all the informations.

Patient: A patient can request an appointment to see doctor; request to have tests done such as blood work, scan and so on; request reference or permission to see a specialist; view Health Fitness Goals, and the steps that are provided by doctors to achieving goals; view doctor posted test results; send private messages to doctors.

Doctor: A doctor can request an appointment for patient to see a doctor; request to send patient to have tests done such as blood work, scan and so on; request to send patient to see specialist; view patient medical record and past written notes on patient; view patient previous test results; develop health and fitness goals and write steps needed to be taken to achieve; monitor patient health goals; view list of patients, as well as their profiles; send private messages to patients. In general, doctors can view their list of patients and or search for and open the profile of their specific patient; view profiles of patients such as their contact information, health information and so on; view their appointment calendar.

2.4 Operating Environment

This product will be available on the Google Play App Store. This means it will only be available to users who have smartphones running the Android Operating System. Additionally, the app requires a minimum SDK of 19.

2.5 Implementation Constraints and Future Updates

Currently, this app is only available on Google Play store. In the future, we plan to add support for additional platforms, including iOS and desktop web browsers. For functionalities, even though the patients can view their health and fitness goal and steps that are designed by their doctors, they cannot add their most-updated information such as weight or blood pressure into the process to make this functionality smoother. Our mood update functionality still needs improvements on the interface as well as its functionality; in the future version, we will make it as a pop-up window, and it will pop-up three times a day for a better data collection process and user experience.

For user interface, in the current version, there are no shortcuts for most frequently used functionalities such as "schedule an appointment" or "health and fitness goal", in the future version, these will be added for a better user experience.

3. External Interface Requirements

3.1 User Interfaces

For the patient, the user interface centers around a main screen. Upon a successful login, the patient is taken to their main screen. This screen contains their doctor's information for quick reference, a button to email their doctor. It also has a drop down list that functions as a gateway to the rest of the app's features.

3.3 Software Interfaces

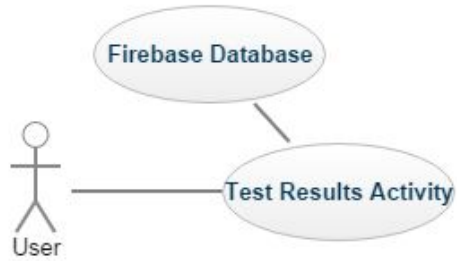
3.3.1 Firebase API

The central database for the YourHealth Application powered by Firebase. All of the connections are handled through The Firebase API. The version used in the app is the 10.2.0 android release version. The app was developed around this database solution offered by Google.

The Firebase database is a NoSQL structure, and therefore not bound by the rigid column and table constraints of the popular SQL database structure. This flexibility to the database was helpful during the development phase to make changes more easily.

Accessing firebase from within the app requires a reference to the database. A connection to the database(using a predefined path) is made by setting an event on change listener. The implemented methods of this listener will be called once by default, to retrieve the data at the path specified. In the case of a patient their test results are read by the path: Patient, HealthID, Unique User ID and lastly, Test Results (see Figure 3.3.1). Once synchronized, any changes made to this location(by the doctor) will be updated on the user's application within seconds.

Fig. 3.3.1



The Firebase API is divided up into several packages. The packages used in this project are: Firebase Authentication, Database and Storage. All of the packages required internet connection in order to connect to the cloud service. The Authentication Package uses provided user credentials to register as well as login users. The Database Package uses a set of "listeners" in order to read and view data at specified paths. The storage package uses a stream processors, this is a "A callback that is used to handle the stream download" for the app[1].

It is important to note that all of these tasks are run Asynchronously, that is, they are run in the background off the main thread. The developer is only required to catch exceptions of paths, object data and security permission that do not exist.

3.3.2 MySQLite

MySQlite was the original design for the database, however, in an effort to make the app as practical and relevant as possible a cloud database solution was chosen.
In sprint 2, our team realized that due to the asynchronous nature of Firebase, implementing responsive and ordered list views through custom adapters would prove to be difficult. The requirement is that the data needs to be available on click and not fetched asynchronously after the list-view is created. For this reason, a second database was used for the list of patients associated with each doctor. Upon Login, a doctor's patient list would be downloaded from the server with the most recent data and written to an sqlite table stored locally on their device.

Fig. 3.3.1
PatientList Table

firstNam e	lastNam e	health #	userID

4. System Features

4.1 User Authentication

The Authentication process is critical to the apps ability to function. This ensures the proper users are given the proper permissions. Additionally, the authentication process is critical for the storage and retrieval of user specific data.

On startup there are two forms of authentication the user can take. The first is Registration, the second is the Login. Registration requires the user to fill out a form with patient specific details and a username and password for the app. Upon submission, the data is verified by a server storing patient data. Upon verification, the user's new account is created.

Fig. 4.1.1:

The Login Activity requires a user to input their username and password. The authentication process here is handled entirely by the Firebase API (See Fig 4.1.2) Once Authentication is confirmed, the user is granted the Patient or Doctor conditions associated with their account type. From this point they will either be forwarded to the Doctor Activity or the Patient Activity.

Fig. 4.1.2:

Eventually at the end of a session a user may wish to sign out. Upon clicking the logout button the activity returns to the Login Activity. Firebase then signs out the current user, as well as clears their instance from disk cache. This ensures that if a new user logs in there is no authentication conflict with previously signed in users.

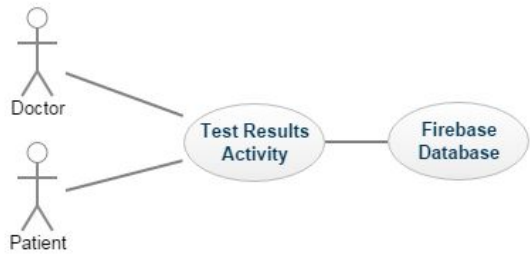
4.2 Test Results

The Test Results in the release build is built to handle one type of test, a standard blood test. In the future, this can be expanded and flexible to handle different standardized test types. This feature is an important to the overall design of the app and is in line with the core motivation of the app mentioned in the introduction.

The Doctor is able to upload new tests, as well as view and edit existing blood tests for any of their patients. The Doctor's input is uploaded to Firebase as an object of type 'TestResults.' This is shown in Fig 4.2.1.

The Patient is only given the privilege to view their own test results. They cannot view test results of other users, nor can they edit. The data is received from Firebase as an object of type TestResults. It is checked for null values and invalid input before being output to the Patient. See below figure 4.2.1.

Fig 4.2.1:



4.3 Calendar and Appointment Feature

Patients are able to create appointments directly with their doctor, instead of needing to book through a receptionist. This allows doctors, especially those working at smaller practices, to eliminate excess overhead with appointment bookings.

Patients select a time, date, and length (15, 30, or 45 minutes) for their appointment. The app then takes them to an autofilled Google Calendar event creation screen based on their selection, and adds their doctor as an attendee. Upon creating the event, Google Calendar will email the doctor asking them to confirm the appointment, at which point it will be added to both calendars.

The patient will also be able to view their Google Calendar from within the app, taking them directly to the current day's events to check for upcoming appointments with their doctor.

4.4 Health and Fitness Goals

The Doctor can set a health goal for the patient. This includes a start date, end date, and steps towards the goal. This feature is meant to make it so the patients can have a reminder to what steps are needed to be taken before their next appointment. This functionality is an important functionality as it is one of the main focuses of YourHealth.

The doctor is the only user that can add and update goals. They can start editing the start date, end date, goal, and steps to goal as soon as they enter the activity. If there was a previously made goal set for the patient in question, than the information is pulled from the database and displayed. After pressing the submit button, the information is saved to the database.

The patient is able to only view the goal set by the doctor. They cannot review the goals of other users. When they enter the activity the start date, end date, goals , and steps to goals are pulled from the database and displayed.

4.5 Information update

Both doctors and patients can update their information in the app. This aspect of the app is not necessary for the app to operate because all the necessary information is taken from the user upon registration. However, it is a functionality that gives the app more options for improvement.

The doctor can update/add address, Postal code, city, province, country, and office phone Number. After the user opens the my information activity they can press the edit information button to be able to change the information listed above. After they are finished adding/changing their information they can press the submit changes button to save the information to the database.

The patient can add/update address, postal code, city, province, country, home phone number, cell phone number, and emergency phone number. Once the user enters the patient information section, the information already known is displayed. After the user presses edit information button, they can update the information listed above. Than they can press the submit button to save the information to the database.

4.6 List of Patients

The Doctor gets a list of their patients. The list is searchable and each patient on the list leads to the patient profile. This functionality is very important, as the doctor needs a way to get access to the patients. There is a search bar on this page to make finding a specific patient more convenient for the doctor.

When this page is opened the first name, last name, and ID of every patient is taken from the database and displayed in a list. The doctor can scroll through their list of patients and select a patient. Each patient is a button that leads to there profile where the doctor can interact with the patient in various ways, such as health and fitness goals. There is a search bar at the top of the page that searches through the doctor’s patients currently registered to the app. The search bar takes user input as a string. An SQL query is then executed using the “Like” function with the columns associated with patient's’ Last Name and Healthcare ID. The results are then returned as an Arrayadapter List of object type ‘PatientList.’ The adapter is notified of the changes and the ListView is refreshed with patients whose details are similar to the search query made by the doctor.

4.7 Patient Profile

The patient profile is only visible by the doctors. This functionality is important, as it is needed so that the doctor can make the necessary changes to the patient's account. All changes made in the functionalities connected to this section are visible by the

patient in question. Some of these functionalities are: test results, health and fitness goals, doctor notes, health information, and prescriptions.

After the doctor opens this page the full name, healthcare number, address, home phone number, cell phone number, and emergency phone number are pulled from the database if the information was set by the user in the update information section. The user can than choose a page from the spinner, the pages are listed in the previous paragraph. After which they are moved to the page selected. When going into any of these pages, the health ID of the patient is passed on.

4.8 Doctor Notes

The doctor notes section is meant to make it so patients can easily get doctor notes from their doctors making it more convenient for them. This is meant so employers, teachers, and professors can see the condition of the teacher so that they can take days off, if needed.

When the doctor opens the Doctor notes page, the last note written is displayed. He can than press the edit note button and proceed to change the date of note and note content itself. After one is done doing so they can press the submit button. Than the information is sent to the database and saved.

The patient can not edit these notes. Only the doctor has permission to do so. Once they enter the page they will see the note written by the doctor.

4.9 Health Information

The Health information section consists of basic information that is added and updated by the doctor and viewable by the patient. This is an important feature as it helps keep track of how the patient is doing and how much has changed between appointments.

The doctor can add information by pressing the “edit information” button. Once they have completed filling out their patient’s health information, pressing the “submit changes” button saves the changes in the database. The patient will then be able to view this information from their profile. After the first addition of information every time the doctor enters this page they see the most recent version of their patient’s health information. This information is pulled from the database. The information that is saved on this page consists of height, weight, body mass index (automatically computed from weight and height), blood pressure, allergies, and current prescriptions.

The patient can see the most recent update of their health information made by their doctor. However, they cannot update the information themselves. The data displayed is retrieved from firebase as entered by their doctor.

4.10 Prescriptions

Doctors are able to upload a prescription to their patient’s individual profiles. This allows the doctor to keep a record of previous prescriptions that have been prescribed to each patient.

The patient will then be able to view their prescriptions for future reference. Currently, when patients fill prescriptions, they typically will give it to a pharmacist, never to see it again. With this feature of our app, patients will have a record that they will have to refer back to over time.

4.11 Payment

Patients can pay for their sessions using our product's payment form function instead of going to the hospital or clinics in person. Patients will be asked to enter their payment information and our application will check whether is linked to a valid Mastercard or Visa. Doctors will be able to invoice their patients and receive payments. When the patient receives an invoice, they will be able to approve a payment through the credit card that they have saved in their profile.

For the current version of the application, secure payment has not yet been implemented. Currently, the payment feature consists of a form that takes in and checks for valid Visa/MasterCard information. The information that the patient entered is stored in the database for reference.

4.12 Email Your Doctor

Patients are able to send an email directly to their doctor through this app, further deepening the level of communication between patient and doctor. The patient will be able to create an email within the app. Clicking on the "Send" button will open a dialog where the patient can select an email client to use to send the email. The patients can also choose to call the clinic/hospital/doctors as long as the numbers are provided. If the user clicks on the phone number provided, it will open up the phone call interface.

These features make communication simpler for patients, and provide them with a direct communication channel with their doctor.

5. Non Functional Requirements

5.1 Maintainability:
Our code has been developed using techniques that enforce reusability and maintainability.

5.2 Performance

Quick response time with robust database system guarantees a reliable throughput for our product.

5.2 Security Requirements

Firebase enforces secure passwords for user accounts.

5.4 Software Quality Attributes

Software functional quality: Our product fits the purpose of our design: provide convenient communications between doctors and patients and make health a priority in this fast pace world. Our application can compete with the existing products from the Google play Store, because we add innovative ideas and plenty of considerations on both doctors and patients.

Software structural quality: Our product YourHealth is robust and easy to maintain as a result of using firebase database; the data will be stored safely and accurately.

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