E-MEDIX

Submitted by	Asad Masood Chaudhry Hafiz Abdul Sattar Butt
Roll. No	0224-BSCS-17 0249-BSCS-17
Session	2017 - 2021
Supervised by	Mr. Yahya Khuram

BS(HONS)
IN
COMPUTER SCIENCE

DEPARTMENT OF COMPUTER SCIENCE
GC UNIVERSITY LAHORE

E-MEDIX

Submitted to GC University Lahore in partial fulfillment
of the requirements for the award of degree of

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Declaration

We, Asad Masood Chaudhry and Hafiz Abdul Sattar Butt students of **BS(Hons)** in the subject of **Computer Science** session **2017-2021**, hereby declare that the matter printed in this thesis titled, **abc...** is my own work and has not been printed, published and submitted as research work, thesis or publication in any form in any University, Research Institution etc in Pakistan or abroad.

Date: ________________ **Signatures of Deponents**

Research Completion Certificate

It is certified that the research work contained in this thesis titled **E-MEDIX** has been carried out by **Asad Masood Chaudhry and Hafiz Abdul Sattar Butt** Roll. Nos **0224-BSCS-17 and 0249-BSCS-17** under my supervision.

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Mr. Yahya Khurram
Assistant Professor

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Submitted Through

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GC University Lahore

Acknowledgements

We are grateful to the Almighty **Allah**, Who blessed us with health, wisdom, knowledge, thoughts and opportunity to make some contribution in the form of present effort. We offer our humblest thanks from the deepest core of our hearts to the **Holy Prophet Muhammad (Peace be upon him)**, the most perfect and excelled among and ever born on the surface of earth.

The research work embodied in this dissertation was accomplished under the able guidance and affectionate supervision of **Mr. Yahya Khurram**, Assistant Professor, GC University, Lahore. we will always remember his moral encouragement, skillful guidance, positive criticism and valuable advice throughout the course of our study.

Dedication

Our research work is dedicated to our families and our honorable teacher Mr. Yahya Khurram who encouraged and helped us to complete our research in the area of formal modeling and formal verification related to computer science.

Abstract

Since the outbreak of COVID-19 on December 1, 2019, we have become aware of the significant gap between people and proper healthcare facilities. The unavailability of healthcare facilities is one of the most salient factors for the increased death rate in Pakistan. Our primary focus is to bridge this gap with the help of our Web Application. We aim to make healthcare easily accessible at all times.

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Chapter 1

Introduction

1.1 Introduction

Since the outbreak of COVID-19 on December 1, 2019, we have become aware of the significant gap between people and proper healthcare facilities. According to the WHO(World Health Organisation) [1], 2,709,041 people have lost their lives due to this pandemic. Pakistan alone has 13,848 deaths caused due to COVID-19 numbers can be anticipated to go higher. The deaths caused could have been avoided with proper healthcare facilities in the country. As a developing country, Pakistan has numerous battles to fight. Due to which the healthcare system of Pakistan has suffered a lot. When it comes to the quality and accessibility of healthcare facilities, Pakistan does not do very well. As stated on Wikipedia[2], Pakistan is ranked 122nd out of 190 in the World Health Organization performance report. According to another study conducted by the Lancet, Pakistan is ranked 154th out of 195 countries. The unavailability of healthcare facilities is one of the most salient factors for the increased death rate in Pakistan. Our primary focus is to bridge the existing gap with the help of our Web Application. E-Medix is a generic web-based system that will facilitate patients, doctors, and clinics by making healthcare accessible anytime, anywhere. Our platform will be a complete platform where patients can maintain their medical reports, book doctors, and order medicine. Our platform will also serve the doctors by allowing them to manage their clinics online. The doctor can view the patient's medical history. The doctor can also provide consultation to the patient through a video call using E-Medix. We will also include a chat bot to help the patients connect with the best doctors and cater to their general queries. We hope our product will play a vital role in the betterment of the healthcare system of Pakistan. We aim to make healthcare easily accessible at all times.

1.1.1 Problem Area

When a patient comes to a new doctor to get diagnosed, they may not have all their medical files. It makes it difficult for the doctor to analyze their problem accurately and suggest treatment accordingly. In developing countries like Pakistan, specialist doctors are scarce. Most of the medical specialists of Pakistan are working in urban areas resulting in a shortage of specialists in rural areas. As a result, the people living in rural areas do not have quick access to quality healthcare services. It is quite problematic for them to get access to basic needs like quality healthcare services. They have to travel a distance to get to urban areas for treatments resulting in many deaths occurring on the way. We can avoid such mishaps if quality healthcare services are readily available. Today we are surrounded by technology. Humans are using technology to bring comfort to their lives. In this fast era, we find ways to save our time and are dedicated to doing more in less time. It will be much more comfortable and time-saving to book appointments and consult your doctor with the click of a button rather than going to a clinic. Another observation is that many people are very skeptical when it comes to healthcare. They feel comfortable getting the consultation from their regular doctor instead of someone new. Now let us suppose that they are traveling and fall sick? With a platform like ours, they will be able to consult their regular doctor from miles away instead of going to a new local doctor.

1.2 Aims of the Project

The aims of this project are to:

- Manage patient's medical record
- To facilitate video conferencing between health care experts and the patients for better treatment and care.
- Online issuing of prescriptions to facilitate both the doctor and patient.
- Provide healthcare to remote locations.
- Help Doctors and clinics manage appointments.
- Help Doctors and clinics keep track of their earnings.
- Making Pharmacy, Laboratory and Doctor accessible at one platform.

1.3 Project Scope

The Scope of the project to make healthcare accessible anytime, anywhere. The patient can book appointments with the selected doctor from my platform and also receive online video consultation from anywhere they are at any time. They can also order the medicines and book clinical tests prescribed by the doctor from the same platform. The patients can chat with a chat bot to connect to the best doctor as per their requirements. The chat bot will also cater to the general queries of the patients. The patients can upload their old prescriptions and lab test reports to the platform. The medical records generated will automatically be added to the patient record. This platform will manage the patient health record for the ease of both the patient and the doctor. This app will also have an emergency portal so the patient can consult the emergency cases with the on-duty doctors. The doctors can use this app to keep track of their appointments and reschedule according to their timetable. The doctors can keep track of his earnings through this platform instead of hiring an assistant. Moreover, the doctor can also view the patient's medical history before the appointment to diagnose the problem accurately and provide better healthcare.

Chapter 2

Requirement Specification

2.1 Functional Requirements

A Functional Requirement describes what the system has to offer,it explains what a system consists of and what does it's components do.

2.1.1 Register

Registering to the platform is the first step.

- This function will register to the platform.
- The user will have to choose one from Patient, Doctor or Clinic.
- The user will then enter the required information in order to proceed with the registration process. The information required will be slightly different for the categories Patient, Doctor and Clinic.
- The user will then click the register button that will redirect them to the home page if their registration is successful and display an error message if their is any error.

2.1.2 Login

- This function will login the user if they are already registered.
- The user will specify if they are attempting to login as a patient, doctor or clinic.
- The user will then enter their specified credentials.
- The credentials will be compared to the credentials stored in the database.
- If a match is found the user will be redirected to their concerned dashboard.
- If no match is found an error message is displayed to the user.

2.1.3 Update Information

- This function will allow the user update their basic information as per their requirements.
- The user will go to their profile where they can change their information except for a few fixed fields.

2.1.4 Add Doctor

- This Function will allow a clinic to add a doctor to their clinic.
- This function will only be available to clinic owners.

2.1.5 Update Doctors

- This Function will allow a clinic to update the information of a doctor who is registered under their clinic.
- This function will only be available to clinic owners.

2.1.6 Delete Doctors

- This Function will allow a clinic to delete doctors from their existing list of doctors at any time.
- This function will only be available to clinic owners.

2.1.7 Manage Patients

- This Function will allow a clinic to add,update or delete patients in their list of patients.
- This function will only be available to clinic owners.

2.1.8 Manage Appointments

- This Function will allow a doctor to manage their appointment.
- The doctor can accept the appointment.
- The doctor can reschedule the appointment.
- The doctor can send reminder to the patient.

2.1.9 View Patient History

- This Function will allow doctor to preview the medical history of the patient who has scheduled an appointment with them.

2.1.10 Prescribe Patient

- This Function will allow a doctor to write a prescription and send it to the patient's dashboard.

2.1.11 Diagnose Patient Remotely

- This Function will allow a doctor to generate a link for video call and send it to the patient for online diagnosis.
- This function will only operate if the patient has booked an online appointment.

2.1.12 Book Appointment

- This Function will allow a patient to book an appointment with the doctor of their choice.

2.1.13 View Appointment History

- This Function will allow a patient to view their past appointments.

2.1.14 Download Prescription

- This Function will allow a patient to download the prescription given by the doctor.

2.1.15 Upload Medical Record

- This Function will allow a patient to upload their past medical records

2.1.16 Get Help

- This Function will allow a patient to get help from a chat bot.
- The chat bot will cater to the general queries of a patient.

2.2 Non-functional Requirements

A Non Functional Requirement focused on how the system should perform it's functionalities rather than what functionalities it should perform.

2.2.1 Security

- Users should register into the system to perform any operation.
- Only login users are allowed to interact with the system.
- All important operations are handled by a server (administrator) only.
- The app must ensure that no one can access or bypass the secured information or data.
- The personal information of any person or organization must be kept safe.

2.2.2 Performance

- The application should work well with other interactive systems.
- All the features of the application must ensure that work is done on time and the app performs well on different devices.
- Data integrity must be maintained for good response of time.
- System must give access guidelines.
- System must response in seconds.

2.2.3 Availability

- When an action is called for at an unknown, i.e. random, time, the degree to which a device, subsystem, or piece of equipment is in a given operable and commit able state at the start of the mission must be available.

- If any system failure or error occurs, system broadcast message to all user.

2.2.4 Usability

- The device should be simple to use, or user friendly.
- In general, usability is a central tenant in social interaction, and it is concerned with making programs simple to understand and use, as well as reducing the frequency and severity of errors.

2.2.5 Flexibility And Scalability

- Flexibility is a personality trait that defines a person's ability to adapt to changing situations and think of problems and tasks and imaginative ways. System must provide scalability in the future for increased number of users.
- Software scalability is a feature of a tool or device that allows it to expand its capacity and functionality in response to user demand. Scalable software can adjust to updates, improvements, overhauls, and resource reductions while remaining stable.

2.2.6 Maintainability

- The system should be easy to maintain.
- Maintainability is a measure of an item's ability to be kept in or returned to a given condition when maintained by staff with a specific skill set.
- The System shall provide ease for updating system with new features.

2.2.7 Modification

- Must ensure its modifying anytime without affecting other modules(functions).

- A software product requires maintenance in order to accommodate new functionality requested by customers or to modify various types of device functionalities in response to customer demands.
- Modifying keeps all features from previous update.

Chapter 3

Project Design

3.1 Methodology

Software development life cycle is a process used during the development process of any software. SDLC provides us with a detailed explanation of how we can develop, maintain, replace or enhance the software we are developing. SDLC plays a vital role in ensuring the quality of the software. It also makes sure of a smooth flow of the overall development process.
Some of the most famous SDLC models used are as under:

- Waterfall Model
- Iterative Model
- Spiral Model
- V-Model
- Big Bang Model

We will be using the Waterfall Software Development life cycle for this project. The waterfall model is the most simple and easy-to-use SDLC model. The waterfall model is a step-wise software development process. In the waterfall model,

each phase must be completely executed before proceeding to the next phase. The waterfall model is most suitable for our project because our project has no uncertain requirements. All the requirements of the project are clear, fixed, well defined, and documented. The technology to be used is understood and static and there are no ambiguous requirements.
The phases of the Waterfall Software Development Lift Cycle are as follows:

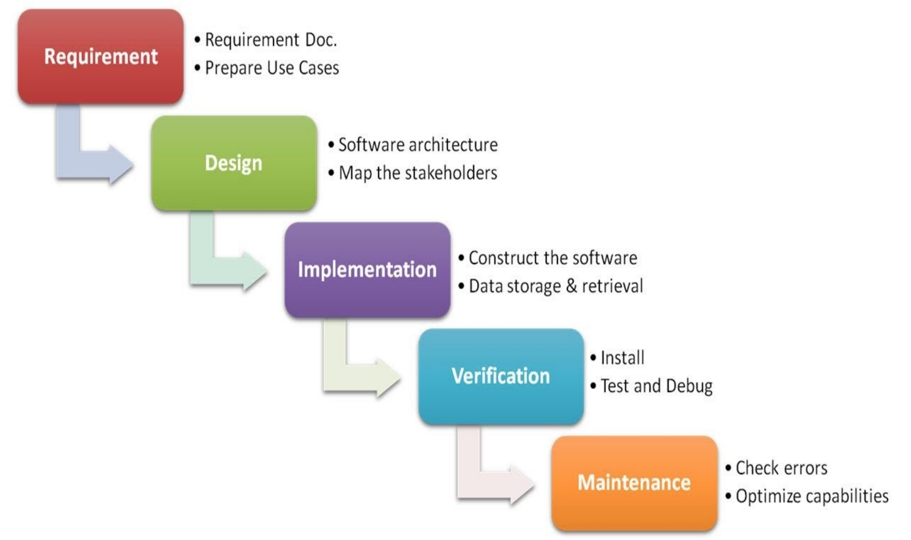


Figure 3.1: The Waterfall Software Development Lift Cycle

3.2 Architecture Overview

We will be using the Django framework during the development process of this project. Django is a high-level open-source Python web framework. Many famous web applications like Instagram got developed using the Django Framework. The Django framework implies an MVT architecture for the development of web applications. The MVT architecture consists of three major components.

1. Models

2. Views

3. Templates

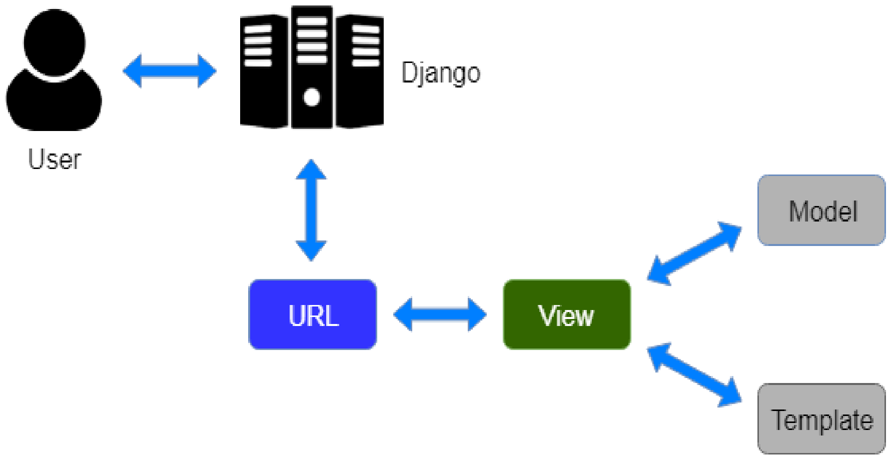


Figure 3.2: Django - Model View Template Architecture

3.2.1 Models

The model works as the interface of the data on the web application. The model is the component where we implement all our logic for manipulating the data in the database. Model is used to maintain the data used in our application. It is responsible for retrieving, inserting, updating, and deleting data from the database.

3.2.2 Views

The Views in Django form the user interface of the web applications. The views folder stores all the Front end files of the web application (HTML, CSS, Javascript, etc.).

3.2.3 Templates

Templates are an important part of the MVT architecture. Django Templates are used to provide a layout to our web application. A template comprises the HTML of static parts of the user interface and a special syntax explaining how the dynamic parts will be included.

3.3 Design Description

The diagrams included in our documentation are:

- Use Case Diagrams
- Sequence Diagrams
- Class Diagram
- Data Flow Diagrams
- Entity Relationship Diagram

3.3.1 Use Case Diagram:

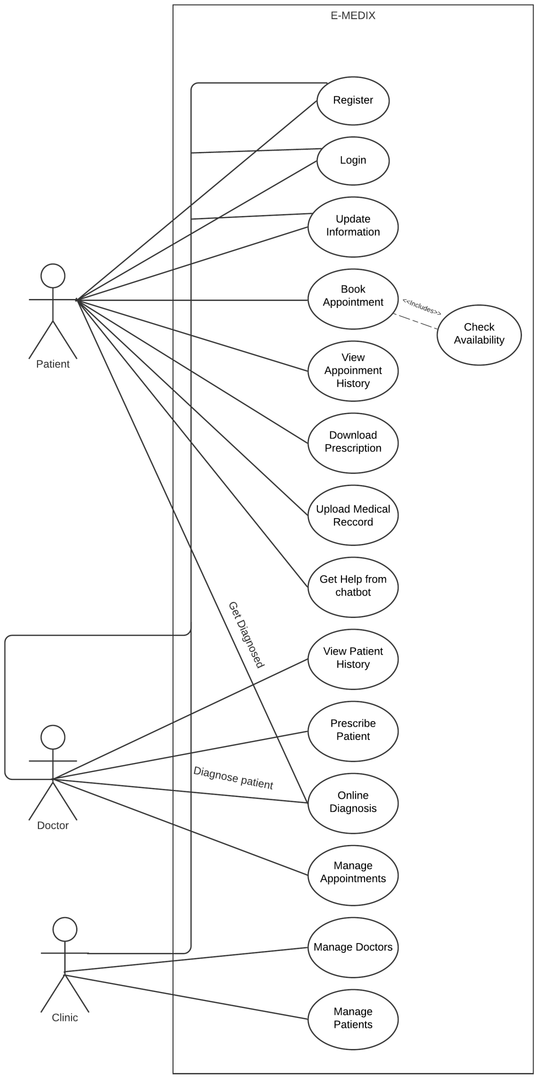


Figure 3.3: Use Case Diagram

3.3.1.1 Use Cases:

Table 3.1: UC-01 Register

ID	UC-01
Name	Register
Description	This use case will describe how a user registers on our web application.
Actors	Patient, Doctor or Clinic
Precondition	User must be connected to internet
Scenario	• User will select the type of registration i.e Patient, Doctor or Clinic. • User will enter their information. • User will press the register button.
Expectations	User might get registered to the web application.
Post Conditions	User will get registered to the web application.

Table 3.2: UC-02 Login

ID	UC-02
Name	Login
Description	This use case will describe how a user logs in our web application.
Actors	Patient, Doctor or Clinic
Precondition	User must be already registered
Scenario	• User will select the type of login i.e.,Patient,Doctor or Clinic. • User will enter their credential • User will press the login button.
Expectations	User might get logged into the web application.
Post Conditions	User will get logged into the web application.

Table 3.3: UC-03 Update Information

ID	UC-03
Name	Update Information
Description	This use case will describe how a user changes their general information.
Actors	Patient, Doctor or Clinic
Precondition	User must be logged in
Scenario	• User log in as a doctor, patient or clinic. • User will then update the fields available. • The available fields will vary for each type of login.
Expectations	User might update their information.
Post Conditions	User information is updated.

Table 3.4: UC-4 Book Appointment

ID	UC-04
Name	Book Appointment
Description	This use case will describe how a user books an appointment
Actors	Patient
Precondition	User must be logged in as patient
Scenario	• User will select the book appointment option. • User will then select their desired doctor. • The appointment will be booked if the doctor is available.
Expectations	User might book an appointment with a doctor
Post Conditions	• If the doctor is available the appointment will be booked. • If the doctor is not available the user will be asked to select a different doctor

Table 3.5: UC-05 View Appointment history

ID	UC-05
Name	View Appointment history
Description	This use case will describe how a user views the details of their past appointments.
Actors	Patient
Precondition	• User must be logged in as a patient. • User must have booked doctor appointments using the web application in the past.
Scenario	• User will select the view appointment history option. • All the past appointment history of the patient will view in front of them
Expectations	User might view their appointment history
Post Conditions	The user's appointment history will be loaded. .

Table 3.6: UC-06 Download Prescription

ID	UC-06
Name	Download Prescription
Description	This use case will describe how a user downloads the prescription given by a doctor.
Actors	Patient
Precondition	• User must be logged in as a patient. • Any doctor must have given the patient a prescription
Scenario	• User will select the download prescription option. • User search for the prescription they want to download from the list of the prescriptions prescribed to them. • The required prescription will be downloaded
Expectations	User might download a prescription.
Post Conditions	The prescription required is downloaded.

Table 3.7: UC-07 Update Medical Record

ID	UC-07
Name	Update Medical Record
Description	This use case will describe how a user will upload their past medical records.
Actors	Patient
Precondition	User must be logged in as patient
Scenario	• User will select the upload medical records option. • The user will then upload the desired filed by browsing through their device.
Expectations	User's files might be uploaded to the website.
Post Conditions	The user successfully uploaded their past medical records.

Table 3.8: UC-08 Get help from chatbot

ID	UC-08
Name	Get help from chatbot
Description	This use case will describe how a user can use the chatbot to solve their general queries and make the best out of the web application.
Actors	Patient
Precondition	User must be logged in as patient
Scenario	• User will click on the chatbot icon. • The user will then type in their query.. • The chatbot will get back to them regarding their query
Expectations	User might get the answer they required for their query.
Post Conditions	The user will get the required guidance.

Table 3.9: UC-09 View Patient history

ID	UC-09
Name	View Patient history
Description	This use case will describe how a user will view the medical history of their patient.
Actors	Doctor
Precondition	• User must be logged in as a doctor. • A patient must have booked an appointment with the doctor. • The medical history of the patient does exist.
Scenario	• User will select patient that has booked appointment with them • The user will then select the view medical history option. • The medical history of the patient will be loaded in front of the doctor.
Expectations	User might get the history of their patient.
Post Conditions	The doctor gets the medical history of their patient.

Table 3.10: UC-10 Prescribe Patient

ID	UC-10
Name	Prescribe Patient
Description	This use case will describe how a doctor will write a prescription to their patient.
Actors	Doctor
Precondition	• User must be logged in as a doctor. • The doctor must have had an appointment with the patient they are willing to write a prescription to.
Scenario	• User will select the write prescription option. • The user will then browse through the past appointments with various patients. • The user will select the desired patient. • The user will then fill in a short form. • Finally, the user will press the issue prescription button.
Expectations	The doctor may issue a prescription for their patient.
Post Conditions	The prescription is issued to the desired patient.

Table 3.11: UC-11 Online Diagnosis

ID	UC-11
Name	Online Diagnosis
Description	This use case will describe how a patient and doctor will interact through a video call for an online consultation.
Actors	Doctor,Patient
Precondition	• The doctor must be logged in to their account. • The patient must be logged in to their account. • The patient must have booked an appointment with the doctor for online consultation.
Scenario	• The doctor will initiate the video call when it's time for the appointment. • The user will receive a link on their phone and email. • When the user clicks on that link, they will join the doctor on a video call.
Expectations	Doctor may diagnose the patient online through a video call.
Post Conditions	The doctor successfully diagnoses the patient on a video call.

Table 3.12: UC-12 Manage Appointments

ID	UC-12
Name	Manage Appointments
Description	This use case will describe how a doctor can manage their appointments using this platform.
Actors	Doctor
Precondition	User must be logged in as a doctor.
Scenario	• User will select the appointments option. • It will show all the past and upcoming appointments to the doctor separately.. • The doctor can also see the appointment requests. • The doctor can change their availability status.
Expectations	The doctor might be able to manage their appointments.
Post Conditions	The doctor is successful in managing their appointments.

Table 3.13: UC-13 Manage Doctor

ID	UC-13
Name	Manage Doctor
Description	This use case will describe how a clinic can manage the doctors working for them.
Actors	Clinic
Precondition	User must be logged in as a Clinic.
Scenario	• The user selects the manage doctors option. • The user can view the complete list of the doctors working under them. • The user can add or delete doctors to and from the list. • The user can also update the information of a doctor.
Expectations	User might be able to manage the doctors working under their clinic.
Post Conditions	The user is successful in managing the doctors working under their clinic

Table 3.14: UC-14 Manage Patients

ID	UC-14
Name	Manage Patients
Description	This use case will describe how a clinic can manage their patients.
Actors	Clinic
Precondition	User must be logged in as a Clinic.
Scenario	• The user selects the manage patients option. • The user can view the complete list of the patients being treated at their clinic. • The user can add or delete patients to and from the list. • The user can also update the information of a patient.
Expectations	User might be able to manage the patients being treated at their clinic
Post Conditions	The user is successful in managing the patients being treated at their clinic.

3.3.2 Sequence Diagrams:

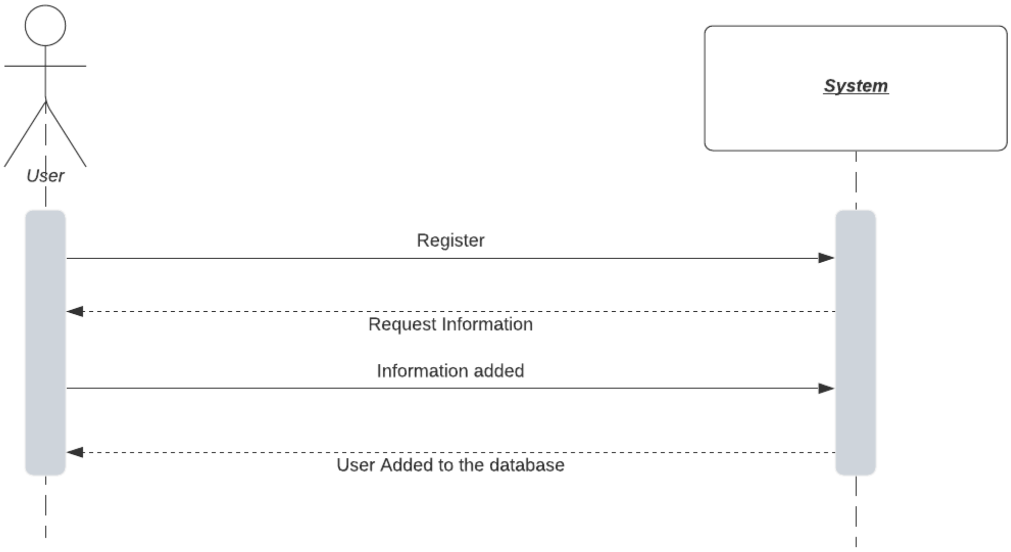


FIGURE 3.4: SD UC-01 Register

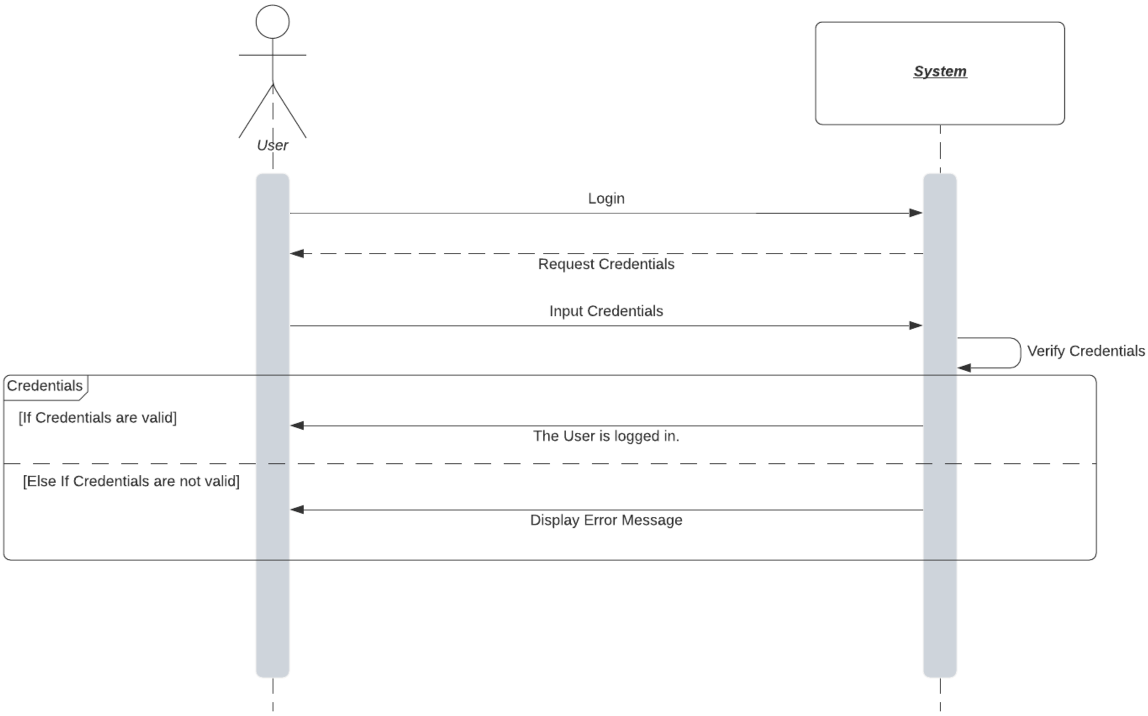


FIGURE 3.5: SD UC-02 Login

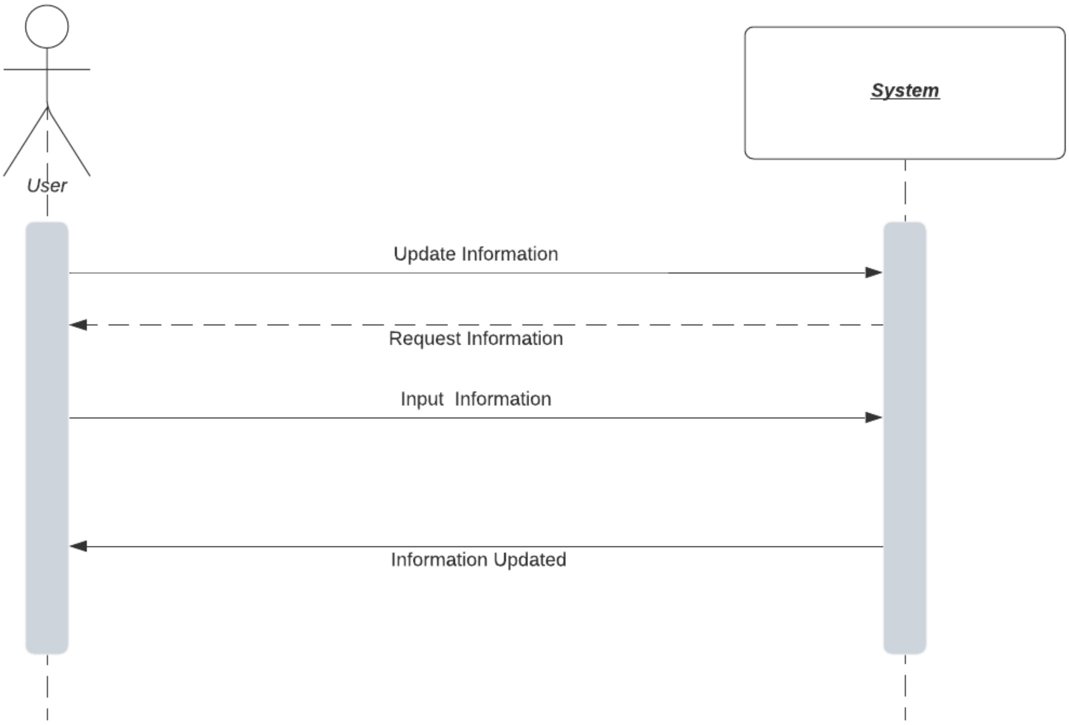


Figure 3.6: SD UC-03 Update Information

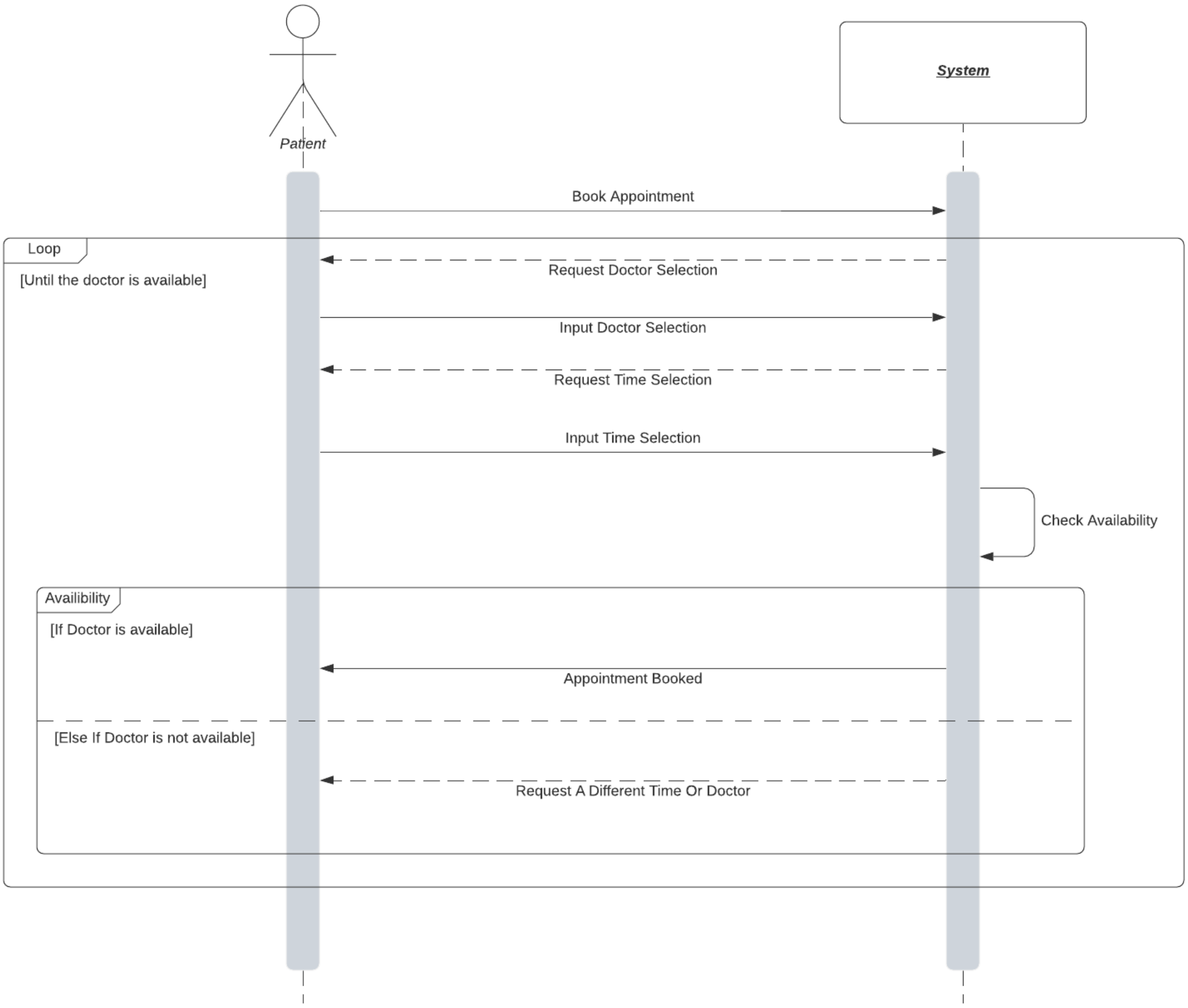


FIGURE 3.7: SD UC-04 Book Appointment

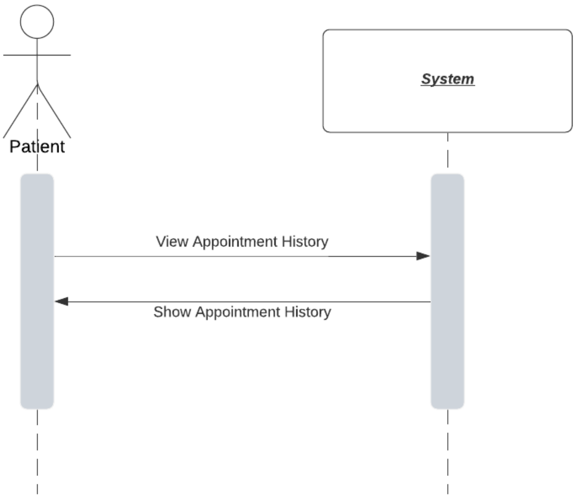


FIGURE 3.8: SD UC-05 View Appointment History

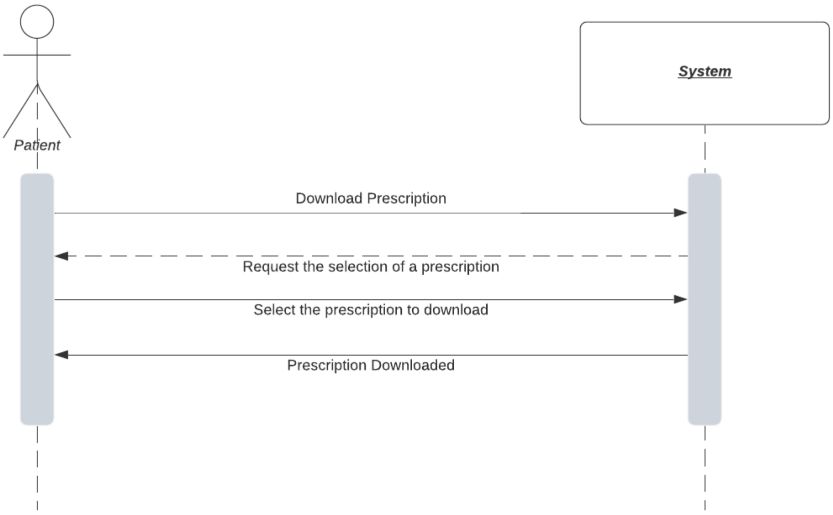

System
Patient
Download Prescription
Request the selection of a prescription
Select the prescription to download
Prescription Downloaded

Figure 3.9: SD UC-06 Download Prescription

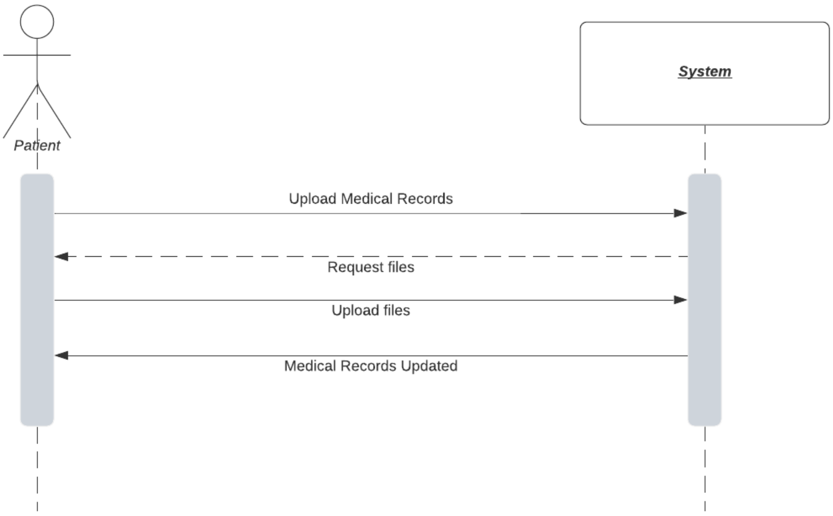


Figure 3.10: SD UC-07 Upload Medical Reports

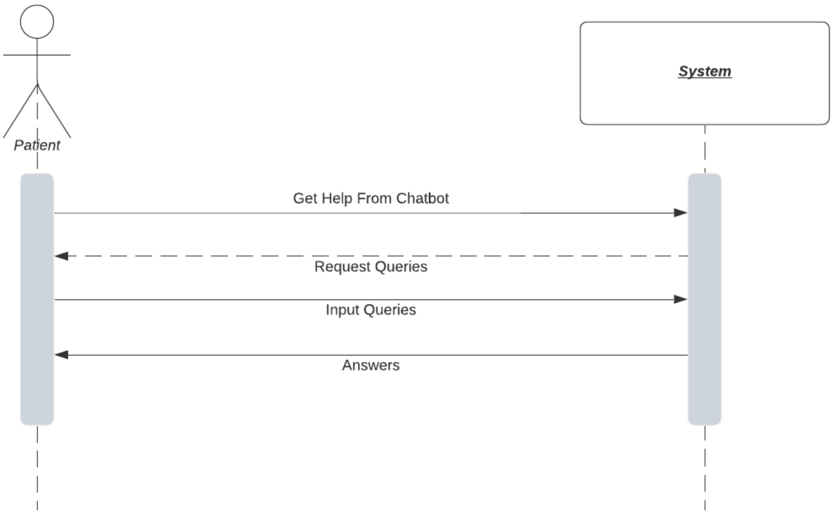


Figure 3.11: SD UC-08 Get help from chatbot

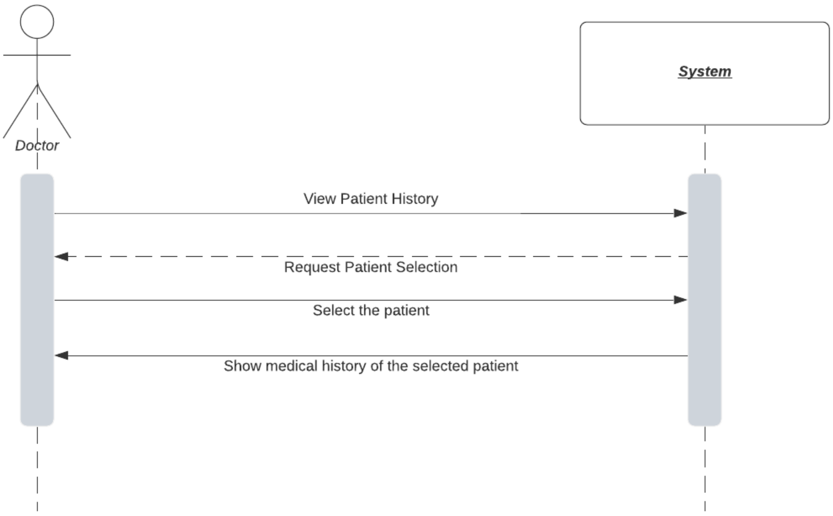

Doctor
System
View Patient History
Request Patient Selection
Select the patient
Show medical history of the selected patient

Figure 3.12: SD UC-09 View Patient History

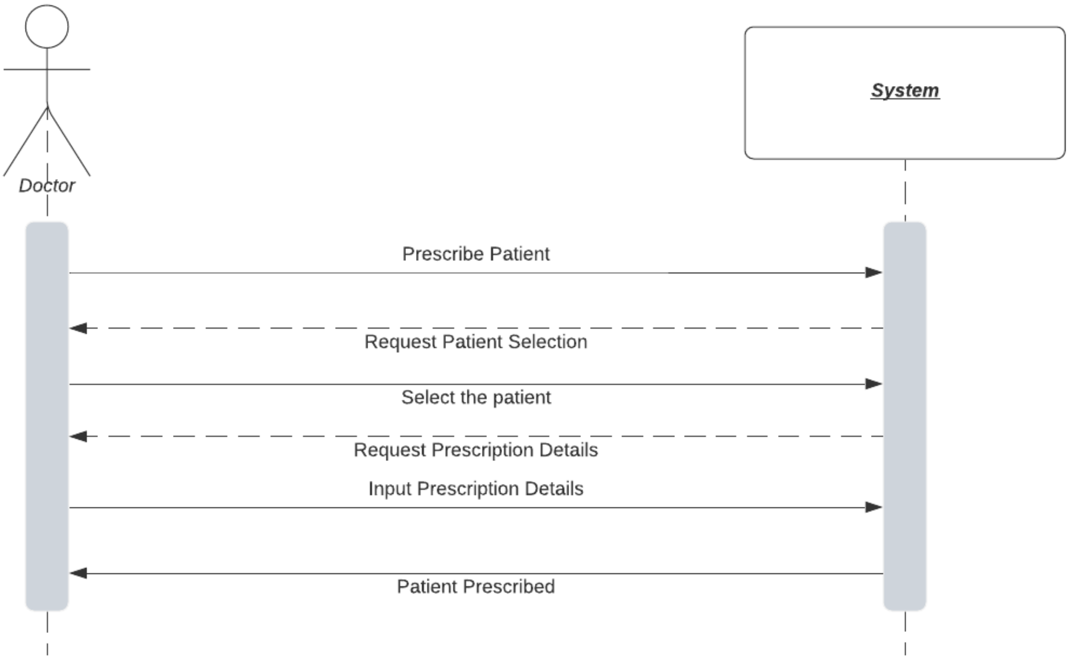

System
Doctor
Prescribe Patient
Request Patient Selection
Select the patient
Request Prescription Details
Input Prescription Details
Patient Prescribed

Figure 3.13: SD UC-10 Prescribe Patient

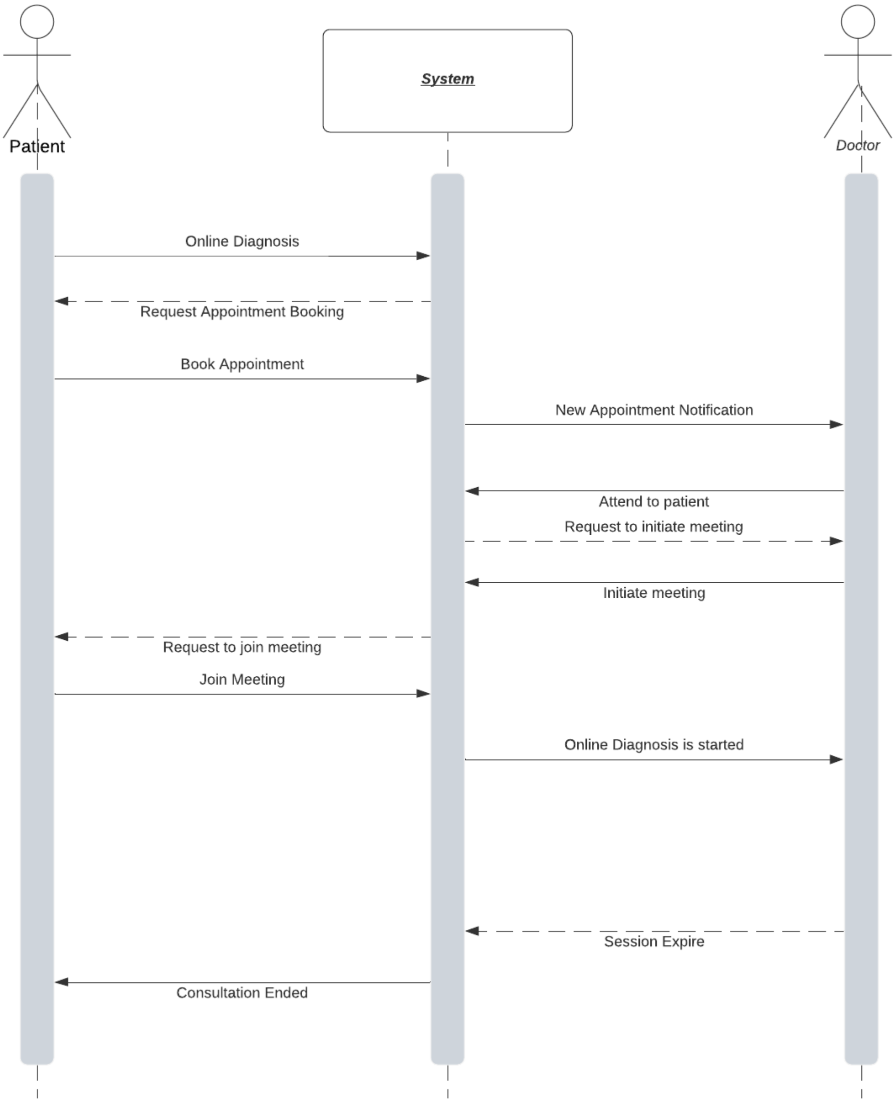


Figure 3.14: SD UC-11 Online Diagnosis

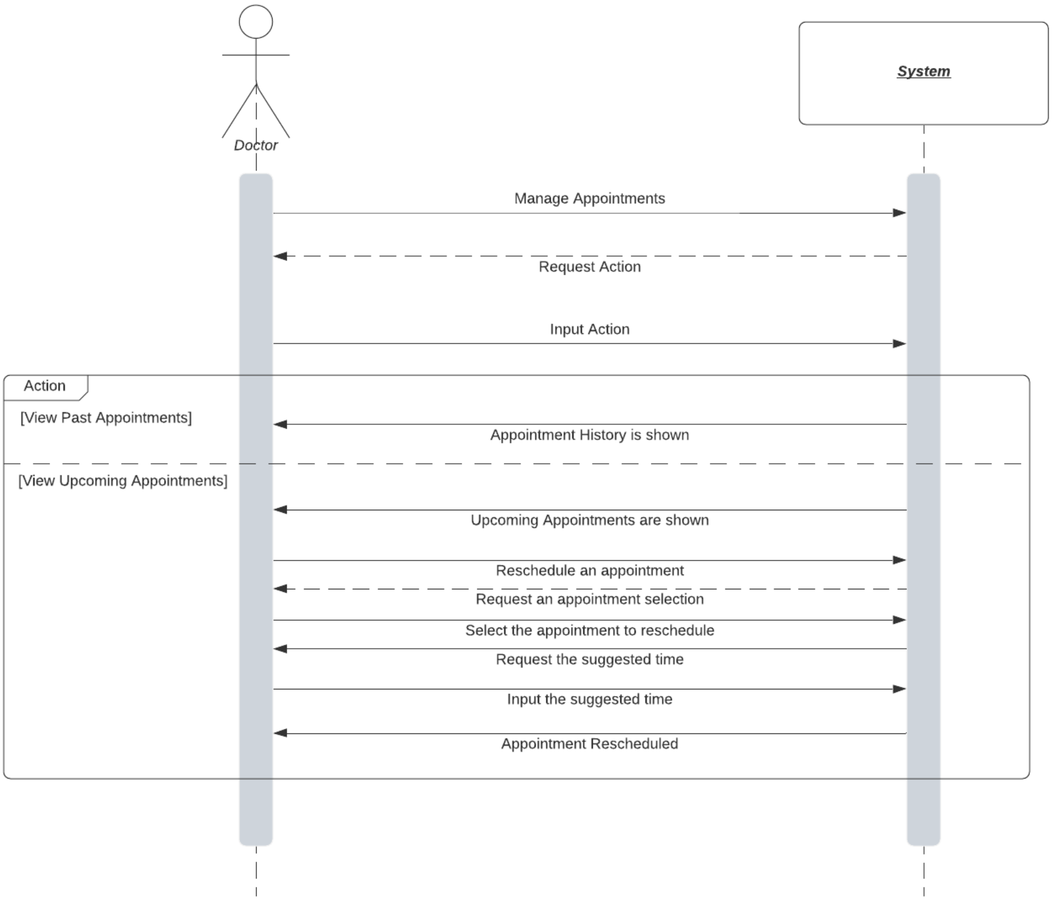

Doctor
System
Manage Appointments
Request Action
Input Action
Action
[View Past Appointments]
Appointment History is shown
[View Upcoming Appointments]
Upcoming Appointments are shown
Reschedule an appointment
Request an appointment selection
Select the appointment to reschedule
Request the suggested time
Input the suggested time
Appointment Rescheduled

Figure 3.15: SD UC-12 Manage Appointments

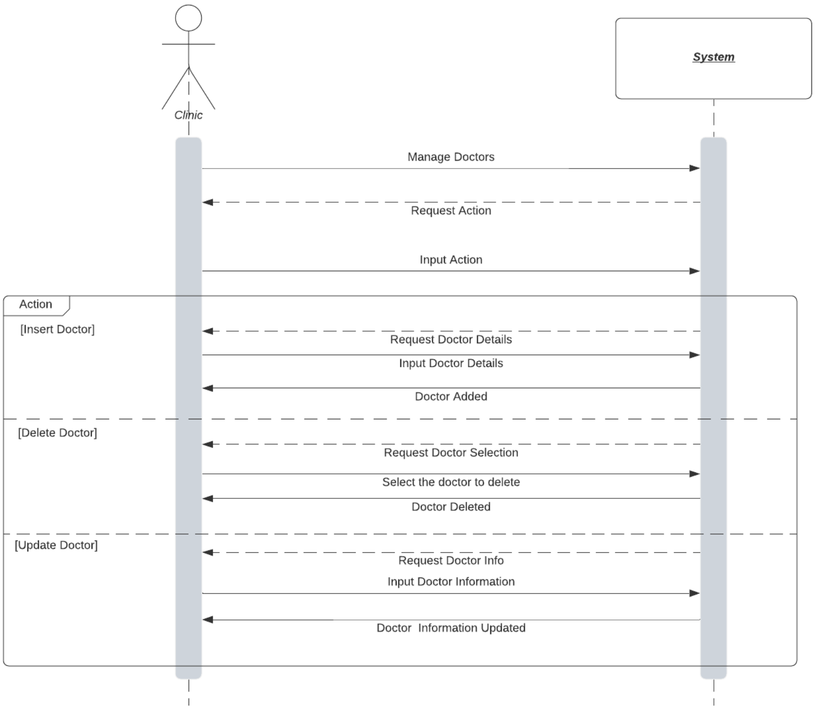


Figure 3.16: SD UC-13 Manage Doctors

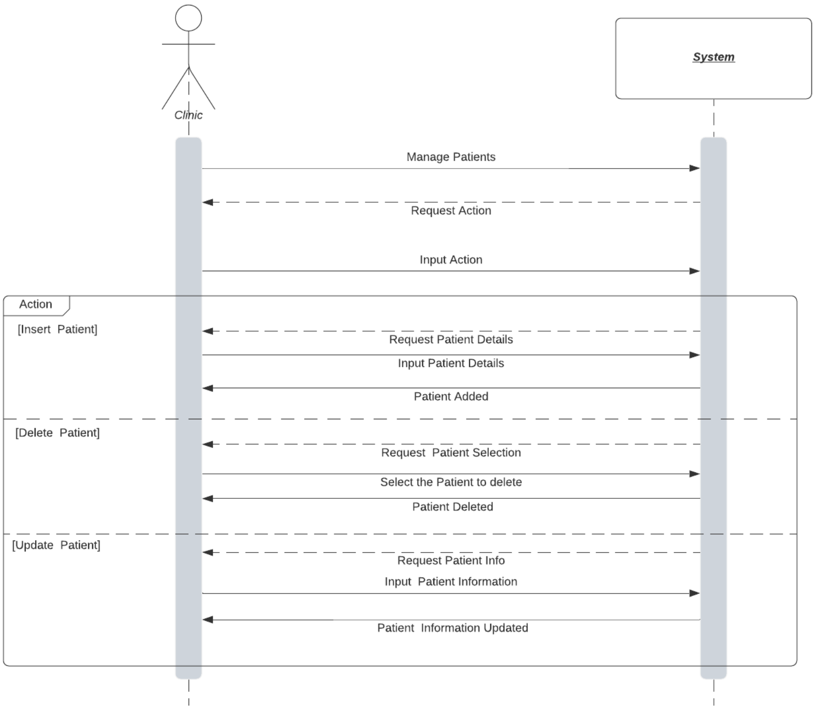


Figure 3.17: SD UC-14 Manage Patients

3.3.3 Class Diagram:

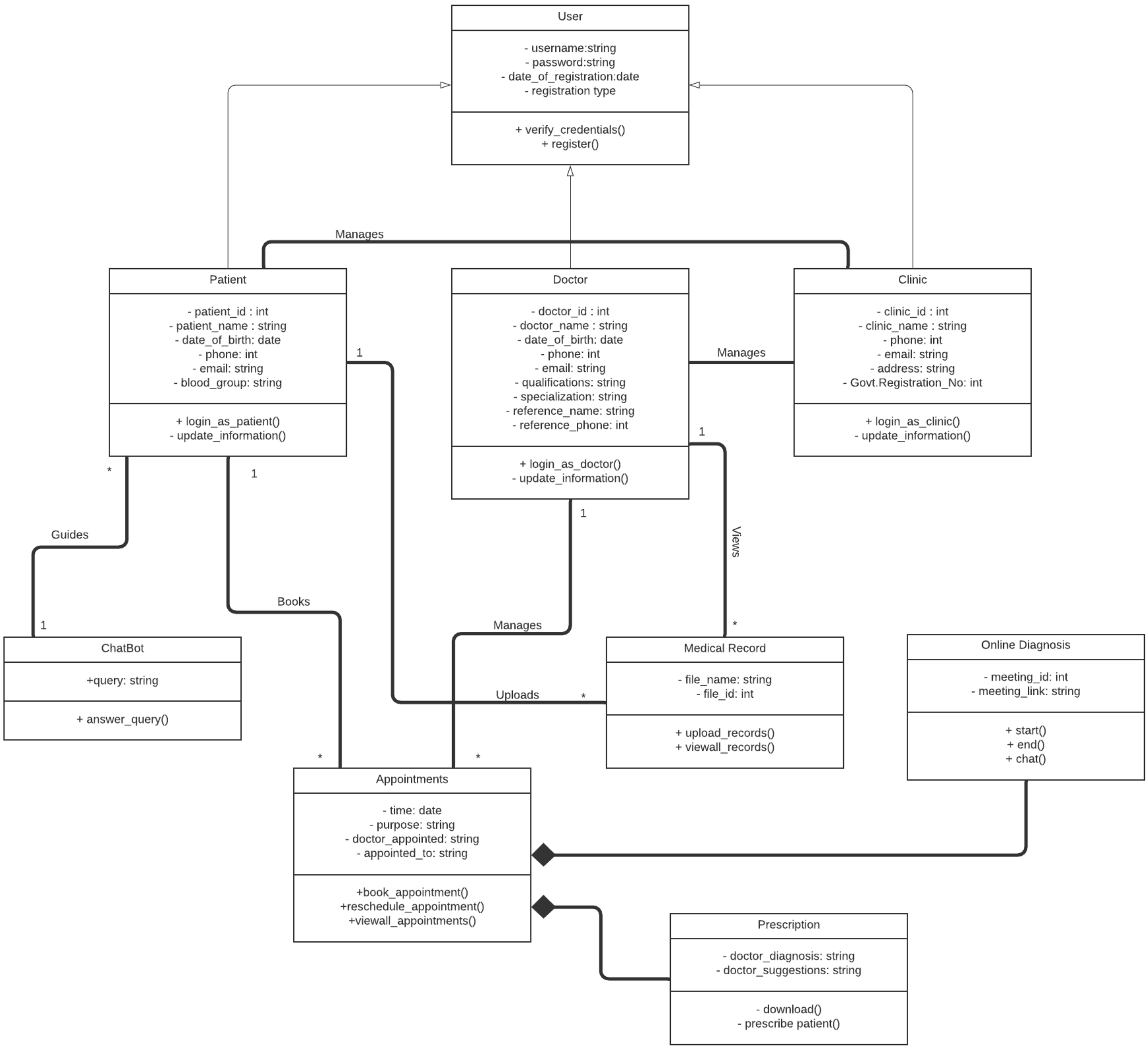


Figure 3.18: UML Class Diagram

3.3.4 Data Flow Diagrams:

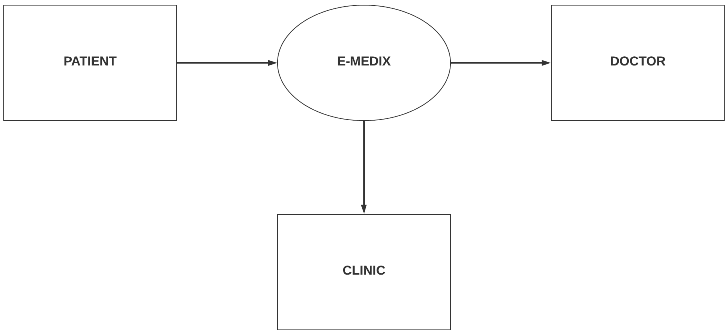


Figure 3.19: Level 0 - Data Flow Diagram

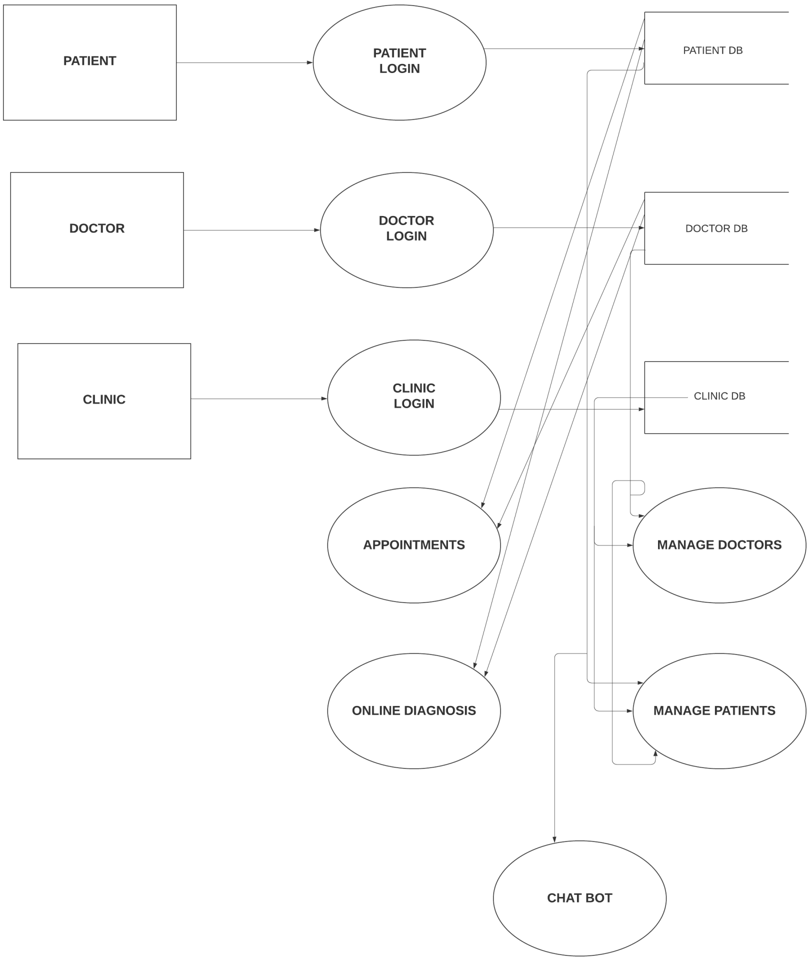


Figure 3.20: Level 1 - Data Flow Diagram

3.3.5 Entity Relationship Diagram:

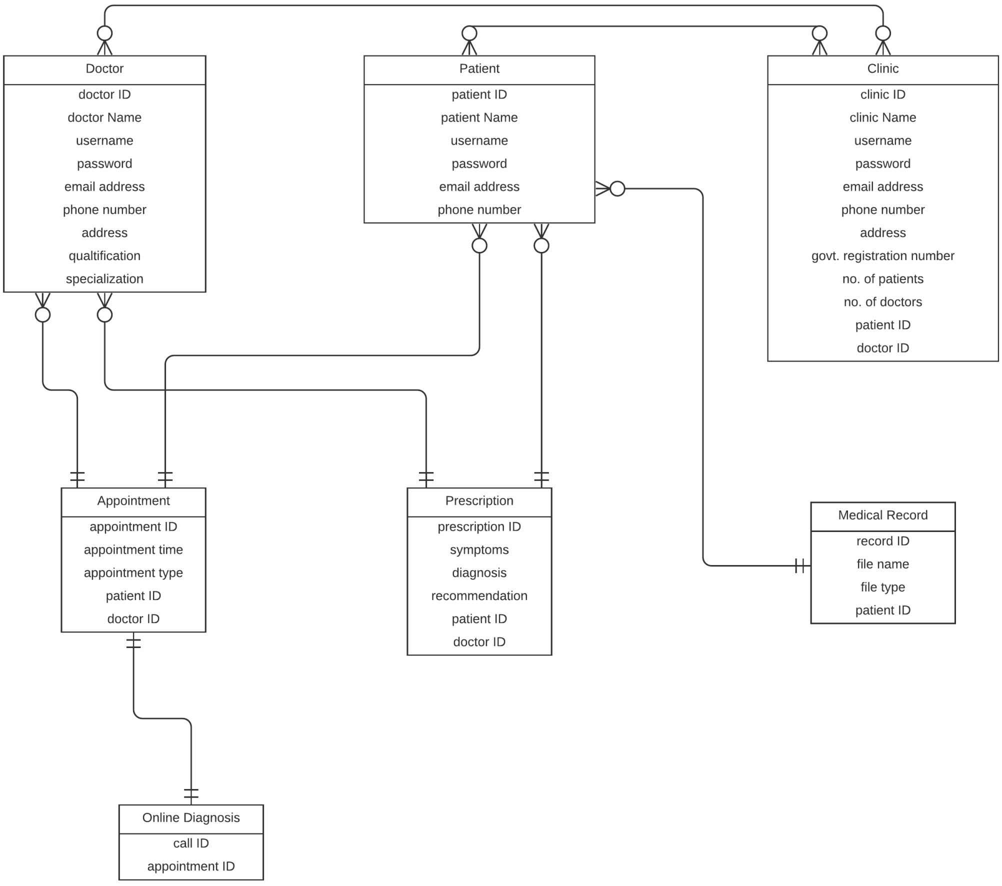


Figure 3.21: Entity Relationship Diagram

Chapter 4

Implementation and Evaluation

4.1 Development Stages

The software development life cycle(**SDLC**) stages are Requirement Analysis, Design, Development, Testing, Implementation and Maintenance.The major aim of SDLC is to improve the development quality of the application to meet or exceed the set requirements. It also ensures that the timeline of the project is following and the project is completed within the cost estimated. Depending on the these stages our application also exhibits the key features of these stages. Every Stage of the SDLC plays a vital role in chalking out the ”ready to hit market” web application. Let’s look into how we carried forward our project through each stage of the SDLC.

4.1.1 Stage 1(Requirements Gathering and Analysis):

The first stage of the SDLC is Requirements Gathering and Analysis. This stage of the SDLC plays a crucial role in the development of our web application. To gather the requirements for the project we conducted one on one surveys with health care workers and explained them the idea of our platform and asked them about how will our system affect their practice. 95 Percent of the total conducted surveys were positive Hence reflecting a need of a platform like ours in the society. Moreover we also conducted interviews with the owners of the existing similar platforms and after analysing their work flow we tried to target the areas they were collectively lacking in.

4.1.2 Stage 2(Design):

The second stage of our project was the design phase. During this phase we decided the basic flow and working of our project and worked on how we want our project to look like. We as a team did brainstorming and noted down the ideas of the flow of the web application and created a list of ways a user will interact with the web application. Once the flow was finalized we went on to decide the look and feel of the platform. We analysed the top trending websites to get an idea of the UI trends. Then we created Mocks with the help of tools like Adobe Photoshop and Adobe XD to finalize how our web application should look like.

4.1.3 Stage 3(Development):

The third stage of the SDLC is the development stage. During this phase we converted all the planning from the stage 2 into code. The development stage was subdivided into two sub phases. Front End Development and Back End Development. During the front end phase we converts the selected User interface from pictorial form into markup language. We used HTML5, CSS 3, Bootstrap4 and Javascript to code our front end. Once all the pages were coded we went on to the back end development to add the functionalities to our user interface. Our Back End was majorly integrated using the programming language Python through the Django web framework. However, during the integration of video consultation several modules of Node.js were also used.

4.1.4 Stage 4(Testing):

This fourth stage of the SDLC is the Testing stage. This is a very critical stage of the Software development process. During the testing phase of the SDLC multiple tests were conducted on the developed web application to ensure the quality of the platform. The testing stage involved the testing of each functionality. Every button was clicked individually to analyse it's working and different scenarios were repeatedly conducted and the behaviour of the system was observed to filter out the abnormalities. Apart from the manual testing automated testing was also incorporated during the testing stage. Scripts were written and executed and run to perform different tasks on the platform. The script analysed how many times did the desired task failed or passed. A tool named Jmeter was also used for an overall vulnerability test. All the bugs and errors in the system were detected, analysed and fixed until no error or bug was left.

4.1.5 Stage 5(Implementation):

The fifth stage of the SDLC is the Implementation stage. Once all the errors are omitted in the testing stage the web application was deployed and made available to be accessed through a URL and the URL was sent to a group of individuals to proceed to the next stage.

4.1.6 Stage 6(Maintenance):

The last stage of the SDLC is the Maintenance stage. This stage helps you to know the opinion of the end user. During this stage the feedback of the group of individuals with the URL for our web application was looked into. This phase helped us to reanalyze some of the functionalities of our system and resulted in the updating on the functionalities of specific modules.

4.2 System Integration

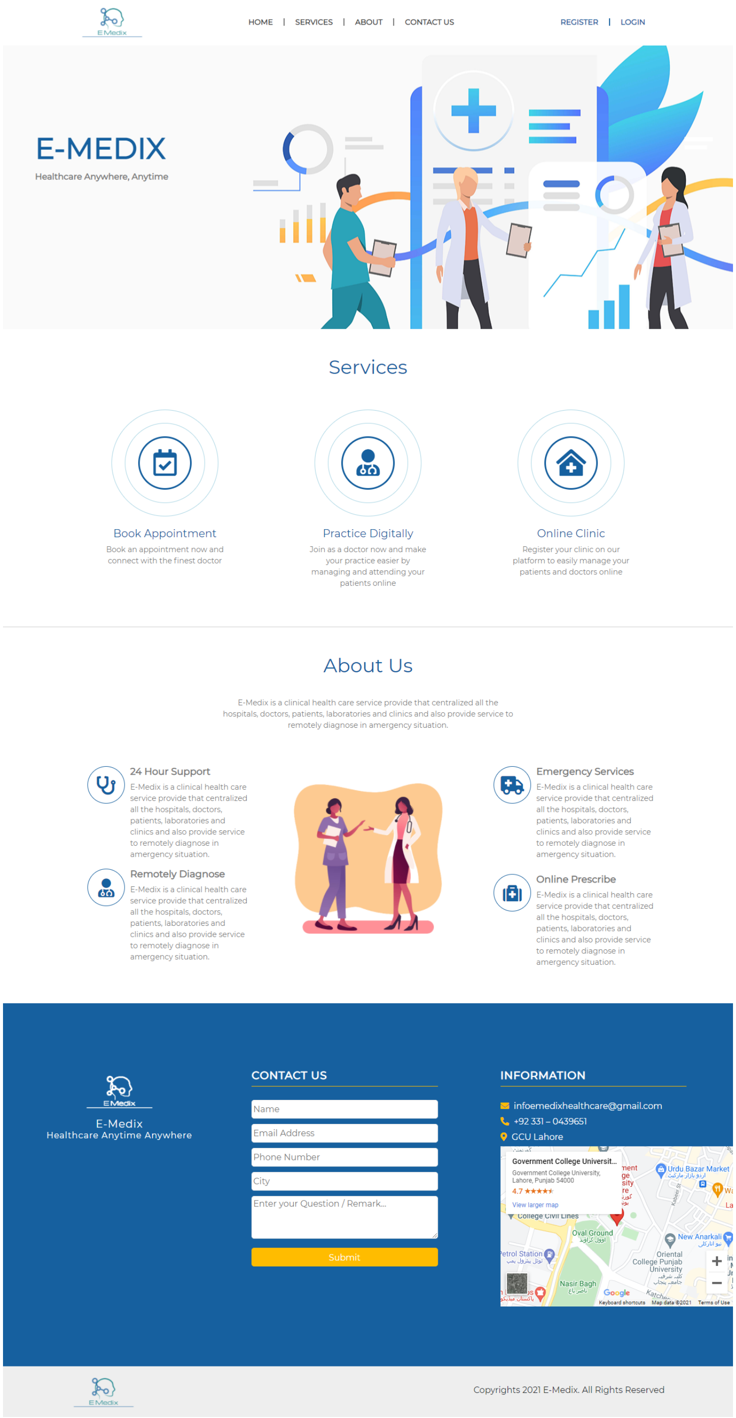
The different components of the E-Medix web application were bought together in the views.py file. Most of the components are co related and act as the foundation of the functionalities of this platform. Successful execution of each component results in the proper functioning of E-Medix.

4.3 User Interface

A good interface is almost unnoticeable by the user. It does not have any unnecessary elements and uses clear language to portray a clear message. A good UI is also consistent and it is created such that it enhances the user's experience on the web application. For our web application we analyzed the general UI trends in the industry and then chalked out a user interface accordingly. Our UI was designed as per the W3C standards and it was created such that it makes the experience of a user coming to our web application better. Our UI is also self explanatory and is targeted to help the users to navigate through the whole website without any external help.

Following are the main UI components of our Web Application:

4.3.1 Main page



E-MEDIX

Healthcare Anywhere, Anytime

Services

Book Appointment

Book an appointment now and connect with the finest doctor

Practice Digitally

Join as a doctor now and make your practice easier by managing and attending your patients online

Online Clinic

Register your clinic on our platform to easily manage your patients and doctors online

About Us

E-Medix is a clinical health care service provide that centralized all the hospitals, doctors, patients, laboratories and clinics and also provide service to remotely diagnose in amergency situation.

24 Hour Support

E-Medix is a clinical health care service provide that centralized all the hospitals, doctors, patients, laboratories and clinics and also provide service to remotely diagnose in amergency situation.

Remotely Diagnose

E-Medix is a clinical health care service provide that centralized all the hospitals, doctors, patients, laboratories and clinics and also provide service to remotely diagnose in amergency situation.

Emergency Services

E-Medix is a clinical health care service provide that centralized all the hospitals, doctors, patients, laboratories and clinics and also provide service to remotely diagnose in amergency situation.

Online Prescribe

E-Medix is a clinical health care service provide that centralized all the hospitals, doctors, patients, laboratories and clinics and also provide service to remotely diagnose in amergency situation.

E-Medix
Healthcare Anytime Anywhere

CONTACT US

Name

Email Address

Phone Number

City

Enter your Question / Remark...

Submit

INFORMATION

infoemedixhealthcare@gmail.com
+92 331 – 0439651
GCU Lahore

Government College Universit...
Government College University, Lahore, Punjab 54000
4.7 ★★★★★
View larger map

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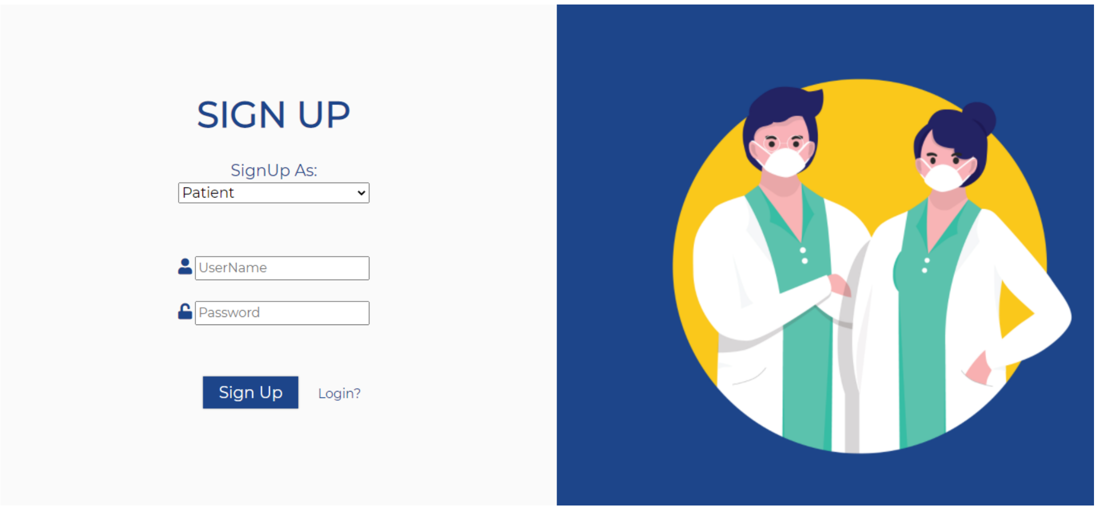
FIGURE 4.1: Main Page

4.3.2 Sign up



SignUp As: Patient

FIGURE 4.2: Sign up

4.3.3 Login

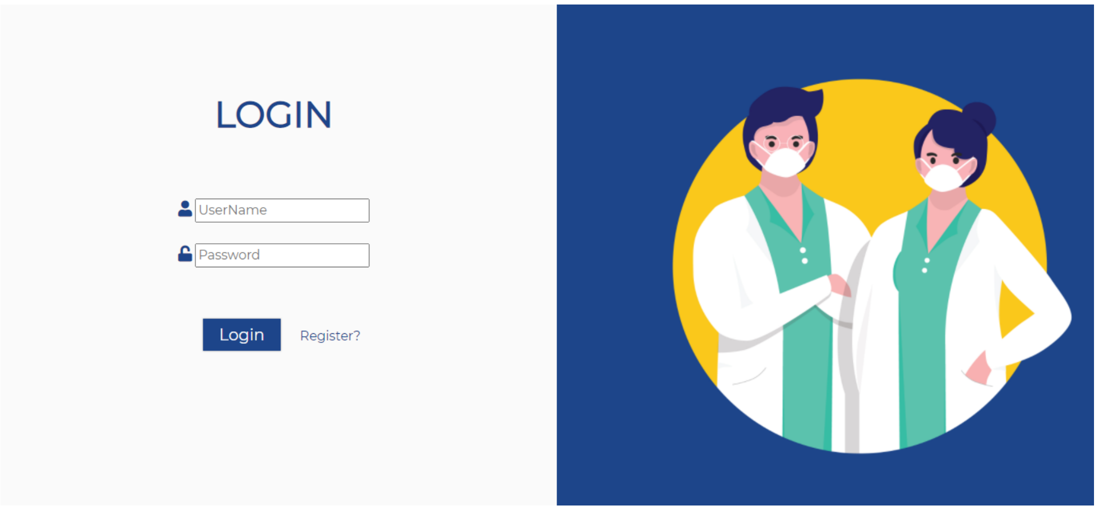
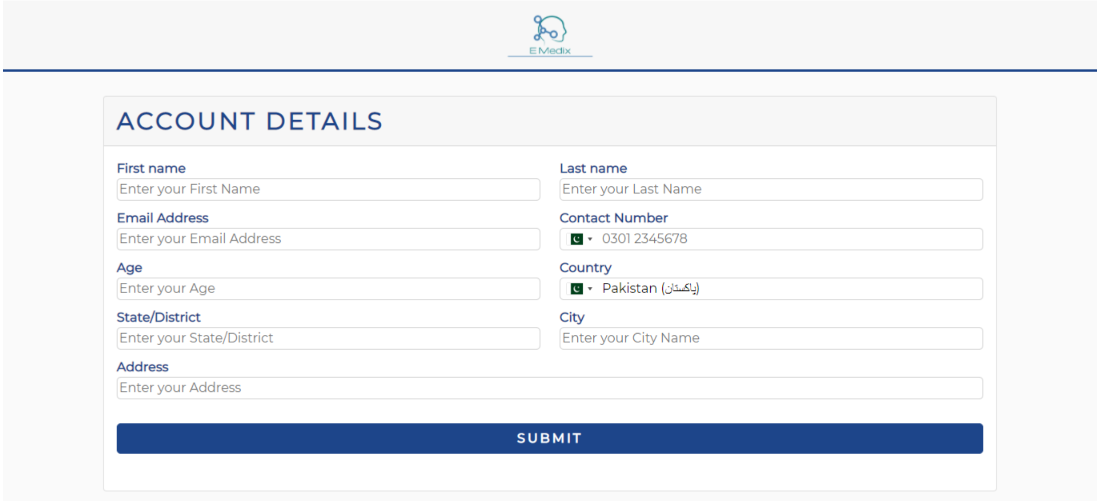


FIGURE 4.3: Login

4.3.4 Patient Details



ACCOUNT DETAILS

First name
Enter your First Name

Last name
Enter your Last Name

Email Address
Enter your Email Address

Contact Number
0301 2345678

Age
Enter your Age

Country
Pakistan (پاکستان)

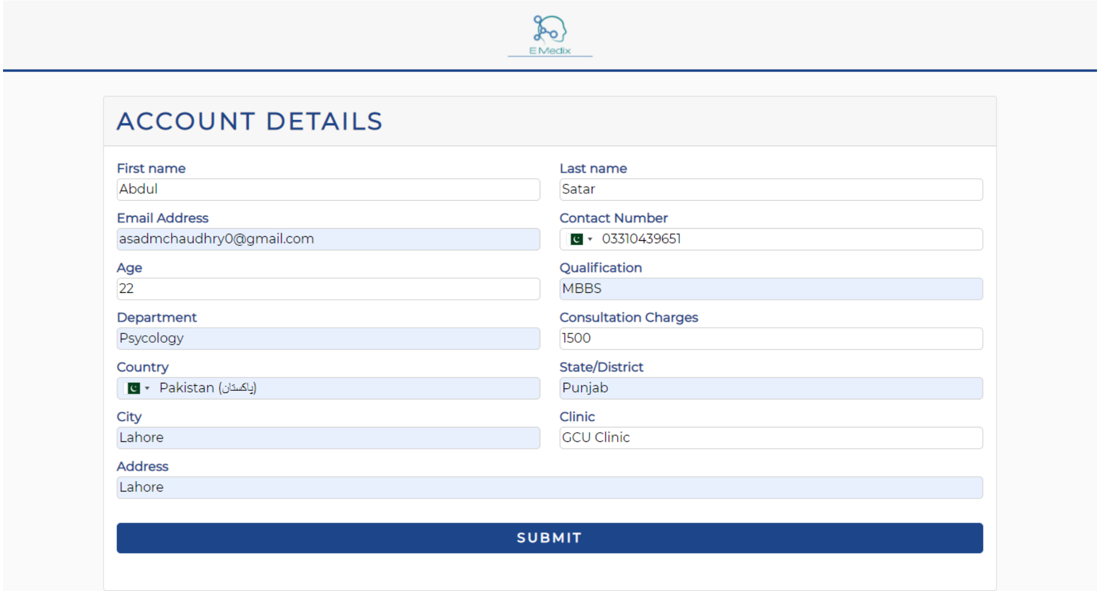
State/District
Enter your State/District

City
Enter your City Name

Address
Enter your Address

FIGURE 4.4: Patient Dashboard

4.3.5 Doctor Details



ACCOUNT DETAILS

First name
Abdul

Last name
Satar

Email Address
asadmchaudhry0@gmail.com

Contact Number
03310439651

Age
22

Qualification
MBBS

Department
Psycology

Consultation Charges
1500

Country
Pakistan (پاکستان)

State/District
Punjab

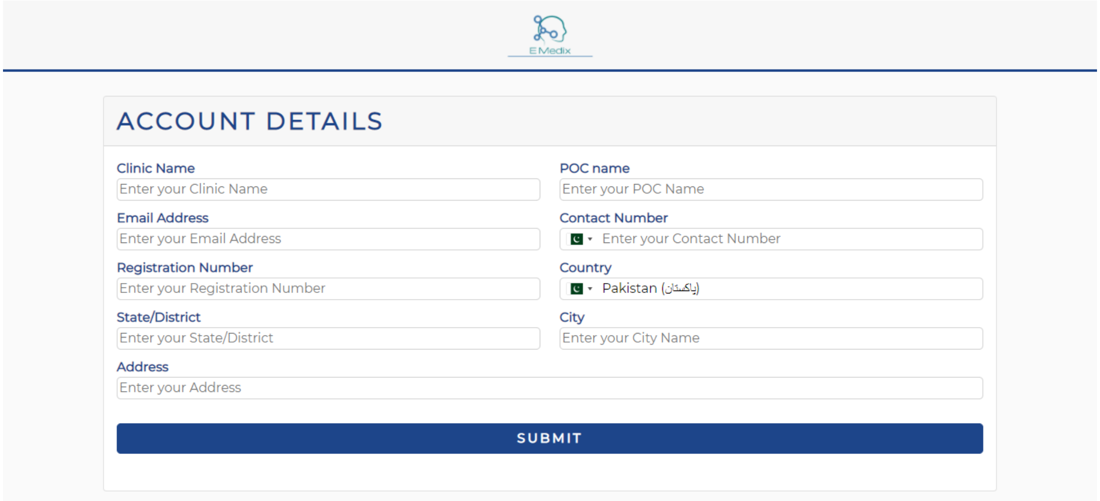
City
Lahore

Clinic
GCU Clinic

Address
Lahore

FIGURE 4.5: Doctor Dashboard

4.3.6 Clinic Details



ACCOUNT DETAILS

Clinic Name
Enter your Clinic Name

POC name
Enter your POC Name

Email Address
Enter your Email Address

Contact Number
Enter your Contact Number

Registration Number
Enter your Registration Number

Country
Pakistan (پاکستان)

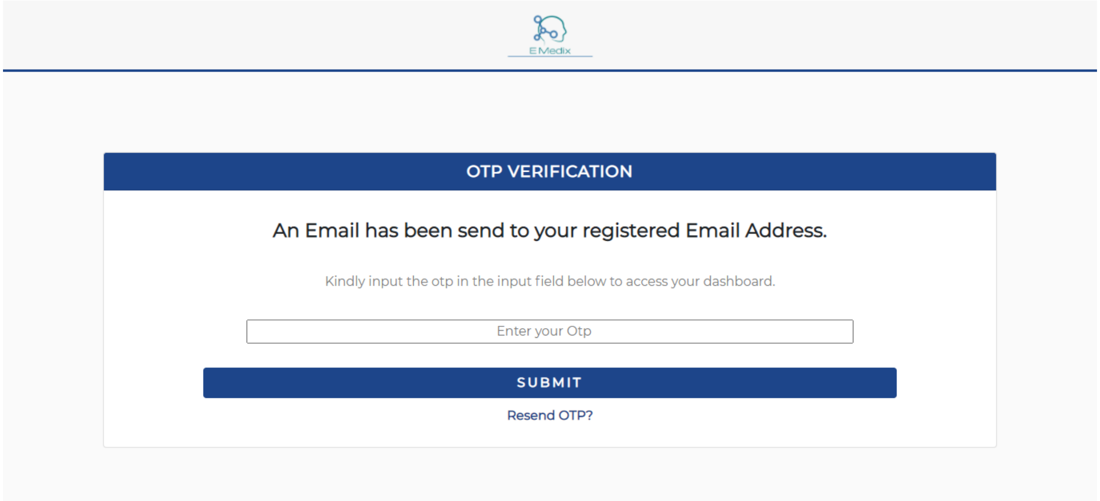
State/District
Enter your State/District

City
Enter your City Name

Address
Enter your Address

FIGURE 4.6: Clinic Dashboard

4.3.7 Two Factor Verification



OTP VERIFICATION

An Email has been send to your registered Email Address.

Kindly input the otp in the input field below to access your dashboard.

Enter your Otp

FIGURE 4.7: Two Factor Verification

4.3.8 OTP Email

infoemedixhealthcare@gmail.com

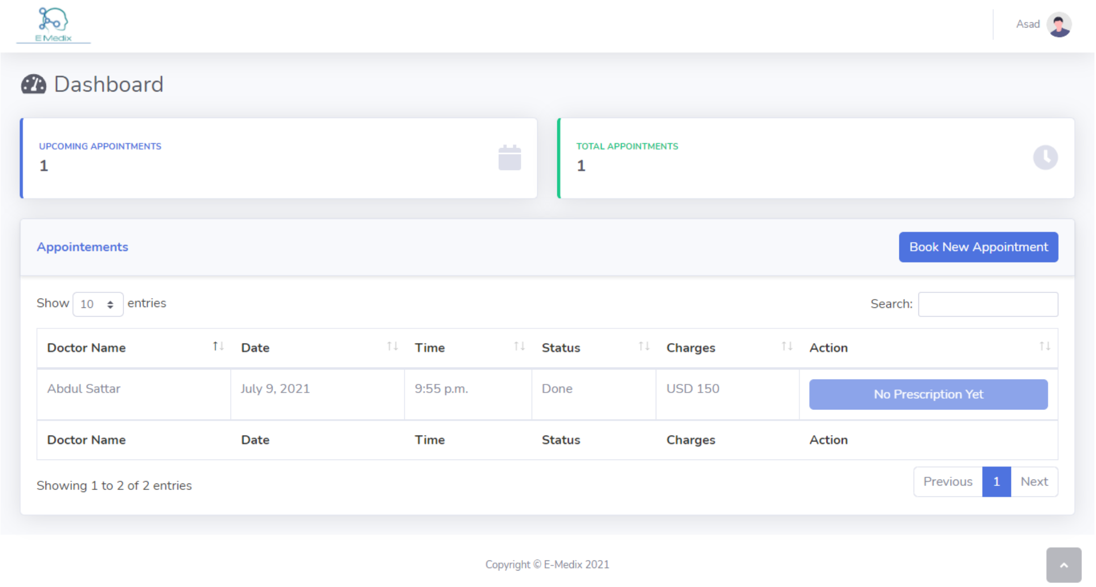
to me

2:29 AM (7 hours ago)

Your One Time Password is: 2891

FIGURE 4.8: OTP Email

4.3.9 Patient Dashboard



Dashboard

UPCOMING APPOINTMENTS

1

TOTAL APPOINTMENTS

1

Appointements

Show 10 entries

Search:

Doctor Name	Date	Time	Status	Charges	Action
Abdul Sattar	July 9, 2021	9:55 p.m.	Done	USD 150	No Prescription Yet
Doctor Name	Date	Time	Status	Charges	Action

Showing 1 to 2 of 2 entries

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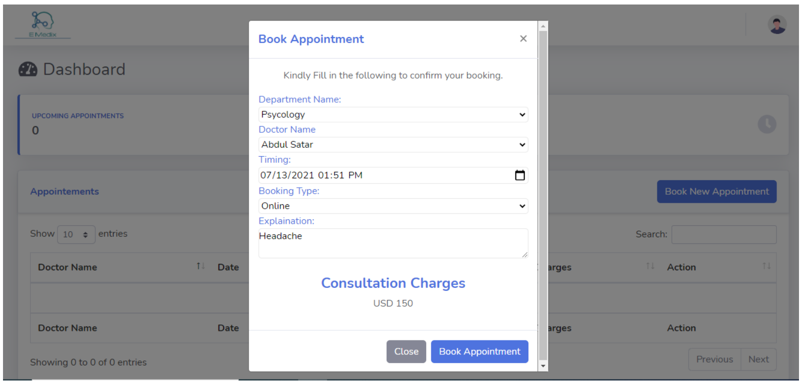
FIGURE 4.9: Patient Dashboard

4.3.10 Book Appointment



Book Appointment

Kindly Fill in the following to confirm your booking.

UPCOMING APPOINTMENTS 0

Department Name: Psycology

Doctor Name: Abdul Satar

Timing: 07/13/2021 01:51 PM

Booking Type: Online

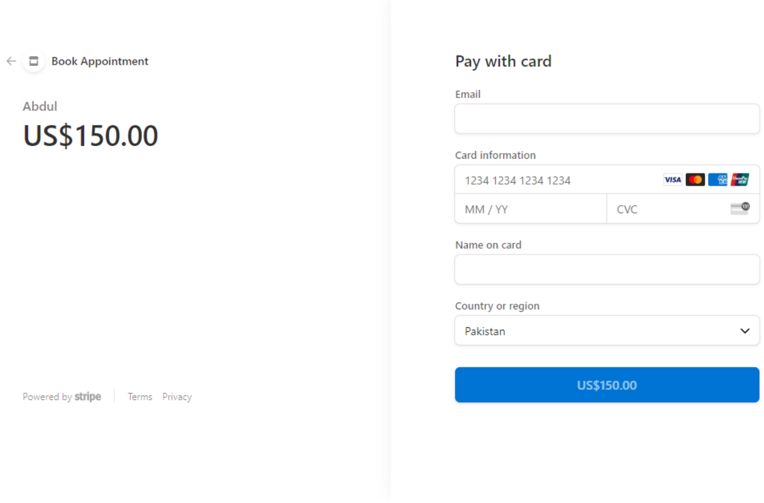
Explaination: Headache

Consultation Charges

USD 150

FIGURE 4.10: Book Appointment

4.3.11 Payment



Abdul

US$150.00

Pay with card

Email

Card information

1234 1234 1234 1234

MM / YY

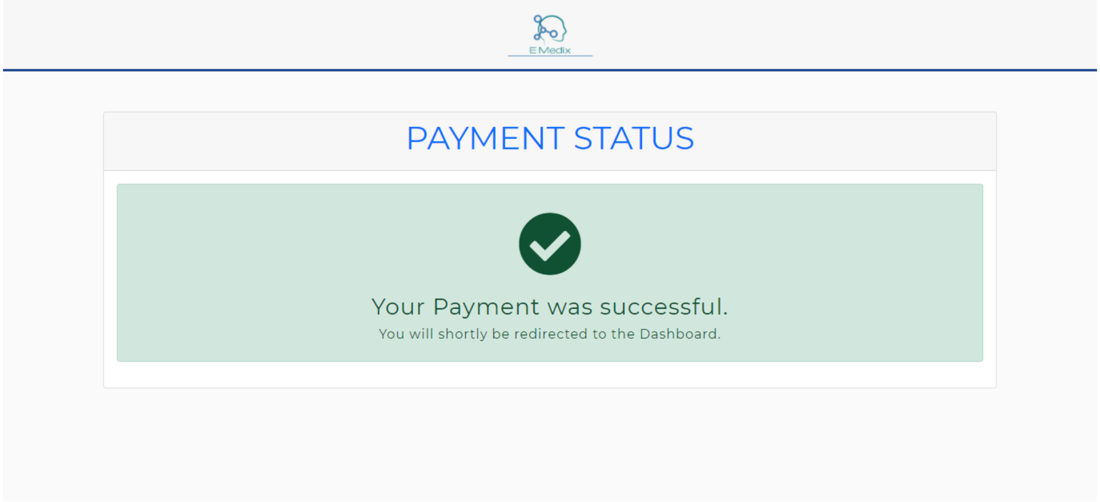
CVC

Name on card

Country or region: Pakistan

FIGURE 4.11: Payment

4.3.12 Payment Success



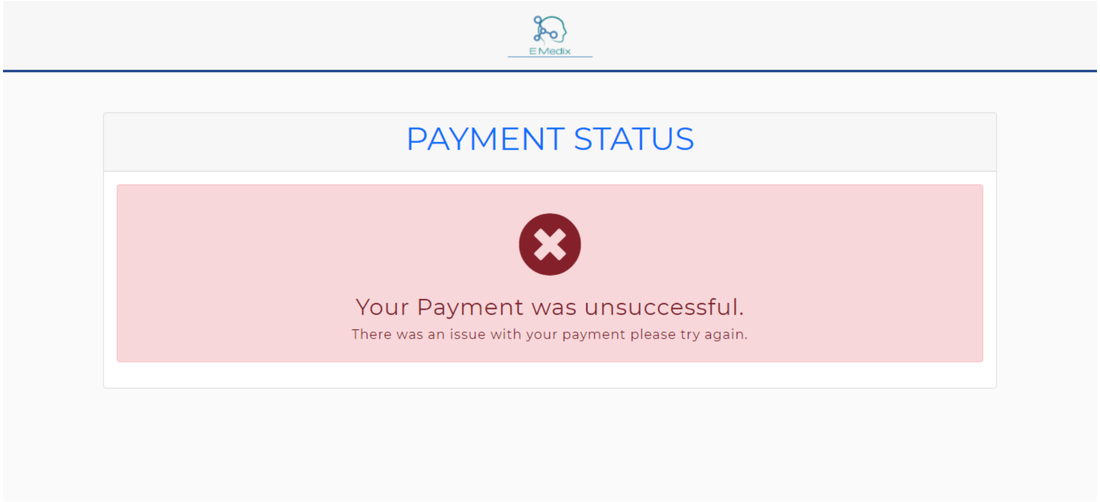
PAYMENT STATUS

Your Payment was successful.

You will shortly be redirected to the Dashboard.

FIGURE 4.12: Payment Success

4.3.13 Payment Error



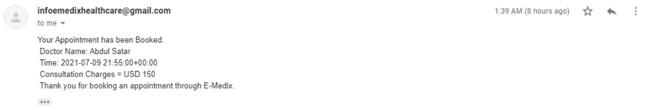
PAYMENT STATUS

Your Payment was unsuccessful.

There was an issue with your payment please try again.

FIGURE 4.13: Payment Error

4.3.14 Confirmation Email Patient



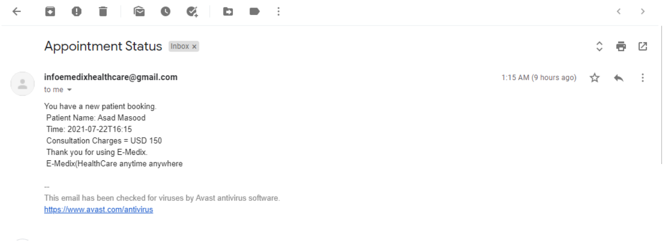
infoemedixhealthcare@gmail.com
to me

1:39 AM (8 hours ago)

Your Appointment has been Booked.
Doctor Name: Abdul Satar
Time: 2021-07-09 21:55:00+00:00
Consultation Charges = USD 150
Thank you for booking an appointment through E-Medix.

Figure 4.14: Confirmation Email Patient

4.3.15 Confirmation Email Doctor



Appointment Status

infoemedixhealthcare@gmail.com
to me

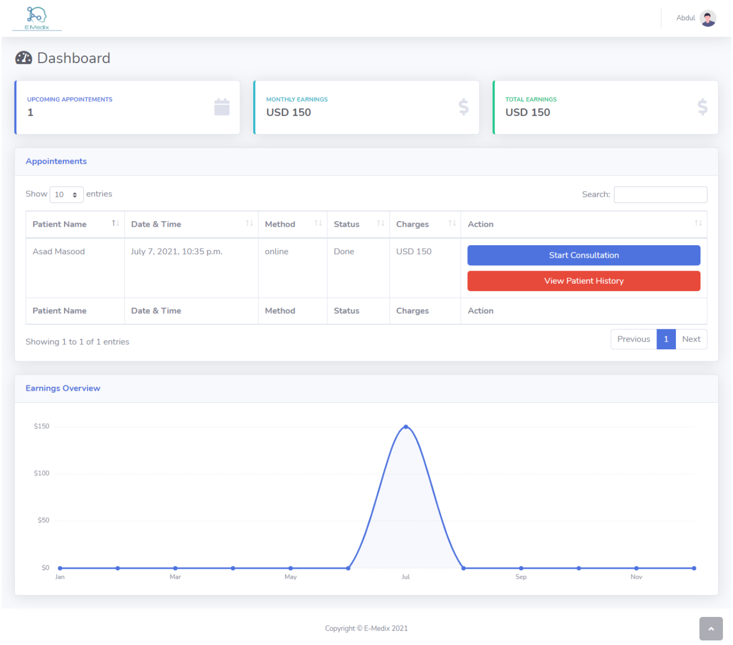
1:15 AM (9 hours ago)

You have a new patient booking.
Patient Name: Asad Masood
Time: 2021-07-22T16:15
Consultation Charges = USD 150
Thank you for using E-Medix.
E-Medix(HealthCare anytime anywhere

--
This email has been checked for viruses by Avast antivirus software.
https://www.avast.com/antivirus

Figure 4.15: Confirmation Email Doctor

4.3.16 Doctor Dashboard



Dashboard

UPCOMING APPOINTEMENTS
1

MONTHLY EARNINGS
USD 150

TOTAL EARNINGS
USD 150

Appointements

Show 10 entries Search:

Patient Name	Date & Time	Method	Status	Charges	Action
Asad Masood	July 7, 2021, 10:35 p.m.	online	Done	USD 150	Start Consultation View Patient History
Patient Name	Date & Time	Method	Status	Charges	Action

Showing 1 to 1 of 1 entries

Earnings Overview

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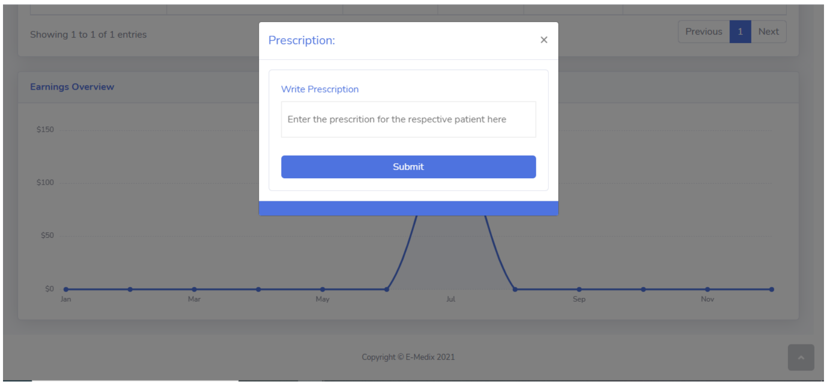
FIGURE 4.16: Doctor Dashboard

4.3.17 Prescribe Patient



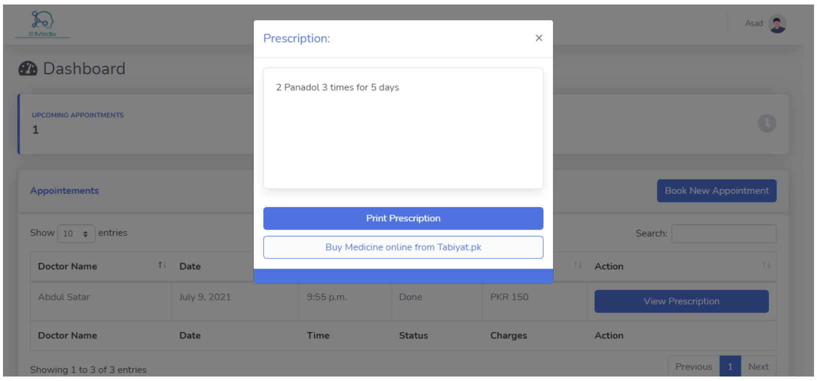
Prescription:

Write Prescription

Enter the prescrition for the respective patient here

FIGURE 4.17: Prescribe Patient

4.3.18 View Prescription



Asad

Dashboard

UPCOMING APPOINTMENTS
1

Appointements

Book New Appointment

Show 10 entries

Search:

Doctor Name	Date	Time	Status	Charges	Action
Abdul Satar	July 9, 2021	9:55 p.m.	Done	PKR 150	View Prescription
Doctor Name	Date	Time	Status	Charges	Action

Showing 1 to 3 of 3 entries

Previous 1 Next

Prescription: ×

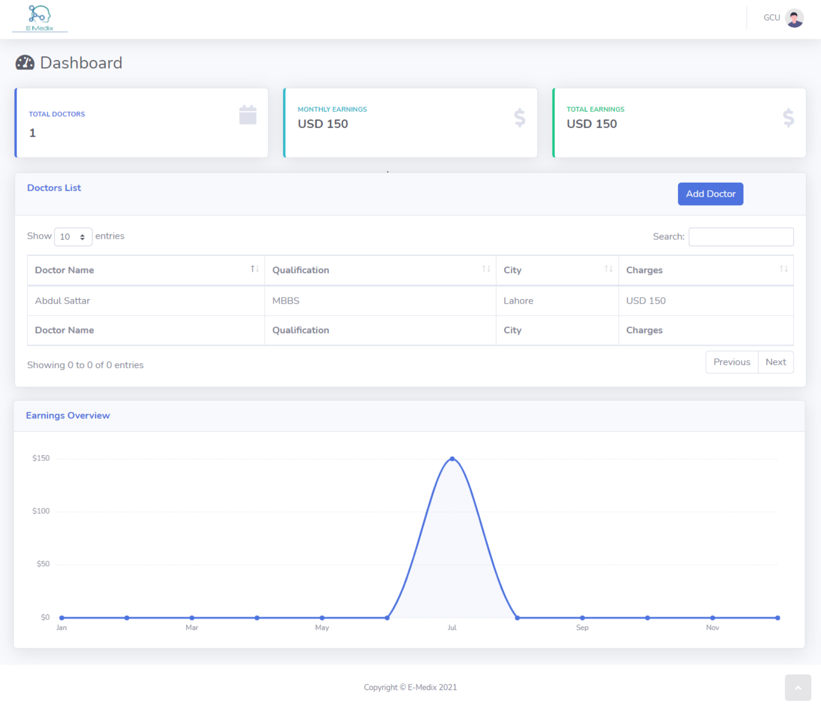
2 Panadol 3 times for 5 days

Print Prescription

Buy Medicine online from Tabiyat.pk

FIGURE 4.18: View Prescription

4.3.19 Clinic Dashboard



GCU

Dashboard

TOTAL DOCTORS
1

MONTHLY EARNINGS
USD 150

TOTAL EARNINGS
USD 150

Doctors List

Add Doctor

Show 10 entries

Search:

Doctor Name	Qualification	City	Charges
Abdul Sattar	MBBS	Lahore	USD 150
Doctor Name	Qualification	City	Charges

Showing 0 to 0 of 0 entries

Previous Next

Earnings Overview

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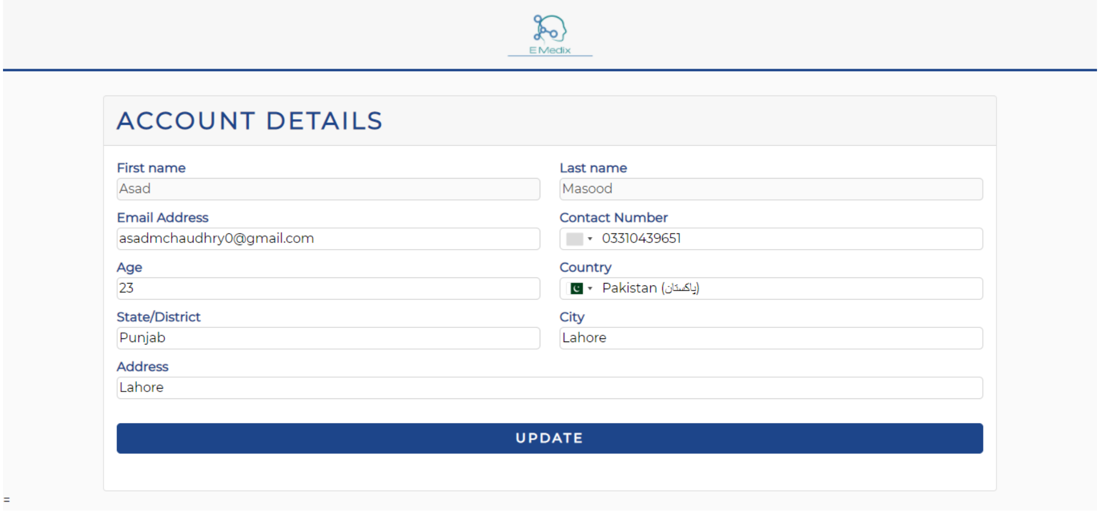
FIGURE 4.19: Clinic Dashboard

4.3.20 Update Patient Details



ACCOUNT DETAILS

First name
Asad

Last name
Masood

Email Address
asadmchaudhry0@gmail.com

Contact Number
03310439651

Age
23

Country
Pakistan (پاکستان)

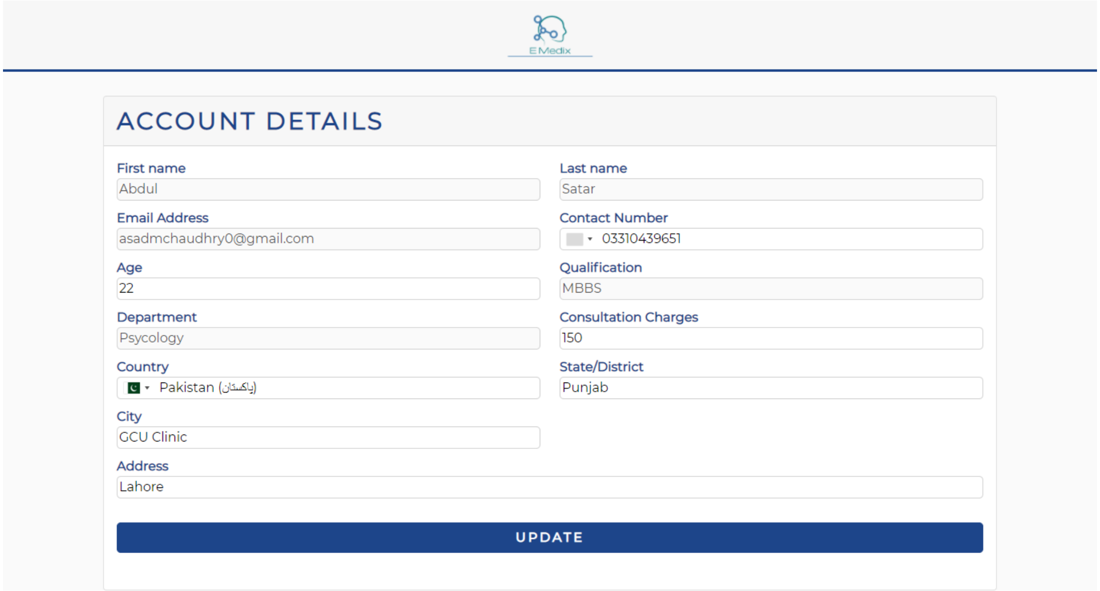
State/District
Punjab

City
Lahore

Address
Lahore

FIGURE 4.20: Update Patient Details

4.3.21 Update Doctor Details



ACCOUNT DETAILS

First name
Abdul

Last name
Satar

Email Address
asadmchaudhry0@gmail.com

Contact Number
03310439651

Age
22

Qualification
MBBS

Department
Psycology

Consultation Charges
150

Country
Pakistan (پاکستان)

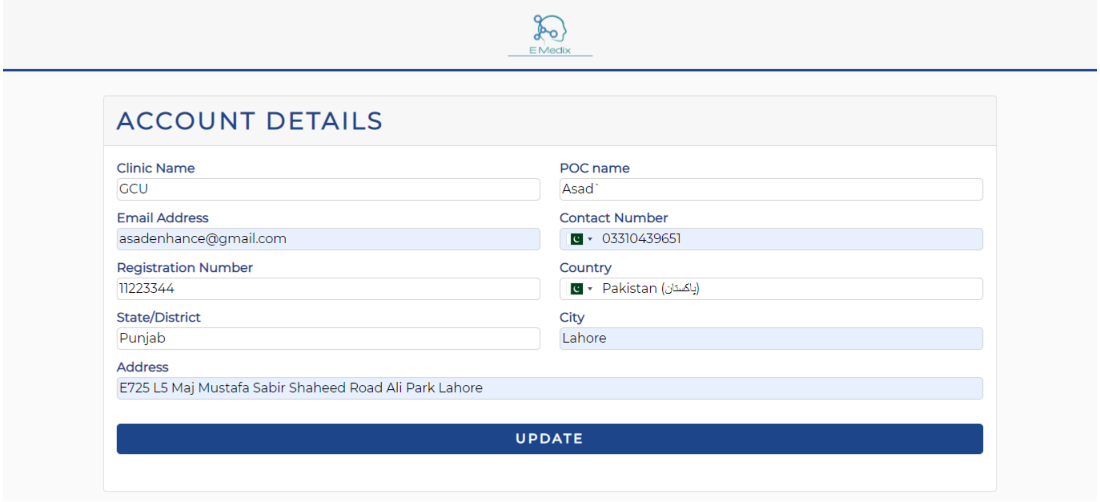
State/District
Punjab

City
GCU Clinic

Address
Lahore

FIGURE 4.21: Update Doctor Details

4.3.22 Update Clinic Details



ACCOUNT DETAILS

Clinic Name
GCU

POC name
Asad`

Email Address
asadenhance@gmail.com

Contact Number
03310439651

Registration Number
11223344

Country
Pakistan (پاکستان)

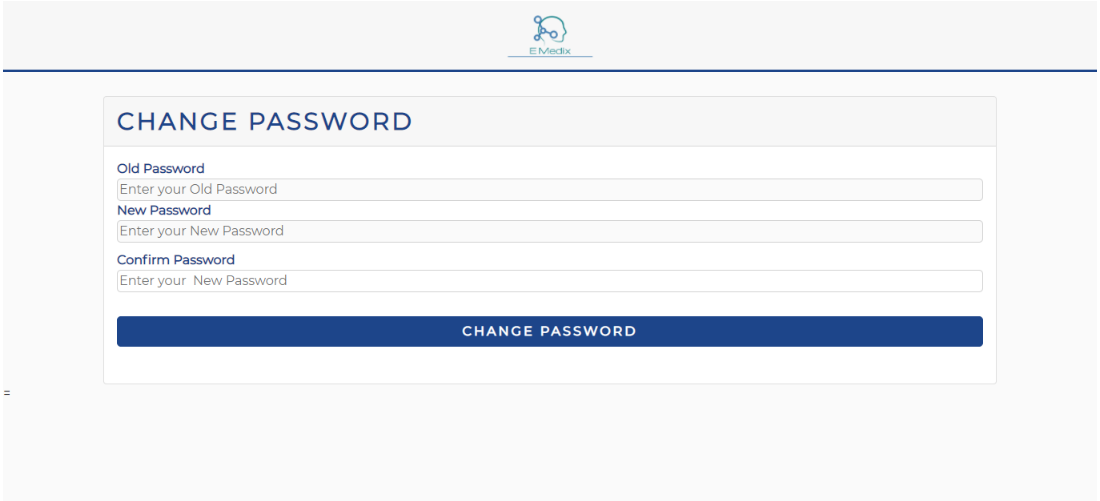
State/District
Punjab

City
Lahore

Address
E725 L5 Maj Mustafa Sabir Shaheed Road Ali Park Lahore

FIGURE 4.22: Update Clinic Details

4.3.23 Change Password



CHANGE PASSWORD

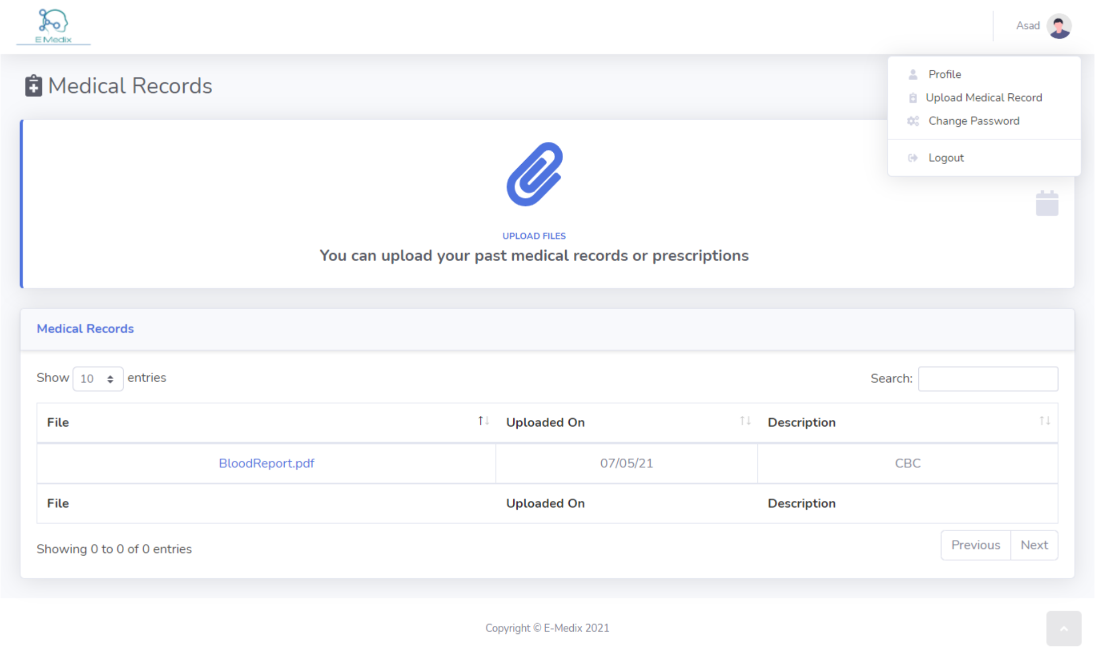
Old Password
Enter your Old Password

New Password
Enter your New Password

Confirm Password
Enter your New Password

FIGURE 4.23: Change Password

4.3.24 Upload Medical Records



Medical Records

UPLOAD FILES

You can upload your past medical records or prescriptions

Medical Records

File	Uploaded On	Description
BloodReport.pdf	07/05/21	CBC
File	Uploaded On	Description

Showing 0 to 0 of 0 entries

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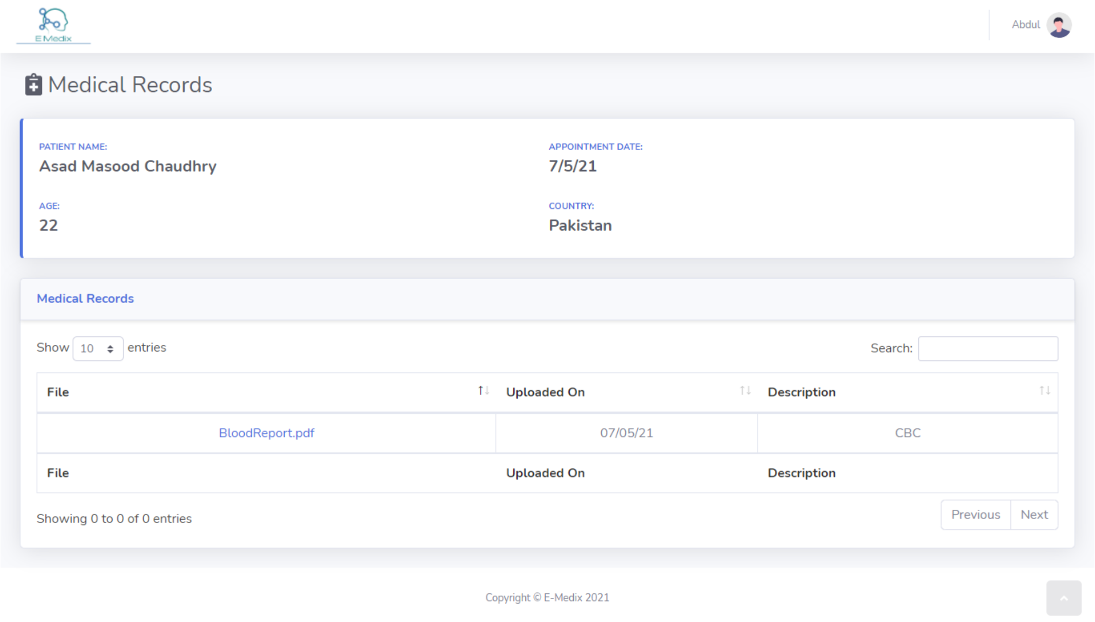
FIGURE 4.24: Upload Medical Records

4.3.25 View Medical Records



Medical Records

PATIENT NAME: Asad Masood Chaudhry

APPOINTMENT DATE: 7/5/21

AGE: 22

COUNTRY: Pakistan

Medical Records

File	Uploaded On	Description
BloodReport.pdf	07/05/21	CBC
File	Uploaded On	Description

Showing 0 to 0 of 0 entries

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FIGURE 4.25: View Medical Records

4.3.26 Video Consultancy

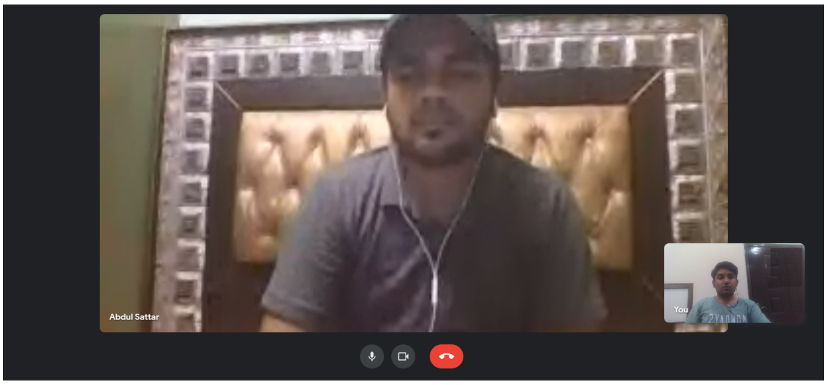

Figure 4.26: Video Consultancy

4.4 Evaluation

After the complete implementation of the code of each module they were integrated together as one unit to perform the complete functionalities. The resultant web application was then ready to be tested. Multiple tests were conducted and the detected errors were omitted.Different types of tests resulted in the detection of different types of errors. We conducted tests for back end code, tests for front end code, tests for the database connectivity, general feature testing, etc. It is certain that the web application will undergo changes once it is presented in front of the end user. These changes can occur due to several possible reasons. The system could be requesting some unexpected input from the user. Once the web application is being used by the end user the developer can analyze the requirement of some additional component or may find it necessary to modify the existing component. Changes in code have a great impact on the overall working of the web application. Testing processes were executed to ensure that each module is working as per the requirements after the changes in code have been made and any abnormality detected is immediately reported and removed. Near the completion of the project, we tested the application thoroughly, testing each individual form and button. We made sure that each module of the web application is working as expected in the form of a single unit.

- All tests were conducted to aid the user experience and requirements.
- Tests were organized and planned before the testing process begun.
- Third party services were availed to make the testing accurate.

4.5 Unit Testing

Testing is performed once the cohesion of framework is finalized. The purpose of the testing is to guarantee the rightness of the web application as far as the working of the modules is concerned. The criteria and steps of testing are laid out before the testing processes are initiated. The unit testing is centered around the rationals of interior preparing and all information structures introduced within the limits of the module. During unit testing we test every module independently. The testing engineer has the adaptability of changing the module undergoing the test until the required output is extracted from the module. We gave tested every module of our web application individually during the unit testing phase. During the unit testing if any error rises we know exactly which module to cater to remove the error.

Chapter 4.6 discusses the test cases executed during the unit testing phase:

4.6 Unit Tests

Table 4.1: Test Cases

Test Case No.	Test Case Short Description
TC-01	Register
TC-02	Login
TC-03	Two Factor Verification
TC-04	Add Patient Details
TC-05	Add Doctor Details
TC-06	Add Clinic Details
TC-07	Book Appointment
TC-08	View Past Appointments
TC-09	Order Medicines
TC-10	Print Prescription
TC-11	View Past Prescriptions
TC-12	Consult Patient
TC-13	Notify Patient
TC-14	Prescribe Patient
TC-15	Analyze Earnings
TC-16	View Doctors
TC-17	Change Password
TC-18	Update Profile
TC-19	Upload Medical Records
TC-20	View Patient History

4.6.1 TC-01 Register

Table 4.2: TC-01 Register

Test Case ID	01
Title	Register
Description	User must register/sign up in order to get access to the platform.
Input	User must have the access to the home page of the website.
Steps to Perform	• User Visit the Home Page then click on Sign Up Button. • He or she must select the user type i.e Patient, Doctor or Clinic. • He or she must set Username and Password. • Then he must press the sign up button.
Output	User is added to the E-Medix Platform.

4.6.2 TC-02 Login

TABLE 4.3: TC-02 Login

Test Case ID	02
Title	Login
Description	User Logs in to use the respective functionalities of specified Dashboard.
Input	User must already be registered to the platform and enter valid username and password.
Steps to Perform	• User Visit the Home Page then click on Log in Button. • He or she must enter valid Username and Password. • Then he must press the login button.
Output	User is logged in to E-Medix Platform.

4.6.3 TC-03 Two Factor Verification

Table 4.4: TC-03 Two Factor Verification

Test Case ID	03
Title	Two Factor Verification
Description	A four digit One time password should be entered to complete the login process.
Input	User must already have entered their valid username and password on the login screen.
Steps to Perform	• User enters the 4 digit one time password. • He or she must click on the submit button.
Output	User is redirected to their respective Dashboard.

4.6.4 TC-04 Add Patient Details

TABLE 4.5: TC-04 Add Patient Details

Test Case ID	04
Title	Add Patient Details
Description	The Patient user adds the required information.
Input	The user must have selected the user type ”Patient” when signing up.
Steps to Perform	• User signs up for the first time. • User then entered all the required information the patient users needs to enter. • User then presses the submit button
Output	User is redirected to the Patient Dashboard.

4.6.5 TC-05 Add Doctor Details

Table 4.6: TC-05 Add Doctor Details

Test Case ID	05
Title	Add Doctor Details
Description	The Doctor user adds the required information.
Input	The user must have selected the user type ”Doctor” when signing up.
Steps to Perform	• User signs up for the first time. • User then entered all the required information the doctor users needs to enter. • User then presses the submit button
Output	User is redirected to the Doctor Dashboard.

4.6.6 TC-06 Add Clinic Details

Table 4.7: TC-06 Add Clinic Details

Test Case ID	06
Title	Add Clinic Details
Description	The Clinic user adds the required information.
Input	The user must have selected the user type ”Clinic” when signing up.
Steps to Perform	• User signs up for the first time. • User then entered all the required information the Clinic users needs to enter. • User then presses the submit button
Output	User is redirected to the Clinic Dashboard.

4.6.7 TC-07 Book Appointment

Table 4.8: TC-07 Book Appointment

Test Case ID	07
Title	Book Appointment
Description	The user books an appointment to consult their medical issues with a doctor.
Input	The user books an appointment as per their requirements and pays for it.
Steps to Perform	• User clicks on the book appointment button. • User then selects the department and doctor and adds the required information. • User then goes on to the payment screen. • User pays for booking fees. • The user is redirected to a payment status screen.
Output	The appointment is successfully booked.

4.6.8 TC-08 View Past Appointments

TABLE 4.9: TC-08 View Past Appointments

Test Case ID	08
Title	View Past Appointments
Description	The User views all the past appointments they have ever had.
Input	The user opens the dashboard.
Steps to Perform	• User logs in as a patient. • User completes the two factor verification. • User scrolls down to the bookings table.
Output	The User can view the details of all their past appointments.

4.6.9 TC-09 Order Medicines

Table 4.10: TC-09 Order Medicines

Test Case ID	09
Title	Order Medicines
Description	The User orders medicines from a third party website Tabiyat.pk.
Input	The user opens a specific prescription.
Steps to Perform	• User clicks on the view prescription button. • The user then clicks on the buy medicines from Tabiyat.pk button.
Output	The User is redirected to the Tabiyat.pk website.

4.6.10 TC-10 Print Prescription

Table 4.11: TC-10 Print Prescription

Test Case ID	10
Title	Print Prescription
Description	The User gets a printed form of prescription.
Input	The user opens a specific prescription.
Steps to Perform	• User clicks on the view prescription button. • The user then clicks on the print prescription button.
Output	The User receives a printing options popup.

4.6.11 TC-11 View Past Prescriptions

Table 4.12: TC-11 View Past Prescriptions

Test Case ID	11
Title	View Past Prescriptions
Description	The user views the prescriptions of any past appointment.
Input	The user logs in and scrolls down to the appointments table.
Steps to Perform	• The user logs in as a patient. • User clicks on the view prescription button.
Output	The User receives a prescription modal.

4.6.12 TC-12 Consult Patient

Table 4.13: TC-12 Consult Patient

Test Case ID	12
Title	Consult Patient
Description	The User consults their patients over a video call.
Input	The User is logged in as a doctor and a patient has booked an online appointment with them.
Steps to Perform	• The user logs in as a Doctor. • User clicks on the consult patient button.
Output	The User is redirected to a video call screen and the respective patient is sent a link to the video call

4.6.13 TC-13 Notify Patient

Table 4.14: TC-13 Notify Patient

Test Case ID	13
Title	Notify Patient
Description	The User notifies the patient that they have an appointment with them.
Input	The user logs in and scrolls down to the bookings table.
Steps to Perform	• The user logs in as a Doctor. • User clicks on the Notify Patient button.
Output	The respective patient is sent a reminder email

4.6.14 TC-14 Prescribe Patient

Table 4.15: TC-14 Prescribe Patient

Test Case ID	14
Title	Prescribe Patient
Description	The User Prescribes a patient that they have consulted recently.
Input	The user logs in and scrolls down to the bookings table.
Steps to Perform	• The user logs in as a Doctor. • User clicks on the Prescribe Patient button. • User inputs the prescription for the respective patient.
Output	The prescription is sent to the prescribed patient.

4.6.15 TC-15 Analyze Earnings

Table 4.16: TC-15 Analyze Earnings

Test Case ID	15
Title	Analyze Earnings
Description	The User keeps track of their earnings.
Input	The user logs in to the system.
Steps to Perform	• The user logs in. • User sees tabs of total and monthly earnings on the dashboard. • The user scrolls down to the graph. • The line graph shows the comparison of the earning in each month.
Output	The User can analyze and keep track of their earnings.

4.6.16 TC-16 View Doctors

Table 4.17: TC-16 View Doctors

Test Case ID	16
Title	View Doctors
Description	The User views all the doctors registered under their name.
Input	The user logs in to the system and scrolls down to the doctors table.
Steps to Perform	• The user logs in. • User scrolls down to the doctors table.
Output	The Clinic User can view all the doctors registered under their name.

4.6.17 TC-17 Change Password

Table 4.18: TC-17 Change Password

Test Case ID	17
Title	Change Password
Description	The User changes their existing password.
Input	The user logs in to the system and scrolls down to the doctors table.
Steps to Perform	• The user logs in. • User clicks on the drop down on the dashboard • User clicks on the change password button • User enters the old and new password • the use then presses the change password button
Output	The User's current password is changed.

4.6.18 TC-18 Update Profile

TABLE 4.19: TC-18 Update Profile

Test Case ID	18
Title	Update Profile
Description	The User updates the information stored inside the system.
Input	The user is logged in and has already provided the details.
Steps to Perform	• The user logs in. • User clicks on the drop down on the dashboard • User clicks on the update profile button • User then adds the information that they need to update. • User then clicks on the update profile button.
Output	The User's information is updated.

4.6.19 TC-19 Upload Medical Record

TABLE 4.20: TC-19 Upload Medical Record

Test Case ID	19
Title	Upload Medical Record
Description	The patient user uploads their medical records to enhance their experience of online consultancy and maintain records.
Input	The user is logged in as a patient.
Steps to Perform	• The user logs in. • User clicks on the drop down on the dashboard • User clicks on the Upload Medical Records button • User then clicks on upload files • User then selects the desired file to be uploaded.
Output	The User's medical record is uploaded.

4.6.20 TC-20 View Patient History

Table 4.21: TC-20 View Patient History

Test Case ID	20
Title	View Patient History
Description	The doctor user Views the medical history of a patient before consulting them.
Input	The user is logged in as a doctor.
Steps to Perform	• The user logs in. • User clicks on View Patient History Button.
Output	The User can now view the medical records of the respective patient.

4.7 Functional Testing

Functional Testing phase is performed once all the individuals modules are linked together to perform the complete functioning of the web application as one unit. We also perform integration testing of the system during the functional testing phase. One of the functional testing test cases is logging in and completing two factor verification to view the dashboard. If the user tries to enter the dashboard URL without logging in or completing the two factor verification they are redirected to the login page. Our system first recognises if the user is logged in or not. Once the credentials are matched it goes on to the two factor verification. A four digit One time password is sent to the user's email. The user then enters the One time password, the system compares the entered one time password with the one generated by the system and upon successful matching of the both the user is given the access to the respective Dashboard i.e Patient Dashboard, Doctor Dashboard or Clinic Dashboard.

4.7.1 Testing Requirements

The main requirement for the testing procedure is the requirement for the dummy data. Dummy data needs to be entered into the system to ensure the proper working of each component of the web application.Large amount of data must be flooded into the system to ensure the load optimization of the system. The most convenient way of doing it is by running an automated script for the testing purposes that automates several hundred users to access the web application simultaneously.

Chapter 5

Conclusion & Future Work

5.1 Conclusion

Upon the completion of the project of E-Medix we conclude that the web application proposed is a major turnover in the health care industry because recently with the COVID-19 pandemic the paradigm of medical consultancy has swiftly shifted towards online consultancy. With this increasing need of online healthcare systems there are only a few service providers. This difference in the demand and supply makes our system a very essential addition to the health care industry. During the pandemic, going to a doctor is the most dangerous thing to do. A doctor's clinic is the place at which person is the most vulnerable to the virus. With our system patients and doctors can stay at their homes and perform their part. A patient can book an online appointment from the comfort of their house and the doctor can consult the patient from the comfort of their house. In future once the pandemic is over the in clinic appointments may again get popular amongst the population. For that situation our platform also allows the patient to book on clinic appointments. In future we are looking forward to also implementing an intelligent chat bot into the system that may analyze your symptoms and suggest the best possible doctor for you. It is already a work in progress but due to the detailed and sensitive nature of the work it requires a very large data set for sufficient training to take such decisions. However, in the near future we will implement the chat bot into the system and it will be available to end user for testing the accuracy.

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