A web based tele consult diagnosis system

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Group: B

An Information Systems Project Proposal Submitted to the Faculty of Information Technology in partial fulfillment of the requirements for the award of a Degree in Business Information Technology

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Declaration

I Jhanvi Chohan declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the research proposal contains no material previously published or written by another person except where due reference is made in this research proposal itself.

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Sign: …… Date: 27/01/2021

Supervisor's Name: Mr. Wallace Muchiri

Abstract

The Internet connects us to millions of people on a daily basis. Not only does it let us connect, but also interact in various methods including, calls, texts and video calls. Similarly, when it comes to the medical field. Patients and doctors can be connected even though they are 10,000 miles away. Patients prefer getting advice from a medical expert from their own comfort rather than waiting in long queues at the hospital. Not only is it time consuming, but it also prevents patients from getting infected from other viruses and infections at such locations. Medical practitioners must check their booking availability before you book any appointments and the consultation fee is very high. Online consultation is rather cheaper and consumes less time. Therefore, to solve this problem a web app will be implemented which would allow users to key in their symptoms and a diagnosis at their own comfort, if they have an internet connection. This tele-medical symptom diagnosis system will be user friendly, allowing for faster delivery methods between patients and their diagnosis as per their symptoms indicated onto the system. This will allow for convenience, cost-effective, privacy and zero chances of getting infected by other infections or viruses. Incremental prototyping methodology will be used in the development of the system and object-oriented analysis and design will be used to design this system. Tools to be used in the project development would include, java programming language, Laravel, MySQL database. Patients visiting the hospital or those who prefers to check their symptoms online. This in return will benefit the community at large as it will also reduce traffic, save time and will be convenient.

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List of Abbreviations

ERD Entity Relationship Diagram

IDE Integrated Development Environment

OOAD Object Oriented

SSAD Structured Software Analysis and Design

MSSQL Microsoft Structured Query Language

MySQL My Structured Query Language

UML Unified Modelling Language

Chapter 1: Introduction

1.1 Background

Technology has connected many individuals across the globe. The internet has brought the world closer than before. If one has access to the internet either via Wi-Fi or mobile data, one can video and audio call on Whatsapp and text for free Telegram. Our world is rapidly evolving, and many people are accepting these changes and adjusting to them (Miller, 2020).

In the field of healing and health includes modern medicine. This includes doctors, nurses, and other specialized practitioners. They can diagnose, treat, and prevent types of diseases and other health aspects (Biggers, 2020). Clinician health workers are those that directly work with patients in a hospital or any other healthcare setting. Physicians are those who assess individuals, diagnosing them, also treating them, and preventing the disease. Health professionals use medicine to cure and prevent these diseases. They use a wide range of instruments to treat patients affected by any diseases or any other condition (Biggers, 2020).

Similarly, modern technology allows us to reach our doctors without the need to visit the clinic, hence more efficient in certain situations. It helps us connect to people around us, making the world a global village. We can benefit the most through easy healthy consultations worldwide (Asadi, 2020). We spend a lot of time when it comes to booking appointments, whether it is a monthly or weekly checkup. When there is an emergency case, for example injury we cannot afford to wait in a queue at the hospital or clinic. Through a tele consult approach, you will always get a quick response to common symptoms and its diagnosis (Murrell, 2020).

1.2 Problem Statement

High quality healthcare is a necessity to all. Although not everyone is able to access this service firstly due to the increasing population, high expeditions for health and the disparities between countries. In the current system where visiting the hospital or any other clinic, the process is quite tedious. This includes, checking availability of the doctor or medical practitioner, booking an appointment, looking for parking, finding the doctor's room, waiting for triage, later waiting for other patients in line, and lastly paying a very high fee. This process consumes a lot of time and sometimes may not go as planned (Asadi, 2020).

Visiting clinics or hospitals is prone to occurrences such as forgetting medical reports or files at home, not carrying previous medicines or prescriptions. If one is sick and visits the hospital, there is a chance that they may be infected by other patients which will worsen the situation. Some patients would be more comfortable knowing more about the doctor and their qualifications before consulting them. Patients should also be confident and trust the doctor while they fulfil their duty (Asadi, 2020).

1.3 Aim

The aim of this proposal is to develop a web application that makes it easy to remotely get prescriptions as per the symptoms you are experiencing. This system will consist of various skilled doctors. Patients can select their preferred doctor as per their specialisation and qualification. And later input their symptoms. Based on the doctors feedback, patients will receive a diagnosis which will include a prescription. And if the doctor suggests that it is necessary for them to see the patient, they will ask the patient to book an appointment and then have a one on one virtual consultation. This can be done from their preferred location, it could be from home or anywhere else. The system will also enable users to locate to the closest hospital and provide its contact details for more critical scenarios.

1.4 Specific Objectives

The specific objectives for the proposed system will be:

I. To analyse the existing hospital patient diagnosis procedures.

II. To identify and critique the online diagnosis software or applications.

III. To design and develop a web app to facilitate online diagnosis.

IV. To test the system.

1.5 Justification

The creation of a web application is the best solution to the identified problem as firstly unlike the most common methods of visiting the hospital. Whenever one wants to visit the doctor, they will have to travel to get there. With an online consultation platform, patients will not need to wait for the bus or need their car to get there. They will simply go online and begin with their online consultation. Patients will now be able to access the system anytime and anywhere. Online consultation is also an affordable solution to one's medical needs. It is a cost effective option. With the aid of an online doctor, patients will be confident knowing that they are using a secure system and server. Their information will always be secure and safe. Everything discussed with your doctor online is kept confidential. We go to the hospital/clinic to visit the doctor to get better. You are traveling to the location where there are other sick people too. While waiting for hours for your appointment, you could catch and also spread all kinds of diseases. When it comes to online consultation, there is no risk or catching or spreading anything. You will be consulting your doctor from your own comfort. Online doctor services also offer automatic record-keeping services which means you can access your reports anytime you want. These records are kept up to date after every appointment. You can also share them with other medical professionals when necessary, making it much more easier and convenient. Lastly, through the use of online consultation users are able to get prompt medical attention. Doctors online are able to provide immediate response.

1.6 Scope/Limitation

This project focuses on how a patient will be diagnosed based on the symptoms they input. Therefore web apps have a limited mobile device feature accessibility. They limit the ability to access a mobile devices native features such as camera and location services (Asadi, 2020). Web apps also have variations in web browsers and can occasionally cause challenges in running the web app without issues. Similarly, web apps are dependent on the internet for use, which means they are not available when a user does not have WiFi or data. Lastly, these systems will not be found on app stores or google play store (Mclachlan, 2020).

Chapter 2: Literature Review

2.1 Introduction

We are living in the age of telehealth. With all these technological advancements now, almost everyone is using smartphones and of doctors currently using tablets, the mobile revolution has helped make adopting telehealth software a much less costly and technologically complex endeavor than in the past. Many modern telehealth software solutions simply require a computer or smartphone and an internet connection to do a virtual doctor visit with a patient (Director, 2020). These days, it is not necessary to go to the doctor for your treatment. You can find qualified doctors available online, with whom you can apply online appointments. The busy schedule of people has caused many bad effects on health. Doctors have a very busy life schedule and it is not certain to find the proper doctor at the time of your need. In this case, an online appointment may be the best option for you. This service is useful for those who urgently need to consult a doctor. This is a very good service because websites are easily available.

2.2 Description of current hospital checkup process

When visiting the hospital for a basic check-up, first and foremost for those driving, you will have to look for parking space. After you have gotten your parking, when headed towards the reception you will need to remove a token and wait for your number to be called through the speaker. If your number is called, then you can proceed to the reception counter and fill the forms and give your necessary details. Then later you must wait to be called once again for triage where you are asked what brings you to the hospital, medical reason, then later examined for blood pressure, height, weight. Once again you are asked to wait outside until the doctor is ready to see you. When the doctor is ready to see you, they will be able to assess you and prescribe medication for you. If the doctor suggests that they you to perform a few tests for example blood test, stool test, urine test or any other test you will need to do so. Depending on the test and how long it takes for the reports to come out you will either need to wait or come back again. Once the reports have been released, you will have to go back and see the doctor with your report from the test and then they will be able to guide you and prescribe the right diagnosis for your symptoms or condition. Later, you must wait in line at the pharmacy to get

your medicine, you hand in your prescription and once again you are asked to wait until your name is called. Once you receive your medicine, you then take it as prescribed and if the medicine is not effective or if you are asked to come back for a follow up, you must visit the hospital once again which means a whole new cycle repeated again if necessary with the tests if not it would just be a doctor patient consultation in regards to your health.

2.3 Current online consultation systems

These are the current online consultation systems available:

2.3.1 - Symptomate

Symptomate (Symptomate, 2020) is an online anonymous and safe health check-up. Your answers are later carefully analysed, and you get to learn about possible causes of your symptoms. Before it requires details about the patient such as age, gender, weight, height, and later asks you to input your symptoms.

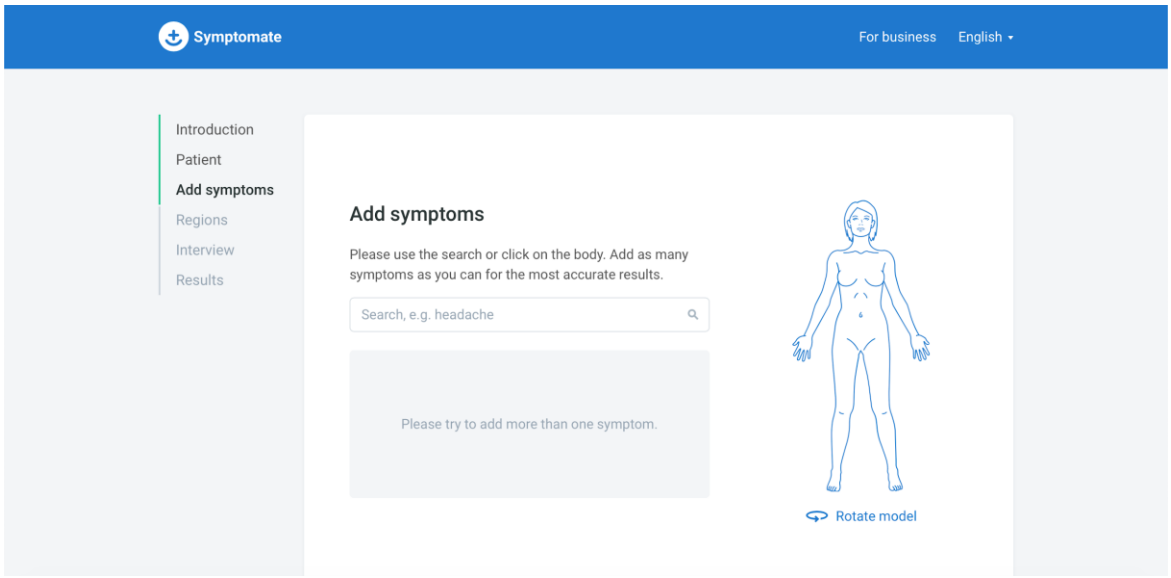


Figure 2.3.1. 1 Symptomate symptom architecture

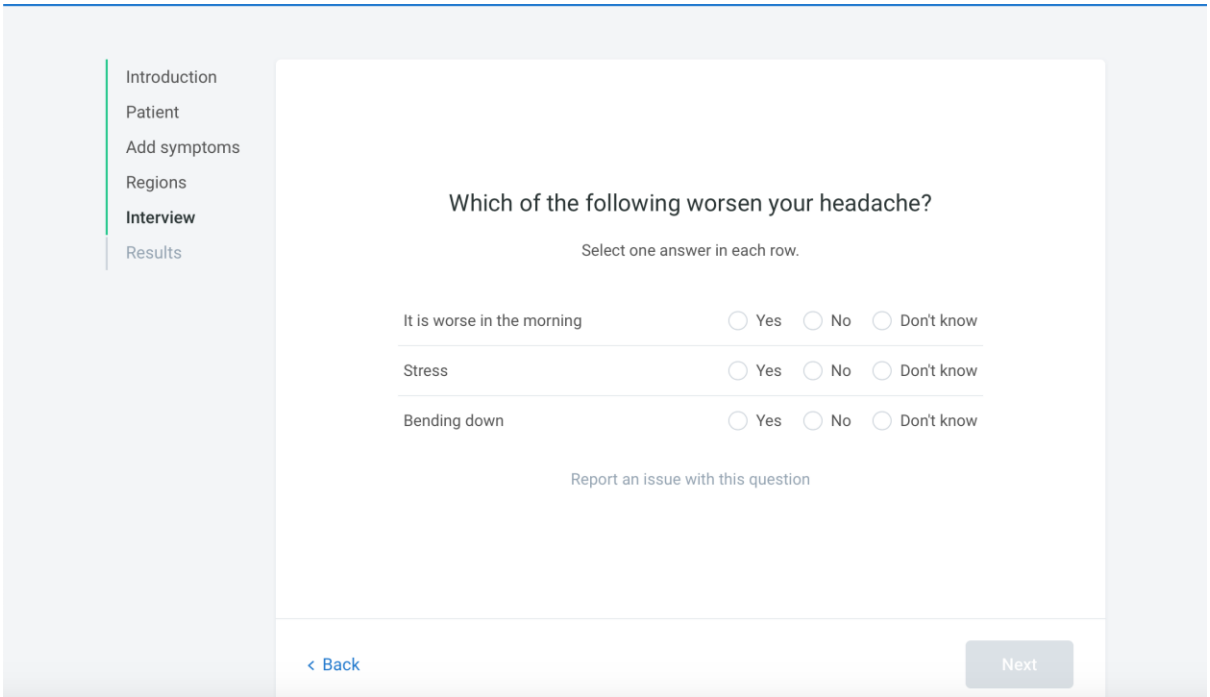


Figure 2.3.1. 2 Symptomate Interview architecture

2.3.2 - Symptom Checker

Symptom checker (Healthcare, 2020) is another online symptom assessor. Once again this firstly asks questions regarding the patient, countries they have visited or their country of residence, including inputting the symptoms too.

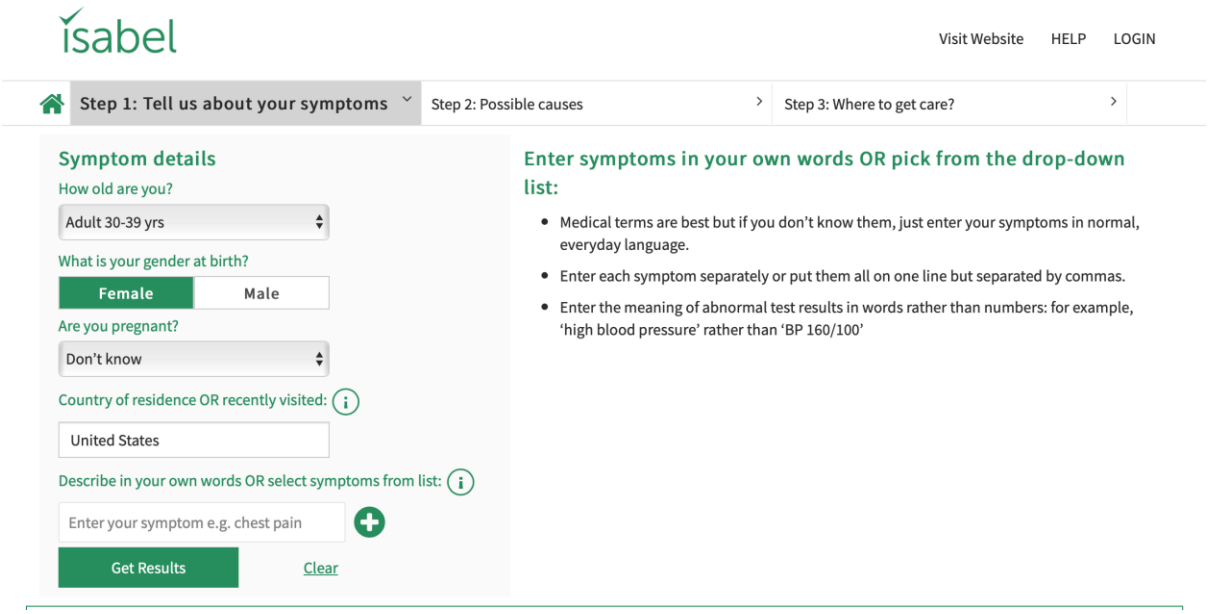


Figure 2.3.1. 3 Symptom Checker Symptom Architecture

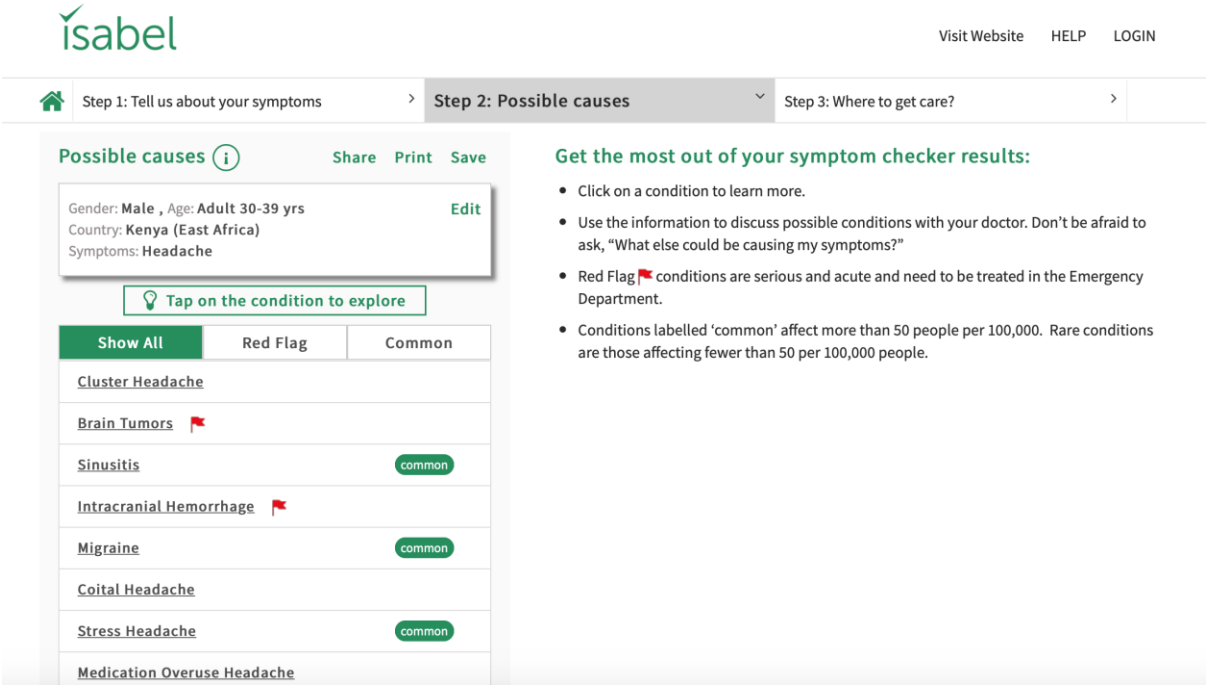


Figure 2.3.1. 4 Symptom Checker Possible Causes Architecture

2.4 Advantages of online diagnosis

When it comes to quick and fast medical attention, it means there are no long waiting queues. When consulting an online doctor, you do not have to wait, you just have to decide on a specific time and a health practitioner will readily attend to you. This consultation may be achieved

either via a phone call or a video chat conference in real-time. Secondly there are no boundaries, which includes no location boundaries, you can consult your regular doctor even if you are out of town or in another state. This aspect can be very important for those who continuously travel for business or work purposes or require daily or periodic evaluations by a physician or nurse (Director, 2020). Next, you do not have to answer the same questions repeatedly, as your medical history is stored online and can be used for future reference. Patient data management becomes very easy. The best part is that you can access your test reports, doctor checkup cost anytime you want. When it comes to online health consultation, doctors are available 24/7 (Mclachlan, 2020). You do not have to wait hours or days for the consultation, you can contact them the moment you start feeling unwell. This is a great option for those who are diagnosed with chronic diseases. You are also able to get your prescription, without having to go visit a doctor face to face to get your prescription. You can be prescribed this medication via an online consultation. At times most people are not familiar with talking to their doctor online, therefore it is very important to make sure you are talking to a medical expert. With a virtual doctor, you know you are confident using a secure server and that your information will be safe and secure (Kumar, 2020).

Whether you are facing symptoms are 2am or 4am? You usually must wait until the next day to get an appointment but with online consultation you can reach your doctor 24/7. With online consultation there are zero chances of catching anything. If you have a low immunity you can speak to your doctor from the safety of your home.

2.5 Disadvantages of online consultation

Although, for doctors to make an accurate diagnosis, they need to examine the patient physically therefore the doctor cannot do the physical examination in the online consultation, and so it can result in an inaccurate diagnosis. At times, patients are not able to tell the problems clearly to the Doctor. There can be a problem of miscommunication where the patient might not be able to give the accurate details of the symptoms as he or she is not aware of them. This can make it difficult for the doctor to make a proper diagnosis (Alam, 2020). With online consultation, it gets difficult to evaluate the quality of doctors. Of course, websites offer expert doctors for online consultation, but the quality of the doctors cannot be judged well. As websites provide limited options to evaluate the quality of care and associations of providers.

Also, you cannot know the past record of the doctors, and so it becomes a challenge to find the best doctor for consultation.

2.6 Gaps in the hospital checkup system

With the current hospital system, you always need to get a prescription if you require regular prescriptions, and to get one, once again you need an appointment with the doctor and the other long queues just to see the doctor and get a prescription. The current hospital checkup system does not give immediate response. There are also location boundaries, as you must be in the hospital for you to be checked. It is important to make sure you're talking to someone with the medical expertise to advise you on your health condition. Hospitals charge a separate fee for consultation and a separate charge for the medication. After all, you are traveling to a location where lots of people are sick. If you are sitting and waiting for hours for your appointment, you could catch all kinds of diseases. It's riskier visiting the hospital which leads to higher chances of catching other viruses and infections especially if the hospital is not hygienic or clean. Extra follow ups are required, which means going back to the hospital for extra checkups, medications and longer queuing lines, and a higher bill payment.

2.7 Tele-medical Consultation

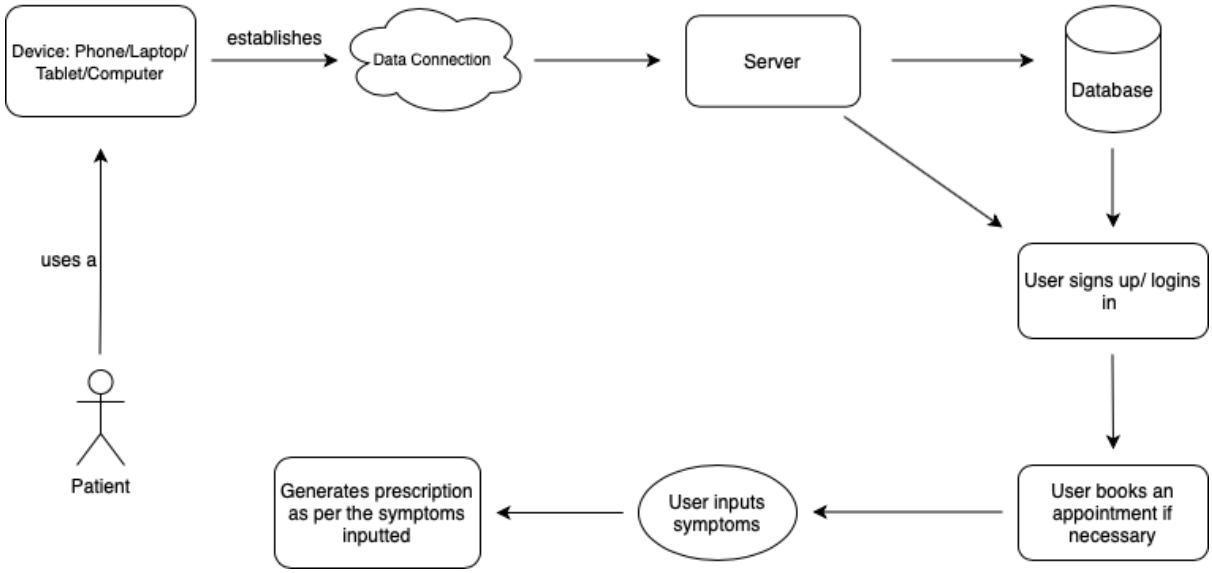
Possible development systems would be an online symptom diagnosis system which will allow for time and cost saving. When visiting a doctor's clinic, first you have to stand in a long queue to book your appointment, and once you have a prescription, then once again you have to wait to pick up medication. When consulting a doctor online, you do not have to wait in a long queue to book the appointment and wait for your turn and hence, it saves your time. Secondly, when it comes to online medical consultation is that you do not have to worry about time and location (Kumar, 2020). If there is an emergency and you need to see a doctor at midnight, or any other odd timings, you are secured. You can consult a doctor online anytime you want because doctors are available 24/7 for online consultation. Also, it does not matter whether you are at home, office or vacation, you can seek medical attention from anywhere, and that too, in no time. You are also able to choose from a wide range of doctors based on their specialty. You

can also download reports which helps you track your progress and also monitor. You can also pay via the system.

2.8 Conclusion

Virtual doctors are board certified doctors who choose to practice online via video and phone appointments, rather than in person appointments. They are just as qualified as regular doctors you see in person and many virtual doctors conduct both in person and virtual consultations. Virtual doctors differ from platform to platform. While some people may hesitate to use a virtual doctor app, there is little concern when it comes to virtual doctor visits. Most virtual doctor apps will require you to register an account before your appointment to help provide doctors with necessary information and maintain contact with physicians and supporting staff (Mclachlan, 2020). Telehealth can expand patient base as its more convenient for patients to access specialist or practitioners which are not always available for consultation at a hospital. Waiting at a hospital is time consuming, requires more money, longer queuing lines and has high chances of getting other infections. Although todays live video communications technology wasn't advanced enough to allow for comprehensive medical care. Most patients and doctors have easy access to technology that allows high-quality videoconferencing. But for some telemedicine doctors, a virtual appointment may not seem enough to diagnose or treat a patient. Not only does telemedicine facilitate many remote health services, including chronic patient monitoring, therapy appointments, and post-operative care. All these services run on software and hardware which can sometimes be costly – requiring training to use, the hire of additional IT staff, and the purchase of servers or other ancillary equipment in addition to the software. The advantages of using online consultation tools outweighs the disadvantages, therefore tele-medical online consultations save time and money allowing for equal participations for patients and always for faster decision making (Alam, 2020).

2.9 Conceptual Framework



2.9. 1 Telemedical Consultation

Based on the diagram above, a telemedical consultation approach indicated above, this shows the procedure in which a user is able to access the online diagnosis system by firstly making sure they are connected to the internet, then keying in their symptoms and waiting for a diagnosis to be generated.

Chapter 3: Research Methodology

3.1 Introduction

The aim of this chapter is to describe the software development methodology that will be deployed to achieve the set objectives in chapter one and also the aim of the research as identified in chapter one. The justifications for the choice of the software methodology will be provided. Based on the targeted population, user needs have been identified. Additionally, the development tools which will be used to develop the tele consult diagnosis system will also be mentioned in this chapter along with the justification of the chosen choice.

3.2 Software Development Methodology

This research proposes to use the rapid application development methodology during the development of the tele consult diagnosis system web application. It is a model is based on prototyping and iterative development with no specific planning involved. This software development methodology focuses on gathering customer requirements through workshops or focus groups, early testing of the prototypes by the customer using iterative concept, reuse of the existing prototypes (components), continuous integration and rapid delivery.

The reason for the choice of this type of software methodology is that uses minimal planning in favour of rapid prototyping. A prototype is a working model that is functionally equivalent to a component of the product. In the RAD model, the functional modules are developed in parallel as prototypes and are integrated to make the complete product for faster product delivery. Since there is no detailed preplanning, it makes it easier to incorporate the changes within the development process (SDLC - RAD Model - Tutorialspoint, 2020). RAD projects follow iterative and incremental model and have small teams comprising of developers, domain experts, customer representatives and other IT resources working progressively on their component or prototype (SDLC - RAD Model - Tutorialspoint, 2020).

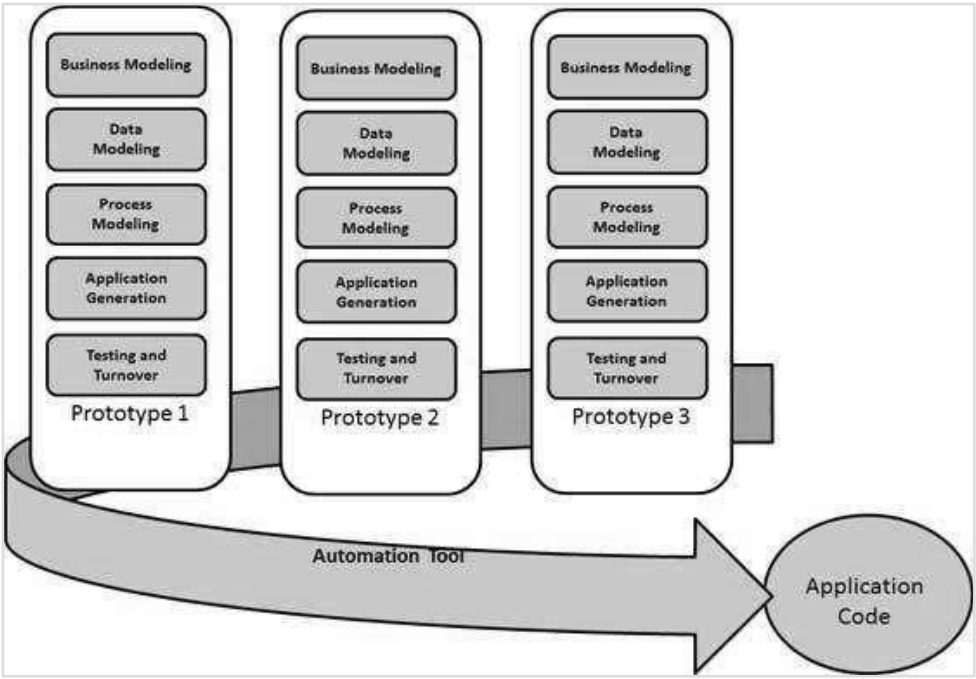


Figure 3.2. 1 RAD model

The phases in the RAD software development methodology as shown in the figure 3.2.1 above, are described below. They include:

3.2.1 Business modelling

This phase entails about the flow of information to various business channels and its importance in RAD rapid application development where initial planning and analysis is usually accomplished. During this phase, it is possible to get a complete picture of business process functionality. During this stage, designers, developers, and users join forces to agree upon business needs, project scope, and application or system requirements.

3.2.2 Data modelling

During this phase information gathered during the business model phase is now reviewed and analyzed to set clear data objects. This helps determine the RAD system development on architecture based feedback from the user therefore allowing for the creation of prototypes. This step is repeated several times as the project evolves.

3.2.3 Process modelling

This phase involves actual coding, testing and integration. Any changes to the data objects are defined and establish information flow. Similar to the data modelling phase, the modelling phase is repeated many times until necessary.

3.2.4 Application generation

This phase constitutes system development and coding completion. During this phase developers use automated tools for the software and later converting processes and data models to prototypes.

3.2.5 Testing and Turnover

During the testing phase, each of the prototype is tested independently during iteration. This reduces the overall testing time. This also reduces the risk for any major issues since almost all programming components are tested in advance.

3.3 Research Design

The research design to be selected will help in the collection of information which is necessary and useful for the creation of the system. When selecting the research design, we use qualitative or quantitative study design.

The purpose of this design is to seek better and credible results. Qualitative research design helps get specific and well-structured end results. Quantitative research has been proven to be the best in terms of viability and reliability. The use of quantitative research design one can identify the means of the information gathered and make sure that the research design will be more accurate. Qualitative research on the other hand suggests the importance of the researcher to understand and explain the situations and experiences of the targeted group in this case the patients who visit the hospital.

Quantitative research will also help between the methods and design in terms of data collection. Not forgetting to mention, when addressing the issue, quantitative design will be used. This research design will consist of the selected group from which data will be collected and gathered.

3.3.1 System Architecture

The system architecture of the proposed tele consult diagnosis system entails of three major components; the frontend which is the user interface, the backend and the database.

The user interface consists of a registration and login form, patients details, users to input their symptoms, diagnosis/prescription and payment. The backend will consist of the MySQL database management system to authenticate users and grant them access to the system. It will also requests to the doctor if a patient is waiting on their diagnosis.

3.3.3 System Design

From the object-oriented analysis, the class diagram technique will be employed to come up with illustrations of the systems view and the application of the different concepts. It helps understand the systems duties and consists of classes, constraints, and user interfaces.

A sequence diagram represents the various classes and objects involved in the developing of the system and the procedure of transfer of information between the objects and their functions. It also shows the interaction process within the system.

An Entity Relationship Diagram (ERD) and database schema are drawn to represent the design and structure of the database along with the management and maintenance.

3.3.4 System Implementation

The tools what will be used in the development procedure will include a DBMS, programming language and an IDE. The DBMS will be used to manage the database is MySQL relationship database management system. This is because the tele consult diagnosis system will be web based and use a Laravel, PHP framework, mySQL for the backend development and classic Laravel blade template engine, along with bootstrap and jQuery for the front end development.

3.3.5 System Testing

A functional testing will be performed to make sure that the web applications functionalities meet the specifications. Examples include usability testing, system and unit testing. Usability testing refers to evaluating a product or service by testing it with representative users. For example the ease of user navigation within the system. System testing is used for evaluating whether the system meets the specifications. Lastly unit testing involves the testing of the modules to verify whether they are functioning as expected.

3.4 Target population

The study will focus on global users who prefer online consultation than actually visiting hospitals or clinic. These users are those who are suffering from minor to mild

complications and need a prompt diagnosis/prescription before buying the right medication. This saves their time, cost and is efficient.

Chapter 4: System Analysis, Design and Architecture

4.1 Introduction

The aim of this chapter is to provide a list of the identified system requirements and outline the various approaches that are used in the process of gathering requirements. These include the functional and non-functional requirements. Additionally, the system architecture entails the web-based application accessed by the admin, the doctor and the patient.

4.2 Requirement gathering

The method used to gather system requirements is quantitative in nature. These include questionnaires presented to a sample of the targeted population and the results were analysed to understand the user requirements in relation to the tele consult diagnosis system.

However, quantitative method of gathering system requirements was also used within the target population. Interviews were conducted to analyse the efficiency of the current method of visiting the hospital or clinic when going to see the doctor. Moreover, the system requirement were also gathered by analysing the existing hospital system.

The requirements include ; registration, log in, doctors dashboard where patients can select their preferred doctor option, input of symptoms, prescription/diagnosis from the doctor and even payment methods.

4.3 System Requirements

The system requirements, are requirements that are related to the functional aspect of the tele consult diagnosis system, and compromise of function and non-functional requirements as shown below in section 4.3.1 and 4.3.2.

4.3.1 Functional Requirements

The systems functional requirements are those related to the functional aspect of the tele consult diagnosis system, as listed below in table 4.3.1.1

FR1	The system should allow patients to login upon registration
FR2	The system should allow patients to select their preferred doctor
FR3	The system should allow patient to key in their personal details
FR4	The system should allow patients to key in their symptoms
FR5	The system should allow patients to edit and view their profile
FR6	The system should allow patients to view their visits
FR7	The system should allow patients to book an appointment if necessary
FR8	The system should allow patients to upload reports
FR9	The system should allow patients to download prescription upon payment
FR10	The system should allow the admin to login upon registration
FR11	The system should allow the admin to create a new doctor
FR12	The system should allow the admin to delete an existing doctor
FR13	The system should allow admin to manage bookings as per the different doctors
FR14	The system should allow admin to view doctors and patient profiles
FR15	The system should allow doctors to login upon registration
FR16	The system should allow doctors to manage their profile
FR17	The system should allow doctors to view patient profile
FR18	The system should allow doctors to manage bookings
FR19	The system should allow doctors to view reports of patients
FR20	The system should allow doctors to view patient visits
FR21	The system should allow doctors to diagnose and provide a prescription

Table 4.3.1. 1 Functional Requirements

4.3.2 Non-Functional Requirements

The systems non-functional requirements are those requirements that do not relate to the functional aspect of the tele consult diagnosis system and are the expected specifications of the system. They describe the environment under which the developed tele consult diagnosis system will work. They are listed in table 4.3.2.1 below.

NFR1	The system should allow users to navigate the user interface with ease
NFR2	The system should only grant access to registered users through the authentication middleware
NFR3	The system should provide access to registered users at any time they attempt to access the system
NFR4	The system should only grant privileges to modify data within the system to authorized users.
NFR5	The system should only be accessible from anywhere.

Table 4.3.1. 2 Non-Functional Requirements

4.4 System Architecture

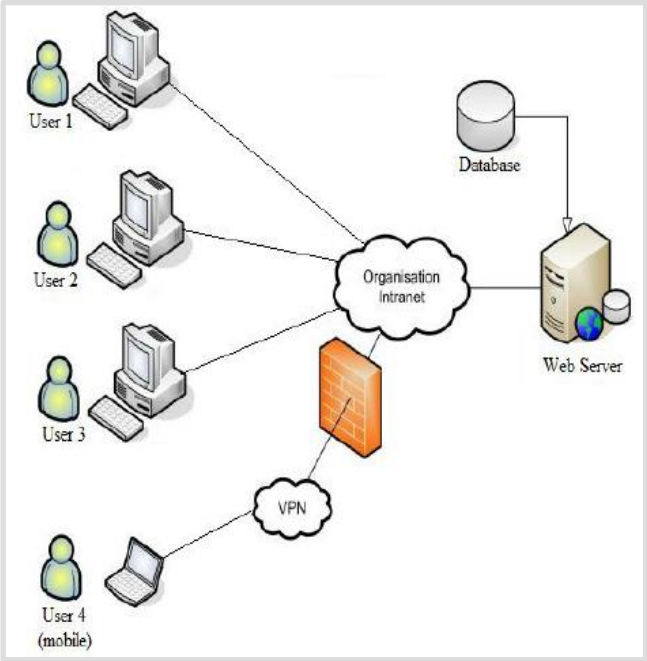


Figure 4.4. 1 System Architecture

The system architecture is a diagram illustrating the interaction between the system components as shown in figure 4.4.1 below

The system architecture comprises of two main components; the web-based applications, and the database. One of the web-based applications shall be accessed by
Users, who is the admin, doctor and patient. Once a patient registers and logs in, they will be able to input their details and also input their symptoms. Based on what they input based on the symptoms and the doctor on the other hand is then able to provide a diagnosis which would be a prescription. The admin can add a new doctor into the system and also delete a doctor if necessary. All this data will stored onto the database.

4.5 System Design

System diagrams are diagrams that illustrate the visual model of a system's components and their interactions. Below are the system diagrams that are to illustrate the visual model of the tele consult diagnosis components and their interactions. These include a use-case diagram, a sequence diagram, a class diagram, an entity relationship diagram and a database schema, as previously mentioned in section 3.3.3.

4.5.1 Use Case Diagram

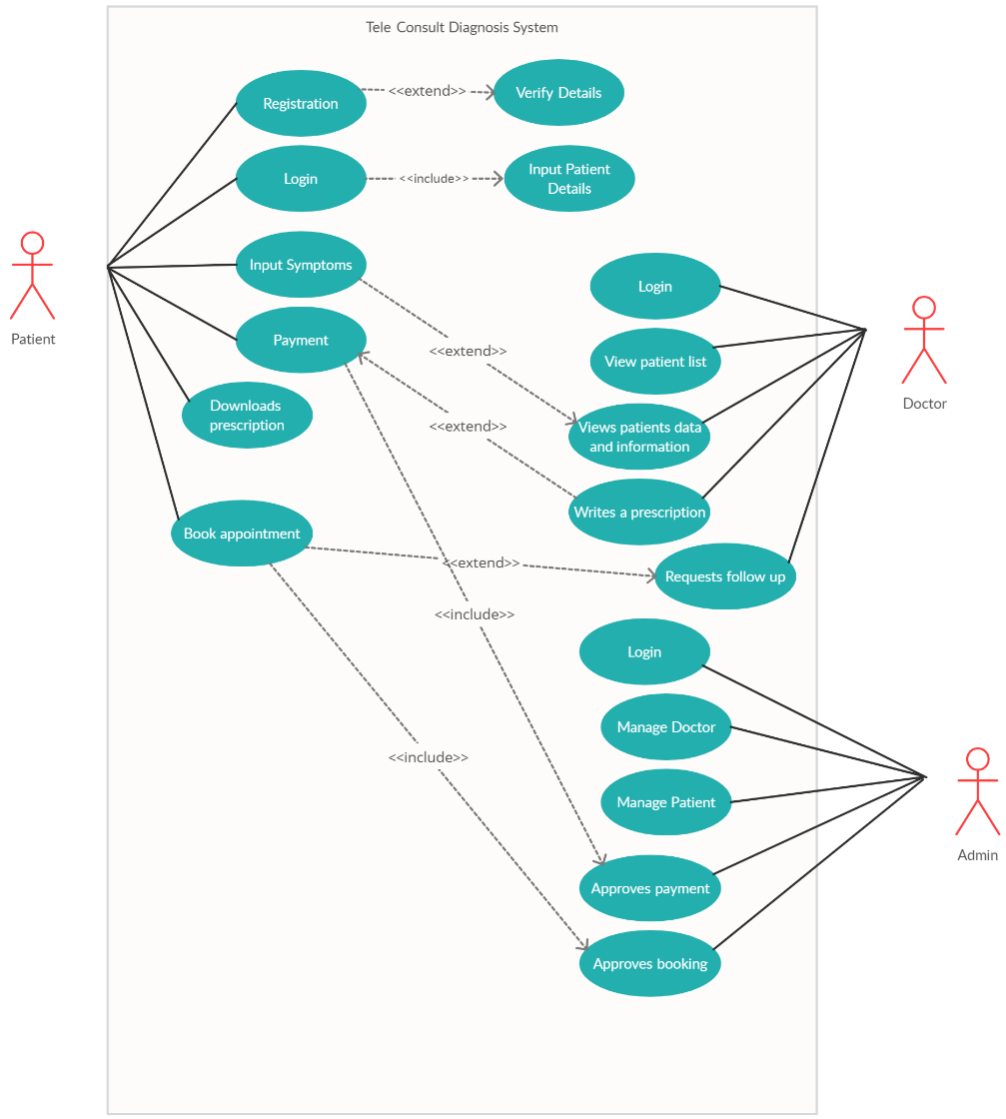


Figure 4.4. 2 The Use Case Diagram

4.5.2 Sequence diagram

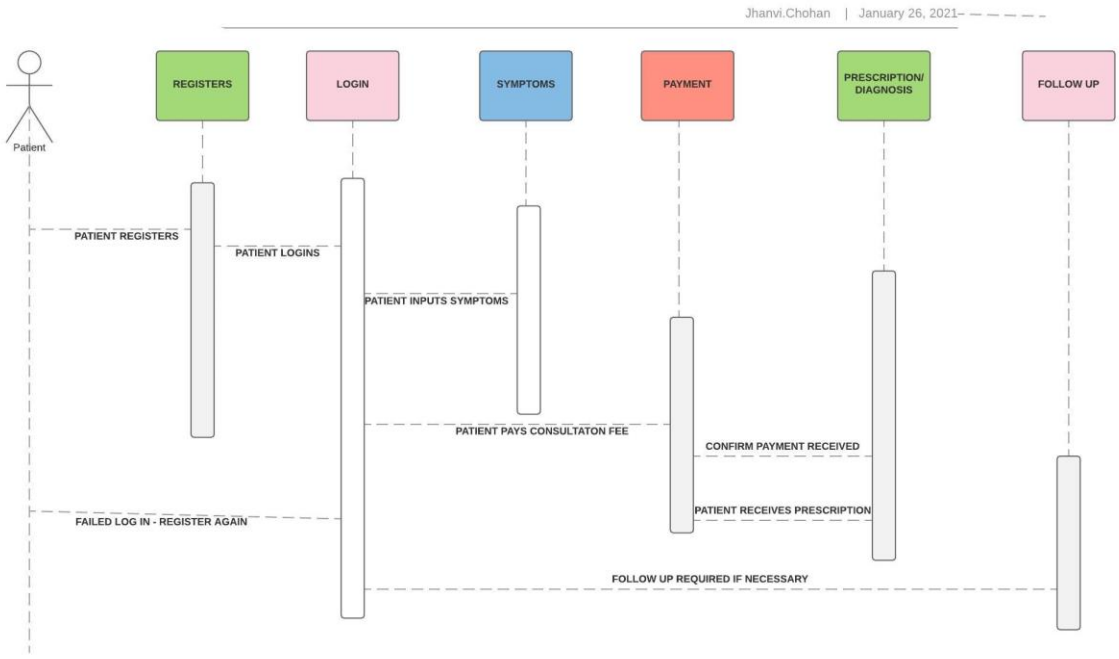


Figure 4.4. 3 The Sequence Diagram

4.5.3 Class Diagram

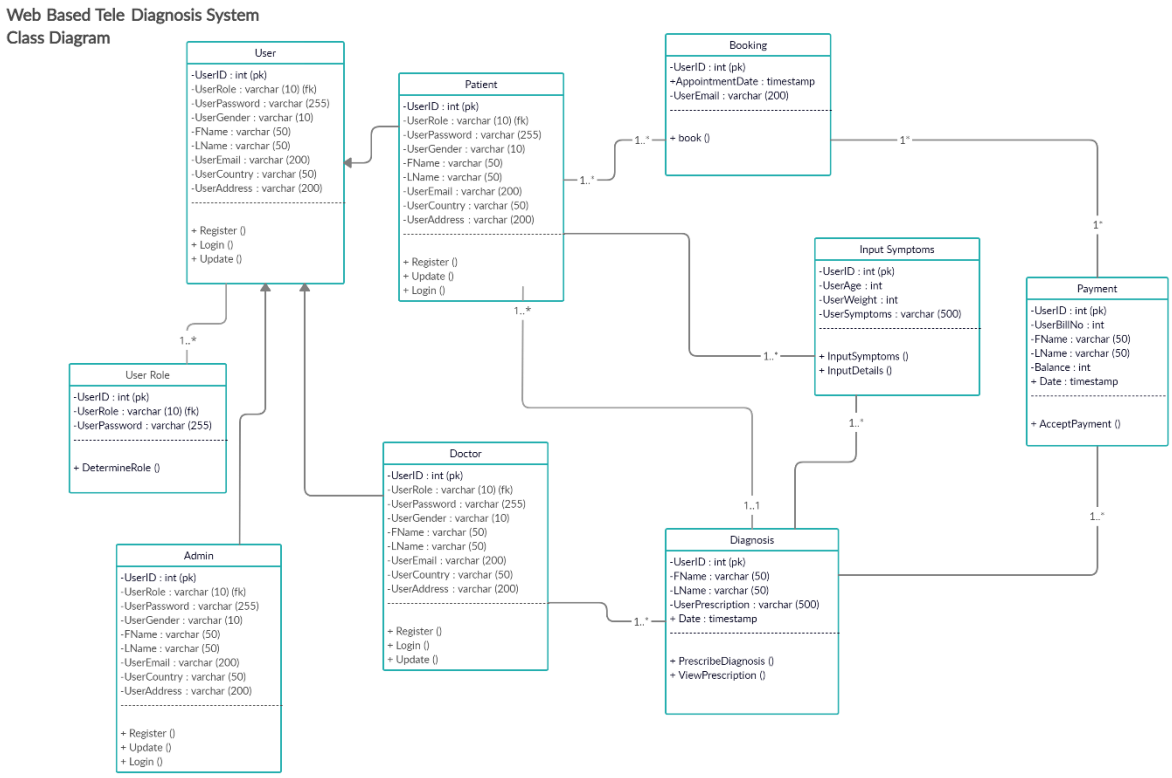


Figure 4.4. 4 The Class Diagram

4.5.4 Entity Relationship Diagram

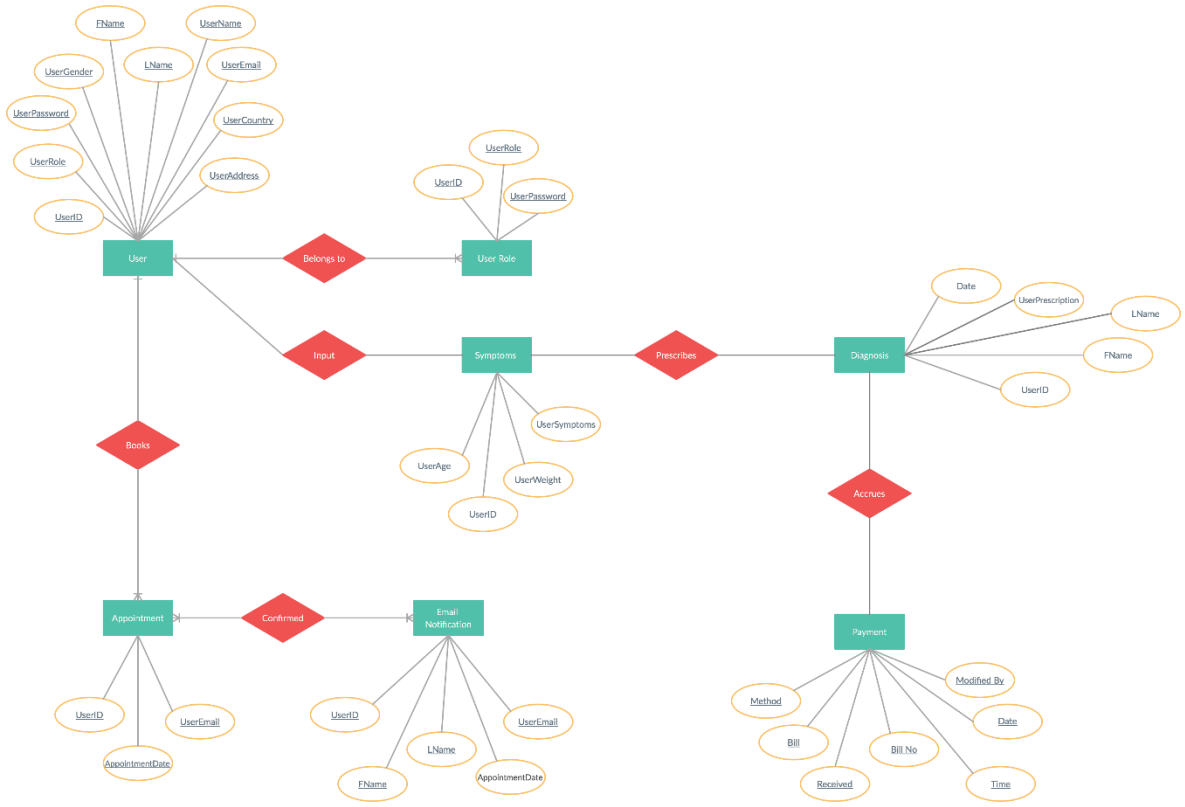


Figure 4.4. 5 The Entity Relationship Diagram

4.5.5 Database Schema

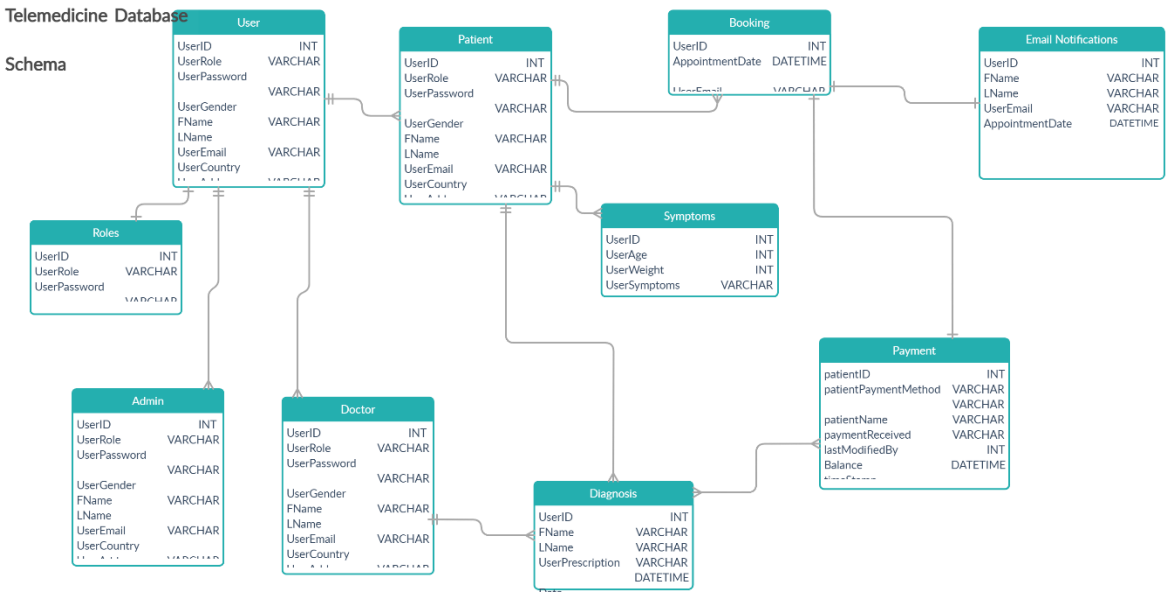


Figure 4.4. 6 The Database Schema Appearance

Chapter 5: System Implementation and Testing

5.1 Introduction

This chapters purposes to focus on describing how the system was developed, the system algorithm used to build the tele consult diagnosis system, the back end logic of the system and the front end, which is the user interface of the diagnosis system. Additionally, it provides a description of how the system was tested to ensure that it fulfilled specified system requirements with the aim of achieving the general objective as mentioned in section 4.

5.2 System implementation

The system was built in regard to the system analysis and design methodology as mentioned above.

5.2.1 System logic construction

The system was built upon an MVC (Model, View and Controller) architecture framework. The model refers to all the data-related logic that the systems user has to work with. The view refers to all the logic of the user-interfaces. Lastly the controller refers to the interfaces between the model and the view which involves the process of incoming requests, data manipulation, and employing the model component and rendering the final result through interaction with the view.

5.2.2 System's modules – Login/Register

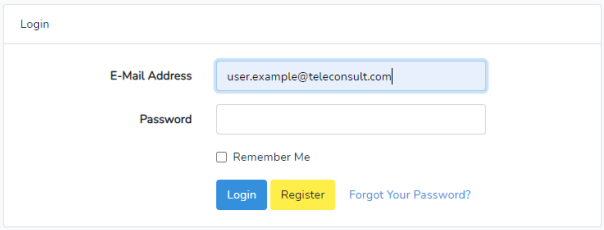


Figure 5. 1 The Login Form

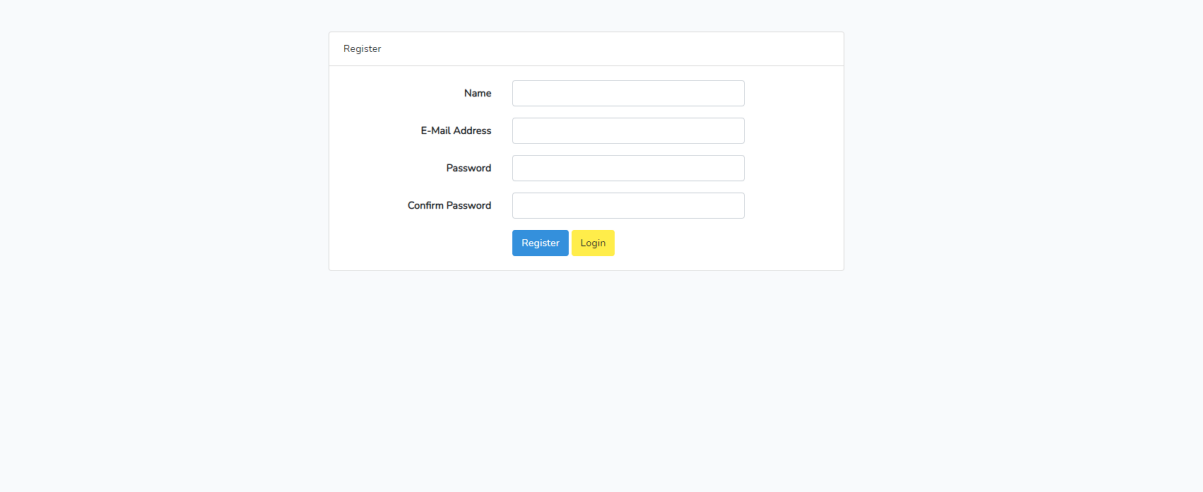


Figure 5. 2 The Registration Form

The Login and registration modules of the application use the PHP Sessions for basic authorization. On registration the user is automatically set as patient as doctors are created by the administrator alone.

5.2.3. System's modules – Edit profile

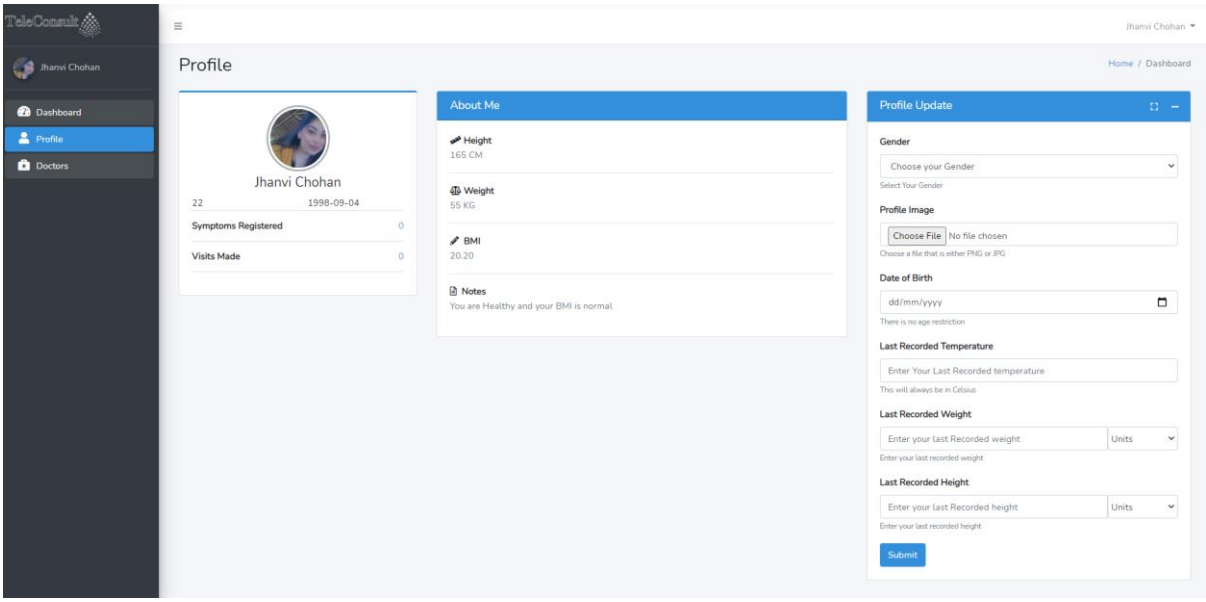


Figure 5. 3 The Profile Settings Page

The form on the right uses jQuery event handlers and is submitted into an XHR handler called Axios which on returning a successful HTTP Response will reload the page to refetch the data to show that the details have been updated

5.2.4. System's modules – Input Symptoms

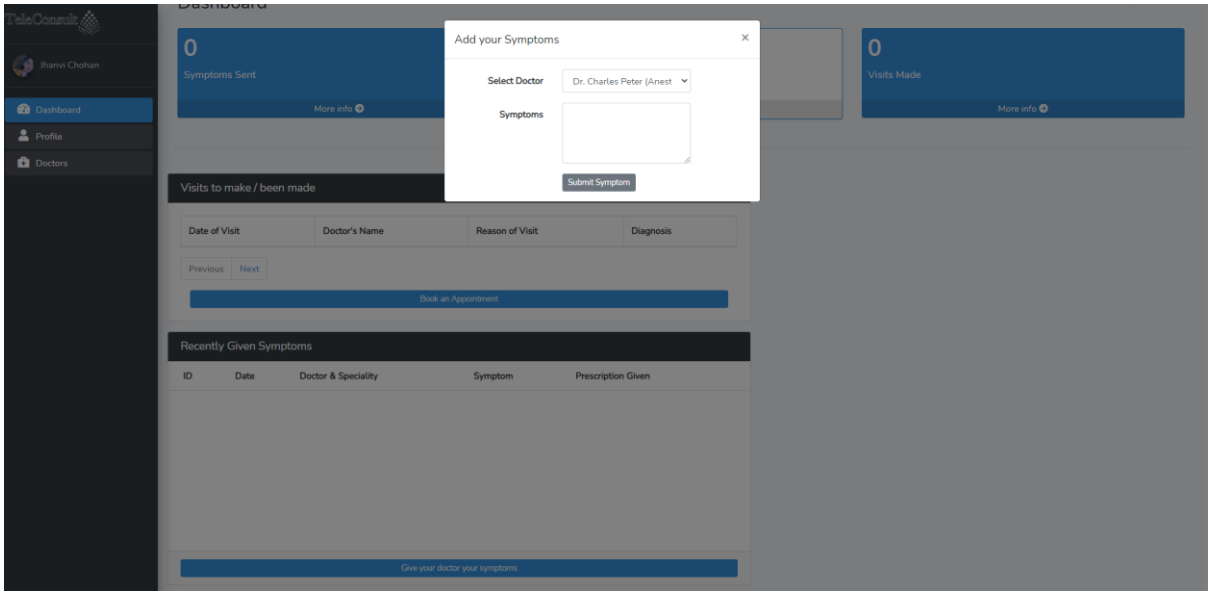


Figure 5. 4 The Symptoms Modal Form

5.2.5. System's modules – Book Appointment

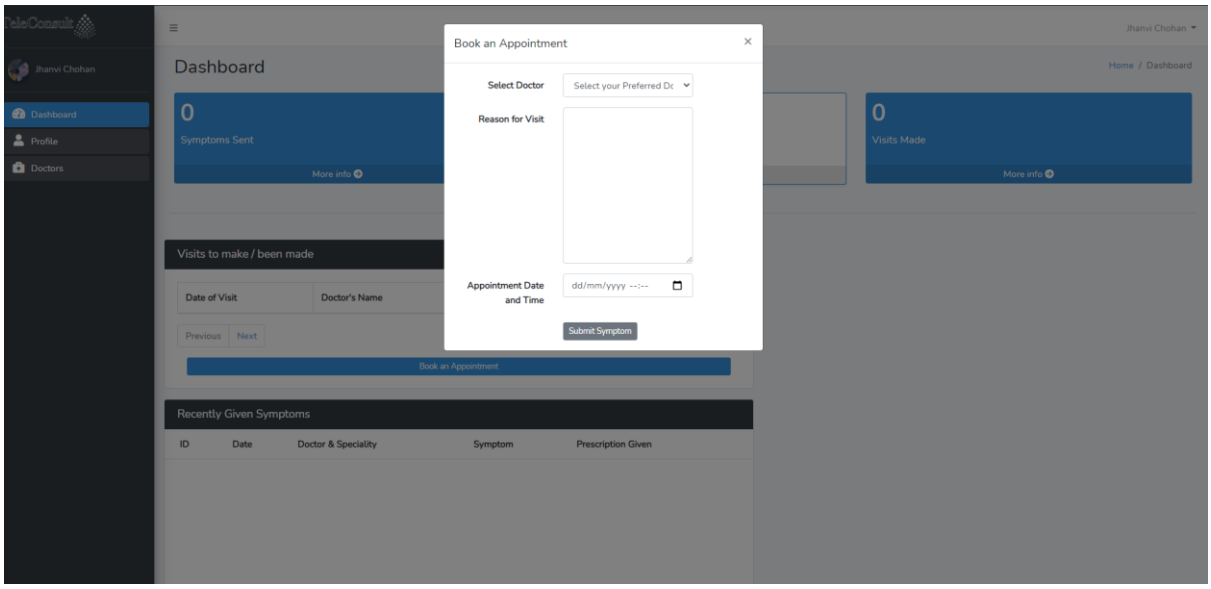


Figure 5. 5 The Appointment Booking Form

5.3 System testing

As earlier mentioned above, the functionality testing, usability and unit testing have been employed to ensure that the system meets the specified requirements. The system has been tested using Laravel's and CodeIgniter's preferred unit testing package **PHPUnit.** When running these tests the environment was set up for testing and observation of all the responses in JSON format of the API's were seen to produce the right results and appropriate coding measures were taken to ensure that the data is displayed well.

5.3.1 Functionality testing

The tele consult diagnosis system satisfied all of the specified requirements. The satisfied requirements include: admin, doctor and patient being able to log in, view records, edit profile, delete doctor, and add a new doctor. Other requirements satisfied include inputting symptoms, responding and providing a diagnosis and the patient being able to download the diagnosis.

5.3.2 Usability testing

The tele consult satisfied the requirements of enabling easy navigation of the users as they interact with the system. This was done through having a common navigation bar from which access to all other web pages were granted.

Furthermore, the system has a notification mechanism that allows for interactivity between the patient and the doctor. When a patient inputs their symptoms the doctor is notified and they have to provide a prescription or diagnosis.

5.2.3 Unit testing

The components of the tele consult diagnosis system functioned as per the specified requirements when working independently of each other. As mentioned in the start of the chapter, all processes of the system were tested using PHPUnit which is inbuilt in the Laravel Framework. The processes were run in parallel as they were deemed to be small enough for this to work.

Chapter 6: Discussion, Conclusion and Recommendation

6.1 Introduction

The aim of this chapter is to summarize the discussion on the objectives mentioned in chapter 1 above, and to provide conclusions related to the discussion on each objective. Furthermore, it seeks to explore into the technical aspects that will ensure the proper working of the system; the recommendations. Lastly, this chapter focuses on what can be done to improve what the project aims to achieve in addressing the problem as mentioned in chapter 1 above.

6.2 Discussion

As described in chapter 2 above, the current hospital systems include the patient traveling to the hospital or clinic, booking appointments, triage, visiting the doctor, purchasing medicine in a pharmacy, and the making a follow up with the doctor if necessary. Other diagnosis techniques include websites such as Symptomate and Symptom Checker, which one has to register before accessing and using its functionalities. A problem that arises from these software include accuracy, as you do not want to be prescribed or diagnosed with wrong medication or treatment. The systems were based on computer generated answers.

In addition to that, an analysis of these techniques showed that there still are a number of challenges that still arose such as uncertainty of the diagnosis as it was based on machine learning and recommender systems. Another challenge is the duration taken to get to the hospital, and the other procedures that follow. Furthermore, in the case of a online symptom detector, the challenge is the uncertainty of the diagnosis as it may not be 100% accurate as it is computer generated.

During the development of the tele consult diagnosis system for the purpose of attempting to solve the problem mentioned in section 1.2, the factors to which needed to be incorporated include, users to edit the profile. The admin to register a new doctor and also delete an existing doctor if necessary. The system should generate reports based on the interactions they have had with the doctor and system. The system should be accessible anytime and anywhere. Users can have a preference or selecting a specific doctor based on their specialty and qualifications. The doctor should be able to provide a diagnosis based on the symptoms which have been input by the patient.

6.3 Conclusions

In the course of a user signing up as a patient, the user should input their accurate information and details for example, their name, age, gender, contact details, address and any allergies if they have any.

Furthermore, in the process of providing a diagnosis, it was found that ensuring the right symptoms have been input was very essential. This is because if a wrong symptom would be indicated, a wrong prescription would have been provided which could affect the patient.

6.4 Recommendations

For the tele consult diagnosis system to work, the devices used by the user of the system while accessing the system are required to be connected to the internet. The tele consult diagnosis system best works with a web browser as it is a web app and requires an environment with stable internet connection for it to be able to work well. Smart-phone technology and laptops/computers can be used for the best optimum use when inputting details onto the system.

6.5 Future Work

Despite this research aiming to solve problems arising while when visiting the hospital, such as high chances of getting infected with other viruses and diseases and other factors such as time, distance and availability. Therefore, the future work to enhance the research can entail the research and development of the tele consult diagnosis system that enables for GPS location-based services where if there is an emergency, based on the location it can direct you to the nearest hospital or clinic. Secondly, the implementation for various payments methods e.g., MPESA, Visa, Mastercard and PayPal. This would help users pay the doctor based on the services used. And lastly a video call functionality where you can talk to the available doctor in real time.

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Appendix A: Time Schedule

Task/Dates	15th - 21st April	22nd - 28th April	29th Apr - 5th May	13th - 19th May	20th - 26th May	3rd June	10th - 16th June	17th June	18th - 23rd June	24th - 30th June	1st Jul
Problem Identification											
Supervisor selection											
Concept note											
Chapter 1											
Chapter 2											
Chapter 3											

Proposal submission											
Return of marked proposals											
System Analysis & Design											
Behavioural diagram											
Structural diagram											
Entity Relationship Model											
Database Schema											
Progress Presentation											
Coding, Presentation and Documentation											
Final Presentation											

Appendix B: Interesting Code

Using jQuery with other libraries such as Axios and the toast features from Sweetalert2 libraries to carry out XHRs in the system where need be.

```
    // Appointment Form
$('#appointmentForm').submit(e=>{
    e.preventDefault();
    let doctor = $("select#doctor_id2").val()
    let reason = $("#reason_text").val()
    let date = $("#date1").val()
    const form = new FormData
    if (doctor === null || reason === null || date === null) {
        return Toast.fire({

            title:'Warning!',
            icon:'warning',
            text: 'Fill in all your Fields'
        })
    }
    form.append('doctor', doctor)
    form.append('reason', reason)
    form.append('appointment_dateTime', date)
    Axios.post('/api/visits', form)
    .then((res) => {
        if(res.status === 200){
            Toast.fire({
                title:'success',
                text:res.data,      You, 5 days ago • 80%
                icon:'success'
            })

            $('#appointmentFormModal').modal('hide')
            document.getElementById('appointmentForm').reset()
            location.reload(true)
        }else{
            Toast.fire({
                title:'Hmmmmm....',
                text:res.data,
                icon:'warning'
            })
        }
    }).catch((err) => {
        for(const [key,value] of Object.entries(err.response.data.errors)){
            Toast.fire({
                title:'Error',
                text:value[0],
                icon:'error'
            })
        }

    });
});
```

Figure B 1 The XHR Code used to make appointments by the patient

The code above represents the jQuery portion of code that handles the submission of the form for booking appointments done by the user and sent to the doctors.

i. Model Calculations and algorithms

```
public function getMetricHeight(){
    if($this->attributes['unit_height'] == 'FT'){
        $height = ($this->attributes['last_height'])*30.48;
    }else{
        $height = ($this->attributes['last_height']);
    }

    return $height;
}
```

Figure B 2 Model Function to get the patients height in centimeters,

This function above Is used to return the metric height of the patient given that the patient keys in their units in feet instead of centimeters. This is done in order to curb the barrier between those who use imperial height and metric height.

```
public function getMass()
{
    if($this->attributes['unit_weight'] == 'LBS'){
        $weight = ($this->attributes['last_weight'])/2.2046226218488000903;
    }else{
        $weight = ($this->attributes['last_weight']);
    }

    return $weight;
}

public function getBMI(){
    if ($this->getMass() != null && $this->getMetricHeight() != null) {
        $mass =  $this->getMass();
        $height = $this->getMetricHeight();
        return $mass/(($height*$height)/10000);
    } else {
        return null;
    }

}
```

Figure B 3 Model Function to get the patient's weight in kilograms

The first function is the function to return the figure representing the mass in kilograms. This is done incase the user has put in units in pounds so that we sort out both cases of pounds and kilograms inputs.

The second function takes the mass and the height and computes the Basal Metabolic Rate for the patients.

ii. Image Storage from Controllers

```php
public function store(Request $request)
{
    $this->middleware(['auth','admin']);
    $this->validate($request,[
        'name'=>'required',
        'gender'=>'required',
        'specialization'=>'required',
        'start_year'=>'required|numeric',
        'institution'=>'required',
        'email'=>'required',
        'password'=>'min:8',
        'password_confirmation'=>'required_with:password|same:password|min:6',
        'image'=>'required|max:10000|mimes:jpeg,jpg'
    ]);

    $image = $request->file('image');
    $title = Str::slug($request->name);
    $date = Carbon::now()->toDateString();

    if(isset($image)){
        $ext = $image->getClientOriginalExtension();

        $imagename = $date.'-'.$title.'.'.$ext;

        if(!file_exists('images/doctors')){
            mkdir('images/doctors');
        }

        $image->move('images/doctors', $imagename);
    }else{
        $imagename = 'default.jpg';
    }

    $doctor = new User();
    $doctor->name = $request->name;
    $doctor->gender = $request->gender;
    $doctor->specialization = $request->specialization;
    $doctor->start_year = $request->start_year;
    $doctor->institution = $request->institution;
    $doctor->email = $request->email;
    $doctor->is_patient = false;
    $doctor->is_doctor = true;
    $doctor->password = Hash::make($request->password);
    $doctor->image = $imagename;

    $doctor->save();

    return response($request->name.' is now in the system', 200);
}
```

This is from the **DoctorsController.php** which is a controller that works on creating a new Doctor into the system and is only accessible by the administrator. The store function has a piece of code where it handles image storage in the application. It is the most efficient method as it avoids the use of the base64 conversion of the image and stores it as it comes into the **/public/images/doctors.** The stored image name "**$imagename**" is used in both the

database and stored in storage with that same image name. It avoids setting up Laravel Queues which minimizes the LOC count.