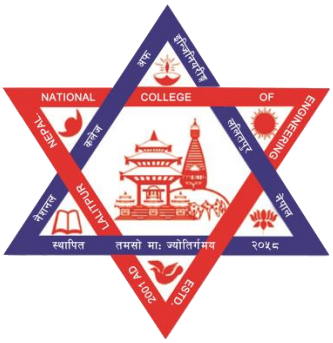

TRIBHUVAN UNIVERSITY
INSTITUTE OF
ENGINEERING

NATIONAL COLLEGE OF ENGINEERING

Home Physio

By:

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A PROJECT REPORT TO THE DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE BACHELOR'S DEGREE IN COMPUTER ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

LALITPUR, NEPAL

MAY, 2022

LETTER OF APPROVAL

The undersigned certify that they have read, and recommended to the Department of Electronics and Computer Engineering for acceptance, a project report entitled **"Home Physio"** submitted by **Monika Shakya, Oshin Shrestha, Ranjila Shrestha and Urja Bajracharya** in partial fulfillment of the requirements for the Bachelor's Degree in Computer Engineering.

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ABSTRACT

‘Home Physio' is a website where patients can book appointments for home physiotherapy sessions who are unable to visit a clinic or hospital for an extended period of time or on a regular basis. This website also aims to provide a freelancing platform for physiotherapists. The patients and physiotherapists gain access to the website through a registration form and an email confirmation after which, distinct dashboards for the users are provided for accessing the system features. The therapist can provide and update their available time slot, respond to the appointment request made by patient and view their appointment schedule and the patients can choose from a range of physiotherapists based on gender, location and specialization. The payable amount will be computed by adding the consultation fee and the distance-based travel fee. The user locations are utilized to compute the distance between the therapist and the patient using the Haversine formula. All the transactions are handled by the system itself using payment gateway.

Keywords: Physiotherapy, User, Physiotherapist, Patient, Appointment, Home

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATION

ADO	ActiveX Data Objects
AJAX	Asynchronous JavaScript And Xml
API	Application Programming Interface
CIL	Common Intermediate Language
CLR	Common Language Runtime
CRUD	Create Read Update and Delete
CSS	Cascading Style Sheets
DOM	Document Object Model
DVCS	Distributed Version Control System
GIS	Geographic Information System
HTML	Hyper Text Markup Language
IIS	Internet Information Services
JS	Java Script
JSON	JavaScript Object Notation
KB	Kilo Byte
KM	Kilo Meter
MVC	Model View Controller
.NET	Network Enabled Technologies
RDBMS	Relational Database Management System
SCT	Systems And Computer Technology
SPA	Single Page Application
SQL	Structured Query Language
TDD	Test Driven Development
UI	User Interface
XHR	XML Http Request
XML	Extensible Markup Language

1. INTRODUCTION

1.1. Background

Physiotherapy, often known as physical therapy is an allied health profession that uses biomechanics or kinesiology, manual therapy, exercise therapy, and electrotherapy to assist patients in regaining, maintaining, and improving their physical mobility, strength, and function. Physiotherapy has over the years proved its effectiveness in helping patients in restoring their health and enhancing their physical strength, function and mobility [1].

Many studies have concluded that physiotherapy services are best on physical interaction. Because physiotherapy is a service that can be required on a regular or long-term basis, it is far more convenient and beneficial for patients to receive treatment in the comfort of their own homes. It is the best options for injured and old age people who have difficulty in visiting hospitals. As many people are still hesitating to visit hospitals and clinic due to the current pandemic, home physio seems like the best option there is. There are many advantages of providing physiotherapy at home including convenience, privacy, increased comfort and involvement of family members. Despite the fact that many people require physiotherapy, our country still lacks efficient home physiotherapy services.

With the advent of the internet and technologies in our country, there have been numerous advancements in terms of arranging appointments for doctors in hospitals, but there are no efficient home visit services for physiotherapy available as of yet. Efficient web services such as “hdphysicaltherapy.com” are only used in developed countries, while such services are still in developing phase in our country. There are websites like “maitreyabodhi.com”, “healthathome.com.np”, “danphecare.com”, that provide physiotherapy services based on clinics. For appointments, patients must call their linked clinics, which appears to be more of an advertisement for the clinic than a web-based service. Patients are unable to choose their physiotherapists and these websites do not clearly disclose what services they provide or how much they charge which is inconvenient for the patients.

In Nepal, finding work as a physiotherapist is extremely tough, and these websites do not address this issue. Furthermore, because these platforms are all clinic-based and freelancing is not provided as an option, physiotherapists have very few opportunities on them.

With a user-friendly interface, “Home Physio” addresses these issues and makes overall process smoother and less stressful. It aims at managing health services related to physiotherapy by handling finance, human resource, maintenance and movement in addition to details of patients, physiotherapists and payment. It focuses on helping people who can't get to the hospital because of their injuries or medical disabilities, as well as elderly people, infants, and pregnant women. It targets people of all ages seeking relief from pain related to back, knee, neck, etc. and also get support in the related problems that occur due to certain kind of diseases like Paralysis, Parkinson’s, Stroke. This service will not only be beneficial for the patients but also will economically benefit the physiotherapist as they can work as a free-lancer. In this way, the country’s existing manpower will be utilized in the best possible way.

1.2. Problem Statement

- Home physiotherapy services are not readily available, despite their importance
- Hospital visits are now impractical as result of the ongoing pandemic
- Making appointment and visiting hospital are difficult especially for injured, disabled, and aged people
- Lack of freelancing opportunities for physiotherapists
- Lack of dedicated home physiotherapy websites
- Available websites have not disclosed the specific services and charges

1.3. Aim and Objective

Aim

- The main aim of this project is to develop a digitally efficient and feasible home physiotherapy service website.

Objective

- To enable patients to book appointments
- To enable physiotherapists to approve appointments
- To view physiotherapist within 5 km of the patients

1.4. Scope of Project

- This system patients from infants to old age.
- The physiotherapists have to be at least 18 years old to access this website.
- The project's scope is confined to the Kathmandu valley.
- Khalti is the only payment gateway used.

1.5. Organization of the Report

The organization of the report is done in the following ways:

1. Chapter 1: It includes the introduction about the problem and the method we are trying to employ to solve it.
2. Chapter 2: It includes the Literature Review about the works related to the project and the notable works prevailing prior to this project development with their results.
3. Chapter 3: It includes the methodology, theoretical background required for the development of the project and the system design.
4. Chapter 4: It includes the output result of the project.
5. Chapter 5: It includes the analysis and the result of the tests we carried out in the project.
6. Chapter 6: It describes the conclusion of the project.
7. Chapter 7: It includes the future enhancements of the project.

2. LITERATURE REVIEW

Apostolakis [2] performed an overview of web 2.0 applications and compared their features to traditional web services under the prism of the medical community and its needs. The advent of web in this era increased the prominence of health services & attracted the interest of both practitioners and patients. This article provided a bird's eye view into the influence of Web in the structure of the community for health care and described how medical information can be used in favor of the community.

Several recent studies [3], [4] have concluded that people receiving physiotherapy service at home had better mental health, were more cooperative and had better experience that those who went to clinics and hospitals.

According to Moffatt & Eley [5], there were many benefits of tele-health system in modern people lives having busy schedules. Tele-health technology has improved the health care system in every way.

The case study on Pathao served as a reference for calculating the distance fare for the service we are providing through our website [6].

A student group at Southern University of Bangladesh created an application that connects between Doctor and Patients using web and android apps and patients are able to search a doctor and ask for his/her appointment as well as for prescription using their Smartphone [7]. This system provides services in regard to connecting doctor and patient very quickly and easily from any location without the involvement of any third party.

Malik, Bibi, Khan, et.al wrote an article on a system "Mr. Doc" [8] which is an android app that provides ease and comfort to patients while taking appointment from doctors and it also resolved the problems that the patients have to face while making an appointment. The android application acts as client whereas the database containing user's detail and appointment details is maintained by the website that acts as server.

3. METHODOLOGY

3.1. Theoretical background

3.1.1. MVC

Model-View-Controller (MVC) is a software design pattern that is often used to construct user interfaces, data, and control logic. It stresses the separation between the business logic and the appearance of the software. This "separation of concerns" allows for more efficient labor division and maintenance. The three parts of the MVC software-design pattern can be described as follows:

- Model: Manages data and business logic.
- View: Handles layout and display.
- Controller: Routes commands to the model and view parts.

3.1.2. Authentication

Authentication is the process of verifying the identity of user or information. User authentication is the process of verifying the identity of user when that user logs into a computer system. The main objective of authentication is to allow authorized users to access the computer and to deny access to the unauthorized users.

3.1.3. Authorization

Authorization is a security technique for determining user/client privileges and access levels to system resources such as files, services, computer programs, data, and application features. This is the process of granting or denying access to a network resource which allows the user access to various resources based on the user's identity.

3.1.4. CRUD operation

CRUD is a computer programming acronym that refers to the four functions that are required to develop a persistent storage application: create, read, update, and delete. Any data storage device, such as a hard disk or a solid-state drive that retains power after being turned off is referred to as persistent storage. Users can use the create function to add a new record to the database. The read command is analogous to the search command. It allows users to search for and read the values of individual records in the table. The update function is used to make

changes to existing records in the database. The delete function allows users to remove records from a database that is no longer needed.

3.1.5. Normalization

The process of normalization involves removing duplication from a relation or group of relations. In relational redundancy, insertion, deletion, and update abnormalities can occur. As a result, it aids in reducing relational redundancy. Normal forms are used in database tables to eliminate or decrease redundancy. Some types of normalization are:

- First normal form

  A relation violates first normal form if it has composite or multi-valued attributes, or it is in first normal form if it does not contain composite or multi-valued attributes. If every attribute in a relation is a single valued attribute, it is said to be in first normal form.
- Second normal form

  A relation must be in first normal form and contain no partial dependencies to be in second normal form. A relation is 2NF if it has No Partial Dependency, which means that no non-prime attribute (attributes that are not part of any candidate key) of the table is dependent on any proper subset of any candidate key.
- Third normal form

  If there is no transitive dependency for non-prime attributes and the relation is in second normal form, it is in third normal form. Every non-trivial function dependence must satisfy at least one of the following conditions for a relation to be in 3NF

  X –> Y, X is a super key.

  Y is a prime attribute (each element of Y is part of some candidate key)

3.1.6. C# Programming Language

Microsoft's.NET initiative, directed by Anders Hejlsberg, developed C#, a simple, modern, general-purpose object-oriented programming language. It is a widely used programming language that is straightforward to learn for programmers who are already familiar with C, C++, or Java. C# removes many of the complexities of C++ and adds capabilities like null able value types, enumerations, delegates, lambda expressions, and direct memory access that aren't accessible in Java. It encourages the use of generic methods, which improves the type's safety and performance.

3.2. Algorithm Used

3.2.1. Haversine Formula

The Haversine Formula is used to calculate geographic distance. If two different latitude – longitude data for two separate sites on Earth are known, the great-circle distance using the Haversine Formula (the shortest distance between two points on the surface of a sphere) can be quickly determined. Prof. James Inman created the name Haversine in 1835. When constructing a GIS (Geographic Information System) application or evaluating paths and fields, Haversine is a popular and often used formula.

Given,

Difference of latitude (ΔlatDifference) = lat1 – lat2

Difference of longitude (ΔlonDifference) = lon1 – lon2

Radius of earth (R) = 6371 km or 3961 miles

Distance computed = d

Haversine formula to calculate distance between two is:

$$a = \sin^2\left(\frac{\Delta\text{latDifference}}{2}\right) + \cos(\text{lat1}).\cos(\text{lat2}).\sin^2\left(\frac{\Delta\text{lonDifference}}{2}\right) \quad \ldots\ldots\ldots\ldots\ldots(i)$$

$$c = 2.\operatorname{atan2}\left(\sqrt{\text{a}}, \sqrt{1-\text{a}}\right) \quad \ldots\ldots\ldots\ldots\ldots(ii)$$

$$d = R.c \quad \ldots\ldots\ldots\ldots\ldots\ldots(iii)$$

3.3. Tools used

3.3.2. Frontend

3.3.2.1. HTML

HTML, or Hyper Text Markup Language, is the standard markup language for documents intended to be displayed in a web browser. It can be aided by technology like Cascading Style Sheets (CSS) and programming languages like JavaScript. Web browsers accept HTML documents from a web server or local storage and convert them to multimedia web pages. HTML semantically explains the structure of a web page and originally includes signals for the look of the content.

3.3.2.2. CSS

CSS is a style sheet language used to describe the display of a document authored in a markup language such as HTML. CSS, like HTML and JavaScript, is a foundational technology of the

World Wide Web. CSS is intended to separate display from content, including layout, colors, and fonts. This separation can improve content accessibility; provide more flexibility and control in the specification of presentation characteristics; allow multiple web pages to share formatting by specifying the relevant CSS in a separate .css file, reducing complexity and repetition in the structural content; and allow the .css file to be cached to improve page load speed between the pages that share the file and its formatting.

3.3.2.3. Bootstrap

Bootstrap is a free and open-source CSS framework for front-end web development that is responsive and mobile-first. It includes design templates for typography, forms, buttons, navigation, and other interface components that are CSS and (optionally) JavaScript-based.

3.3.2.4. AngularJS

AngularJS is a highly effective JavaScript Framework. It is utilized in projects involving Single Page Applications (SPAs). It adds new characteristics to the HTML DOM and makes it more responsive to user activities. AngularJS is open source and fully free, and it is utilized by thousands of developers worldwide.

3.3.2.5. AJAX

Ajax is an acronym that stands for Asynchronous Javascript and XML. Ajax is just a method of retrieving data from a server and modifying sections of a web page without having to reload the entire page. Ajax uses the browser's built-in XML HttpRequest (XHR) object to asynchronously transmit and receive data to and from a web server in the background, without blocking the page or interfering with the user's experience.

3.3.2.6. JSON

JSON (JavaScript Object Notation) is a text-based standard for encoding structured data based on JavaScript object syntax. It's often used in online applications for data transmission (e.g., delivering data from the server to the client so that it may be displayed on a web page, or vice versa).

3.3.2.7. Data table

The jQuery JavaScript framework provides a sophisticated and smart HTML table

enhancement plugin called jQuery DataTable. It's a versatile tool that's designed to display data in tables while also allowing users to interact with them, hence improving data accessibility in HTML tables. With jQuery DataTables, we can easily create dynamic data tables while also adding advanced capabilities like pagination, sorting, ordering, searching, and more to HTML tables. It can be used for both client-side and server-side processing.

3.3.3. Backend

3.3.3.1. NET framework

.NET Framework is a run-time execution environment that manages .NET Framework-targeted applications. It is made up of two primary parts: the common language runtime (CLR), which is the execution engine that handles running apps, and the.NET Framework Class Library, which is a library of tested, reusable code that developers may access from their own programs.

The services that .NET Framework provides to running apps include the following:

- Memory management: Programmers are in charge of allocating and releasing memory, as well as managing object lifetimes, in many programming languages. The CLR delivers various services on behalf of the app in .NET Framework apps.
- A common type system: Basic types are defined by the compiler in traditional programming languages, which makes cross-language compatibility difficult. Basic types in the .NET Framework are specified by the type system and are shared by all languages that target the framework.
- An extensive class library: Instead of writing massive amounts of code to do typical low-level programming activities, programmers leverage the .NET Framework Class Collection's readily accessible library of types and their members.
- Development frameworks and technologies: ASP.NET for web programs, ADO.NET for data access, Windows Communication Foundation for service-oriented apps, and Windows Presentation Foundation for Windows desktop apps are all part of the .NET Framework.
- Language interoperability: Language compilers for the .NET Framework generate an intermediate code known as Common Intermediate Language (CIL), which is then compiled at run time by the common language runtime. This feature allows functions

built in one language to be available to other languages, allowing programmers to concentrate on developing programs in their preferred languages.

- Version compatibility: With rare exceptions, apps that are developed by using a particular version of .NET Framework run without modification on a later version.

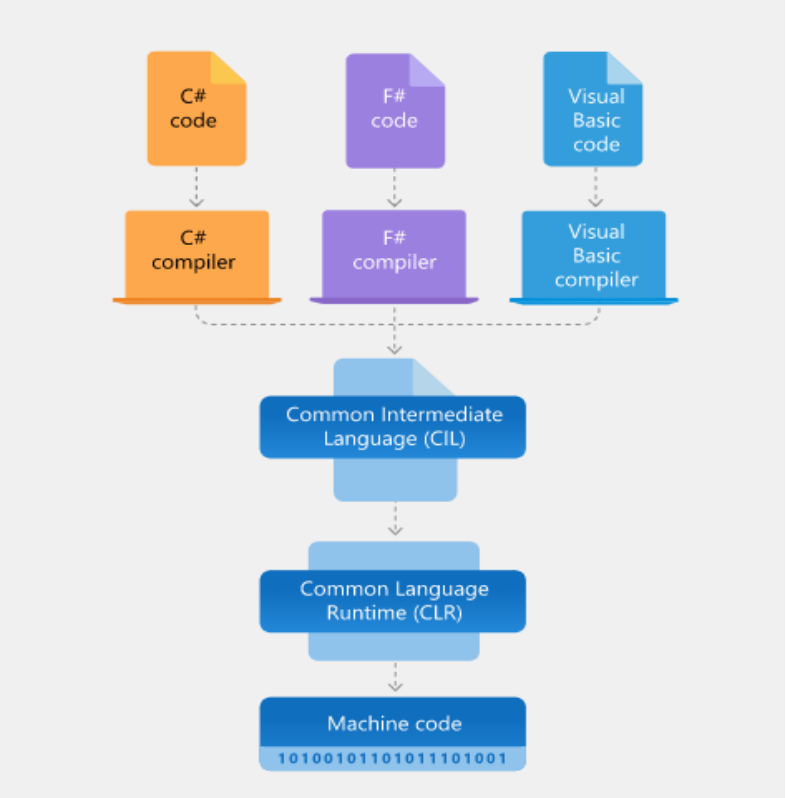

Figure 3. 1 Architecture of .NET framework

The Common Language Runtime and the .NET Framework Class Library are the two major components of the.NET Framework. The execution engine that manages running applications is the Common Language Runtime (CLR). It supports thread management, trash collection, type-safety, exception handling, and other functions.

The Class Library contains a collection of APIs and types that are used to perform common tasks. It has types for strings, dates, numbers, and so forth. APIs for reading and writing files, connecting to databases, drawing, and other tasks are available in the Class Library.

3.3.3.2. ASP .NET framework

ASP.NET is a free web framework that allows you to create beautiful websites and web apps by combining HTML, CSS, and JavaScript. Microsoft created and marketed it to allow programmers to create dynamic websites and applications. ASP.NET is an open-source web framework used to create modern web applications and services with .NET. ASP.NET is a component of the Microsoft.NET platform that operates on top of the HTTP protocol, employing HTTP commands and policies to enable two-way communication and cooperation between a browser and a server. Web Forms, MVC, and Web Pages are the three frameworks for ASP.NET Web application development.

3.3.3.3. ASP.NET MVC

ASP.NET MVC is a web framework built on the Model-View-Controller (MVC) design pattern. Developers may create dynamic web applications with the ASP.NET MVC framework, which allows for clean separation of concerns, rapid development, and TDD compatibility.

3.3.3.4. ASP.NET core

Microsoft's ASP.NET Core is a new version of ASP.NET. It is a free and open-source framework for creating online apps that may operate on Windows, Mac, or Linux. The ASP.NET Core application can run on both the .NET CORE and the traditional .NET Framework (.NET framework 4.x). It is fully redone from the ground up and was initially released as Asp.Net 5, but was later renamed ASP.NET CORE 1.0. Asp.Net Core is an open-source, cross-platform, high-performance framework for developing modern, cloud-based, internet-connected applications. On November 10, 2020, the ASP.NET Core 5.0 version was published. For the development of an ASP.Net Core 5.0 web application, Visual Studio 2019 upgraded version 16.8 is required.

Why Use Asp.Net Core?

- Cross platform: It can run on windows, Linux and Mac.
- Better performance: net core does not depend on system.web.dll for communication between Browser-server. In Asp.net core everything is packages which we need for our application. Packages reduce the request pipeline and improve application performance.

- Dependency Injection: Dependency Injection is in-built in Asp.Net Core.
- Integration with Modern UI Frameworks: It supports modern UI like Angular, ReactJS and Bootstrap etc.
- Hosting-Net Core application can be hosted on multiple Web server such as IIS, Apache, and Docker etc. It is not dependent on IIS.
- Open Source: It is a fully open source framework.
- Testability: Unit testing is very easy in Asp.Net core application.

3.3.3.5. Entity framework

Microsoft's Entity Framework is an open-source ORM framework for .NET applications. It allows developers to work with data using domain-specific objects rather than the underlying database tables and columns where the data is kept. When working with data, developers can work at a higher level of abstraction with the Entity Framework, which allows them to construct and manage data-oriented systems with less code than traditional programs. Entity Framework is an object-relational mapper (O/RM) that enables .NET developers to work with a database using .NET objects. It eliminates the need for most of the data-access code that developers usually need to write.

The following figure illustrates where the Entity Framework fits into our system.

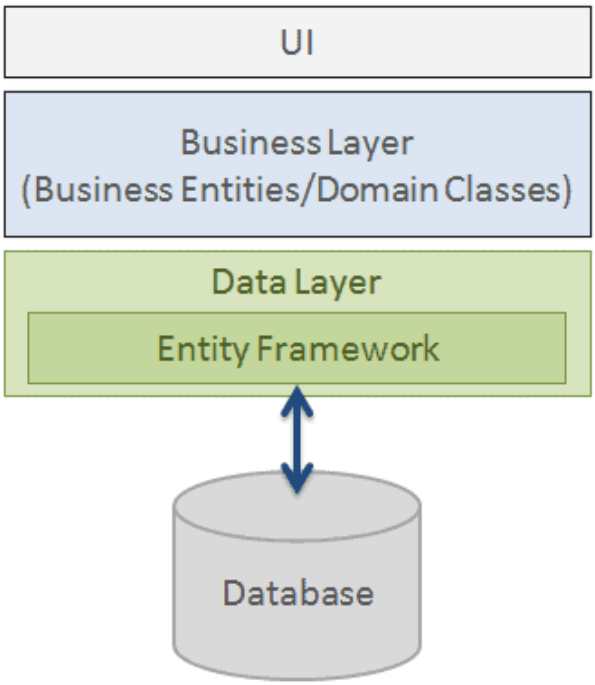

Figure 3. 2 Entity framework

Entity Framework fits between the business entities (domain classes) and the database, as seen in the diagram above. It saves data contained in business entity attributes, as well as retrieving data from databases and converting it to business entity objects automatically.

3.3.3.6. Identity framework

In ASP.NET Core apps, ASP.NET Core Identity provides a framework for managing and preserving user accounts. Identity is added to your project when Individual User Accounts is selected as the authentication mechanism. Identity uses the Entity Framework (EF) Core data model by default.

3.3.3.7. SQL Server

SQL Server is a relational database management system, or RDBMS, developed by Microsoft SQL Server, like other RDBMS software, is based on SQL, a standard programming language for working with relational databases. The SQL Server's principal job as a database server is to store and retrieve data for other applications.

3.3.4. Extra tools

3.3.4.1. Mailjet

Mailjet is a French email marketing platform that was established in 2010 by Wilfried Durand and Julien Tartarin as part of the startup company eFounders. Mailjet is a cloud-based email delivery and tracking solution that allows customers to send transactional and marketing emails. Mailjet's platform offers tools for designing emails, sending large numbers of emails, and tracking emails. The platform employs technologies to assure email deliverability, such as controlling sender reputation and providing authentication certificates.

3.3.4.2. Leaflet

Leaflet is the most widely used open-source JavaScript library for creating mobile-friendly interactive maps. With only roughly 39 KB of JS, it contains all of the mapping features that most developers will ever require.

Leaflet was created with the goals of simplicity, performance, and usability in mind. It runs smoothly on all major desktop and mobile platforms, can be extended with a plethora of

plugins, has a beautiful, straightforward, and well-documented API, and simple, legible source code that is a delight to contribute to.

3.3.4.3. Khalti

Khalti is a payment gateway, digital wallet and API provider system for various online services for Nepal.

With Khalti SDK/API, you can accept payments from:

- Khalti users.
- eBanking users of our partner banks.
- Mobile banking users of our mobile banking partner banks.
- SCT/VISA card holders.
- connectIPS users

There are four steps for integrating Khalti payment to a merchant system:

1. Signup as merchant
2. Understand how khalti payment works
3. Test integration
    3.1. Client-side integration
    3.2. Server-side integration
4. Deploy integration

3.3.5. Version Control

The method of recording and controlling changes to software code is known as version control, sometimes known as source control. Version control systems (VCS) are software tools that aid software development teams in managing source code changes over time. Git is a Distributed Version Control System (DVCS) that allows you to save multiple versions of a file (or a set of files) and access them at any time. Git also makes archiving and comparing different file versions simpler. This implies that you may look up information on what changed, who modified it, or who started an issue at any moment. Users can host Git repositories on GitHub, a web-based platform. It makes project sharing and collaboration with anybody, at any time, much easier.

3.4. System Design

3.4.1. Basic System Overview

The system has three kinds of users: Physiotherapists, Patients, and Administrators. Physiotherapists have the ability to approve or cancel appointments as well as manage their schedules.

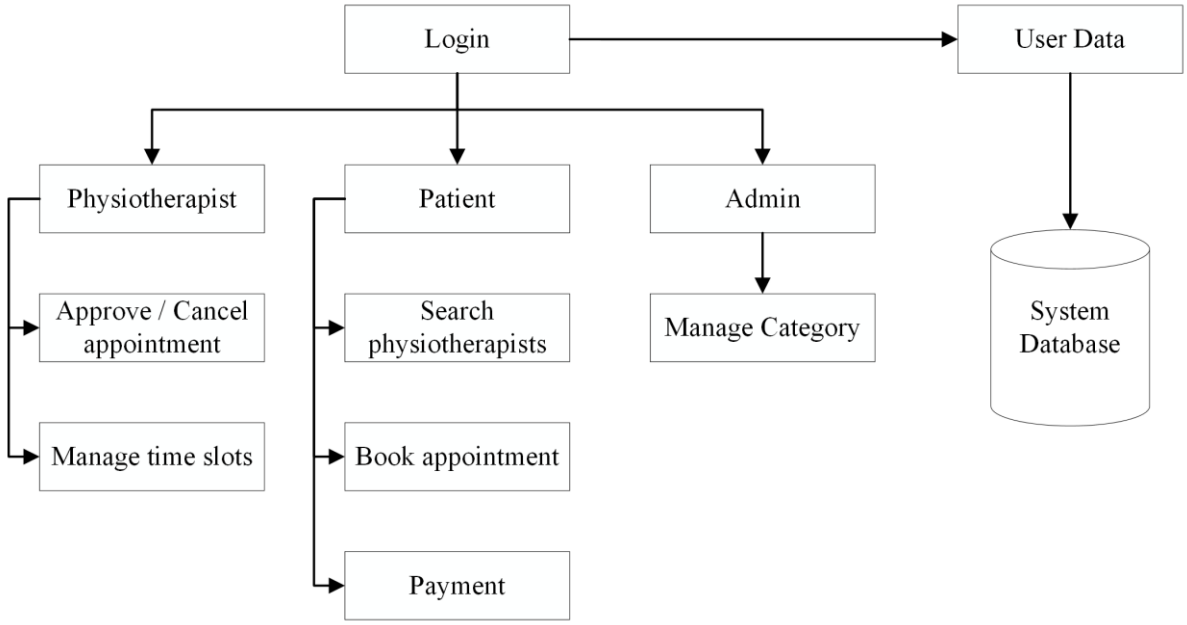

Figure 3. 3 Block Diagram of the System

Patients can use the system to search for physiotherapists, schedule appointments, and pay for them. Admin has control over the physiotherapy category. The user's information is saved in the user database.

3.4.2. System flow for Login Module

Users are of two types: one registered and another non-registered. Registration process requires username, address, e-mail id, phone number, gender and password for both patient and physiotherapist. Physiotherapist must also submit their citizenship number and license number. They must indicate their consultation fee during registration.

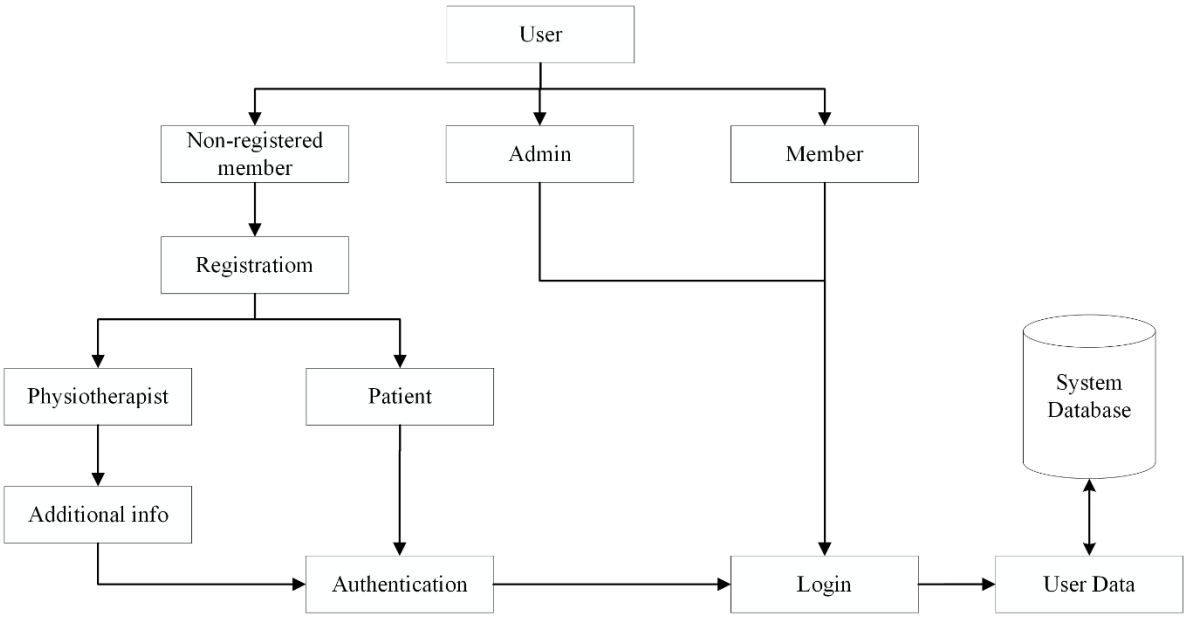

Figure 3. 4 Block Diagram of the Login

Authentication is done via mail. Registered user shall log into our system by using authenticated username and password. All of the login and registration data will be stored in the system database.

3.4.3. System flow for the Patient

The patient will have their own dashboard after logging in. They can also see their health issues, and our system will offer services and physiotherapists based on those concerns. Patients will be able to search for therapists based on specialization. Our system will offer patients with a list of nearby therapists using the “Haversine algorithm” for distance calculation”. Patients can select any of the available time slots after selecting a physiotherapist.

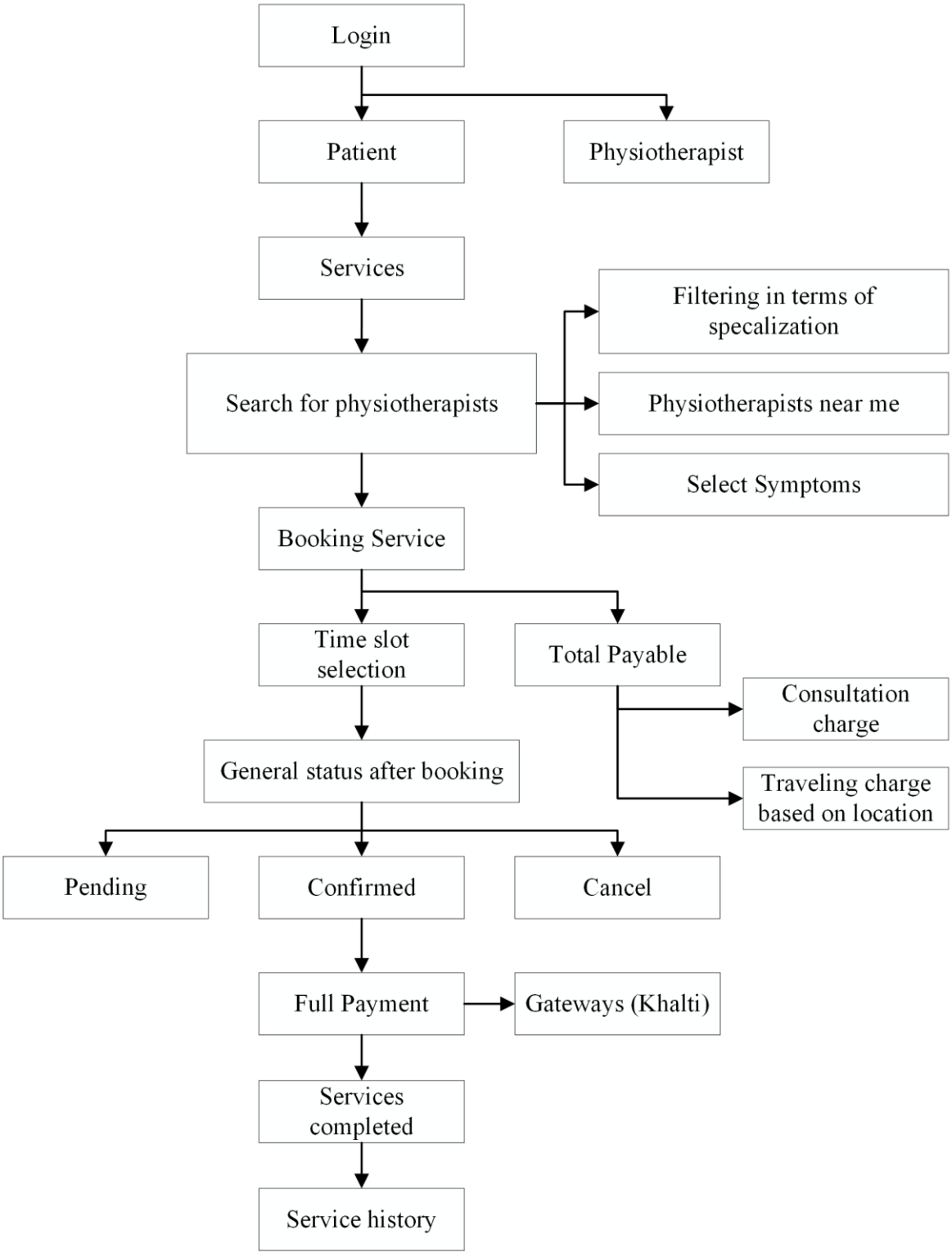

Figure 3. 5 Block-Diagram of the system in terms of patient

The total payment amount, including consultation and travel fees, will also be disclosed. Following the booking, a general booking status will be generated, which will be validated by the chosen therapist later. Payment will be made entirely through the system's payment gateway.

3.4.4. System flow for the Physiotherapists

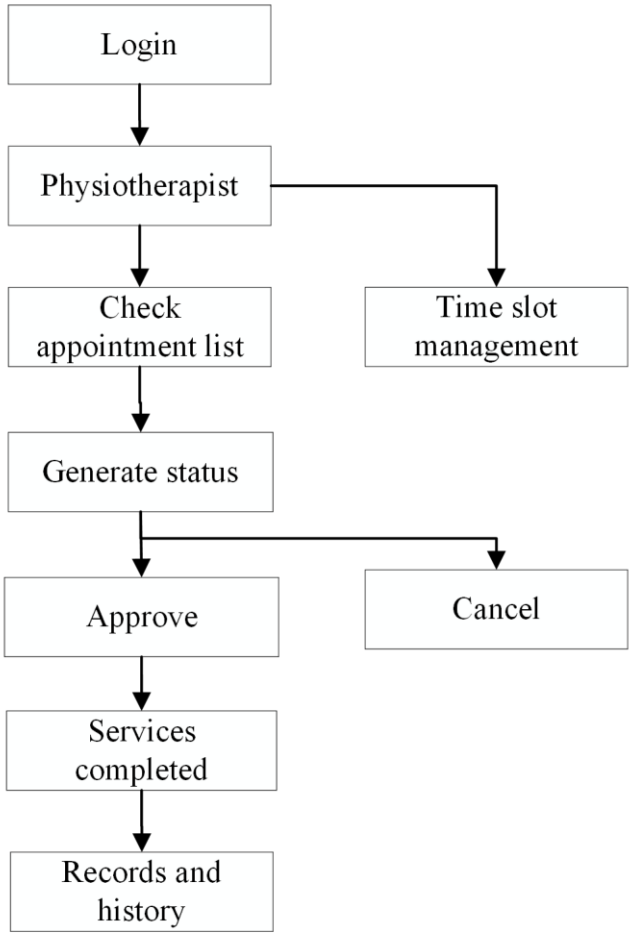

Figure 3. 6 Block-Diagram of the system in terms of physiotherapist

After logging as physiotherapists, user will have privilege of selecting their desired time slots for providing service. As they get appointments from patients, an appointment checklist will be generated for their confirmation. They can either confirm or cancel the appointment based on the information of the patient. Following the completion of their service they will be provided their payments through the website.

3.4.5. Use Case Diagram

Figure 3. 7 Use Case Diagram of the System

The use case diagram of the system has following actors:

i. Patients: The actor patient can login to the system, search for suitable physiotherapists, select them and book appointments as well as initiate payments.
ii. Physiotherapists: The physiotherapist can login to the system, manage their schedule, check their appointments, and provide response to them as well as get their payments.
iii. Admin: The admin is responsible for monitoring the entire system. They can add new categories as well as delete them. The admin is also responsible for providing database access to the users

3.4.6. Schema Diagram

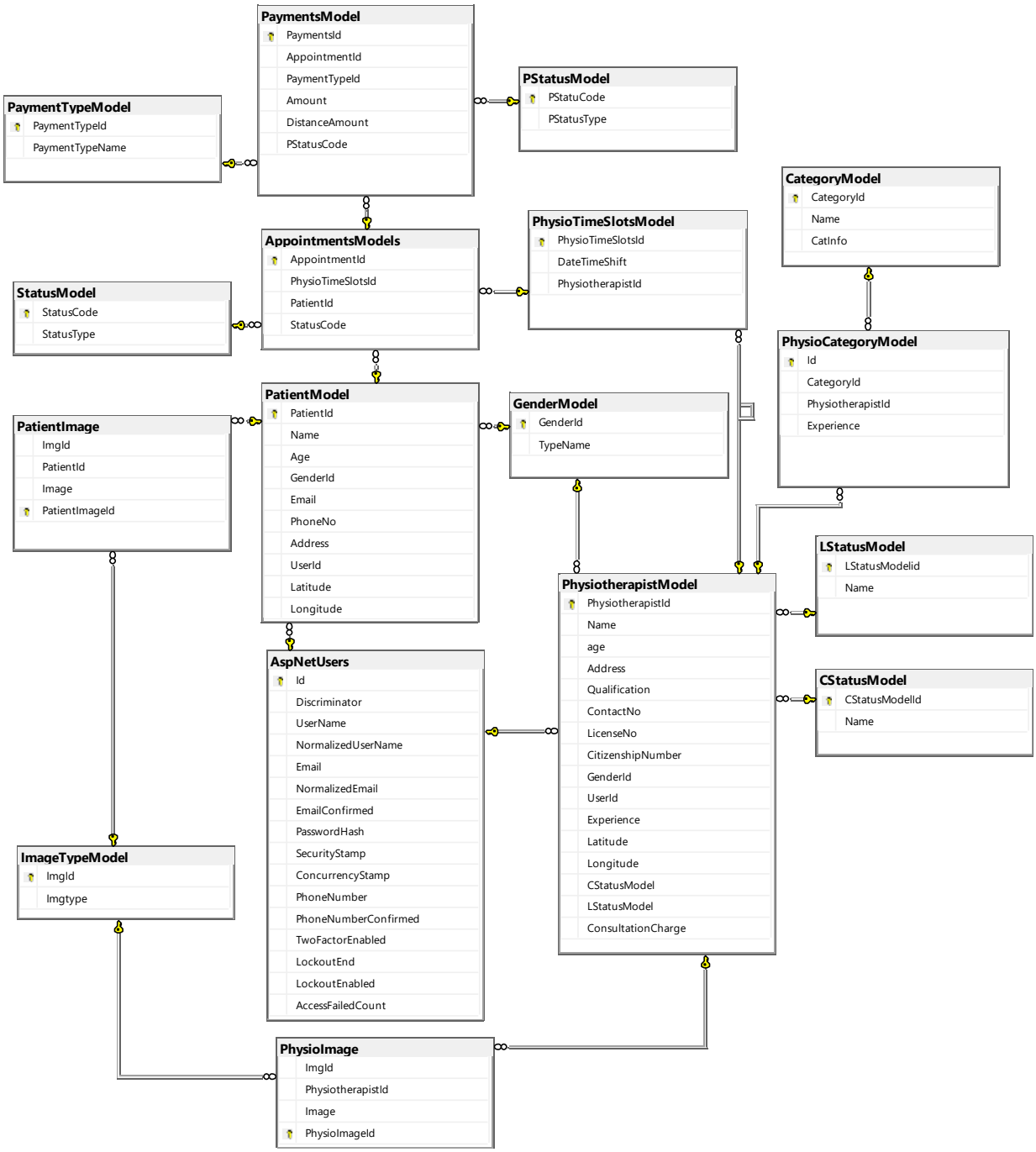

Figure 3. 8 Schema Diagram for the System

Figure 5.5 is the database that we designed for the system, with up to 3F normal form. We have defined primary key for every table and established relationship among table using foreign key.

3.4.7. Activity Diagram

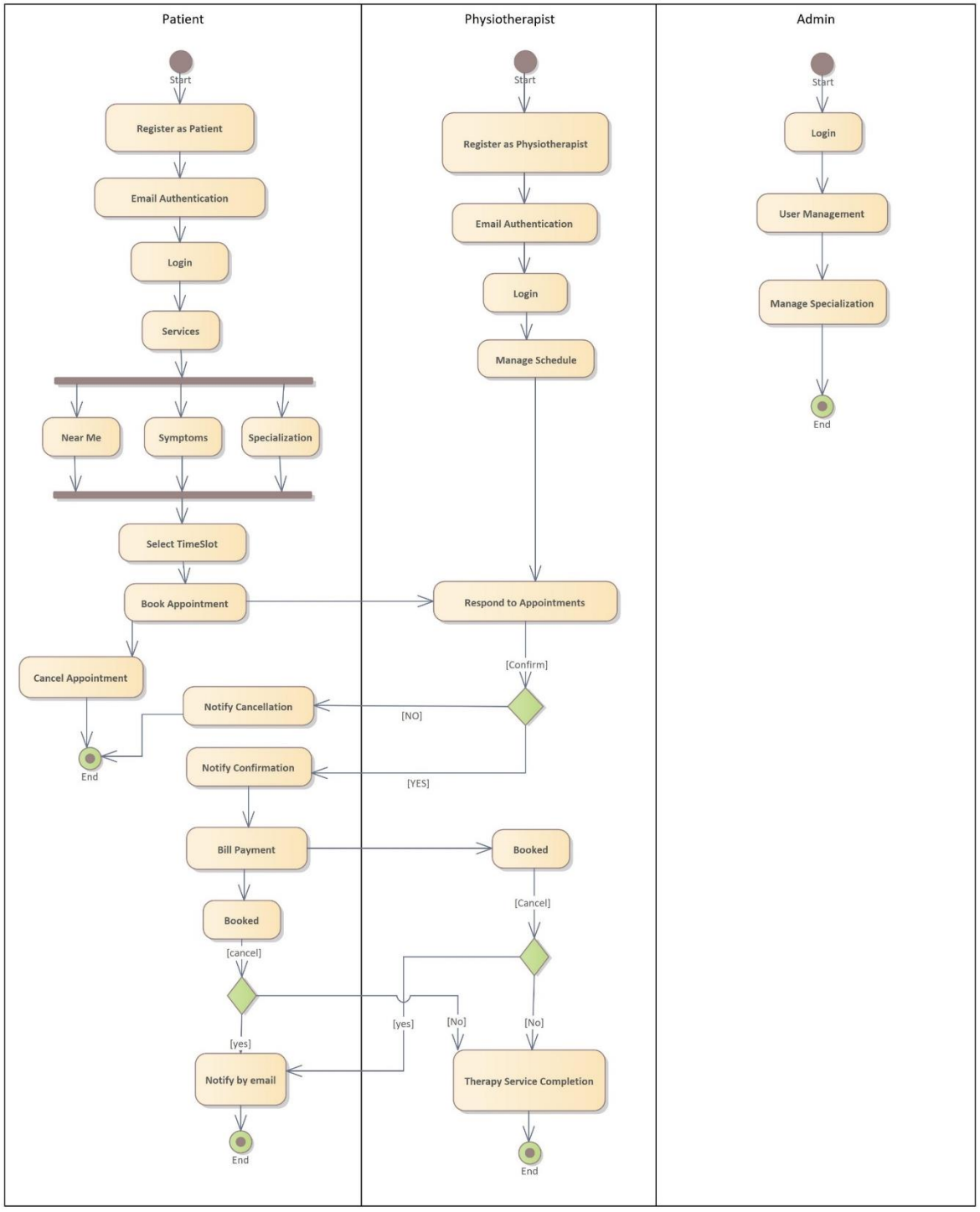

Figure 3. 9 Activity diagram of the system

For the use cases, an activity diagram with swim lanes is used that distinguishes job sharing and responsibilities for sub processes. Figure 5.6 depicts the flow of how users can use the system.

3.5. Software Methodology

3.5.1. Incremental model

The incremental model is a software development process in which requirements are divided into multiple standalone modules of the software development cycle. Each module in this model goes through the phases of requirements, design, implementation, and testing. During the first module, a workable version of software is created, ensuring that you have usable software early in the software life cycle. Each subsequent release of the module adds to the prior release's functionality. The procedure is repeated until the entire system is completed.

This model helps to ease the traumatic effect of introducing a completely new system all at once. The incremental model is effective when the software team is not highly skilled or trained. This model can be applied when the requirements of the complete system are clearly defined and understood. Incremental model is more flexible and risk management is simple because it is handled during its iteration.

After conducting research and consulting with our supervisor and faculty, we were able to determine the system's initial functional and non-functional requirements. The gathered needs were reviewed, and a feasibility analysis was done to see if they were feasible. Following the requirement analysis, we began the design process by creating the database schema, which was followed by system design. Based on the design, we began work on the first increment. The module was then tested, and any bugs discovered throughout the testing process were fixed. Using the same technique, other functions were identified and incorporated in subsequent increments. Similarly, we finished our project.

3.6. Requirement Specification

A software requirement specification is a description of a software system to be developed. It lays out functional and non-functional requirements. It describes what the software productis expected to do and what not to do. It enlists enough and necessary requirements that are required for the project development. It mainly aids to describe the scope of the work and provides software designers a form of reference.

3.6.1. Functional Requirements

Functional requirements describe the functionality that the system must perform. These capture the intended behavior of the system.

This software system requires the following functionalities:

- System should be able to block non-registered member from entering the service page
- Patient should be able to book appointment through system
- Both physiotherapist and patient should be able to edit their profile
- System should be able to filter physiotherapist based on their specialization
- System should generate lists of physiotherapists near the patients.
- Physiotherapist should be able to choose their working time slots
- System should be able to notify confirmation/cancellation/completion of appointment

3.6.2. Non-Functional Requirements

The non-functional requirements of the system can be summarized as follows:

1. Performance: The system shall have quick, accurate and reliable results.
2. Capacity and Scalability: The system shall be able to store a huge amount of data efficiently and scale with an increase in data.
3. Availability: The system shall be available to the user anytime whenever there is an internet connection.
4. Recovery: In case of malfunctioning or unavailability of the server, the system should be able to recover and prevent any data loss or redundancy.
5. Flexibility and Portability: System shall be accessible anytime from any location.
6. User friendly interface: System should be user friendly.

3.7. Feasibility Assessment

A feasibility assessment is done to analyze the viability of an idea. In the case of software development, it assesses the practicality of the project or system. The result from the feasibility assessment determines whether the project should go ahead, be redesigned, or be dropped. There are five areas of feasibility - Technical, Economic, Legal, Operational, and Scheduling.

3.7.1. Technical feasibility

Technical feasibility assessment examines whether the system can be developed using available technologies.

3.7.1.1. Hardware requirement

- For admin:
  Processor: I5 processor or higher
  Processor speed: 2 GHz or more
  RAM: 8 GB
- For user:
  Processor: I5 processor or higher
  Processor speed: 1.0GHz or more
  RAM: 4 GB

3.7.1.2. Software requirement

- For development:
  Application software: IDE (visual studio), Microsoft Visio, Enterprise Architect
  Languages and frameworks: HTML, CSS, C#, JavaScript, ASP .NET core
  Operating System: Windows 7 and above
  Version control: Git and GitHub
- For user:
  Since we are building a website, so the user only requires a web browser and stable internet connection

As our team members are capable of converting ideas into working system with available resources and all the necessary hardware and software are available for development and implementation of the project, the project can be considered technically feasible.

3.7.2. Economic Feasibility

Economic Feasibility checks whether the cost required for complete system development is feasible using the available resources in hand. Since the system is hosted on servers that are easily available on the market, with the costs and performance being optimum, the system can be considered economically feasible for development.

3.7.3. Legal Feasibility

Legal Feasibility assessment checks the system for any conflicts with a legal requirement, regulations that are to be followed as per the standard maintained by the governing body. Since

the data obtained from the users is being consented to and does not violate any other obligation of law and privacy, the project can be considered legally feasible.

3.7.4. Operational Feasibility

The operational feasibility analysis describes how the system operates and what resources the system requires for performing its designated task. The system runs in a website accessing data from the database server. The system is designed to be operated in the browser environment, and hence eliminates the difficulty of installation in every computer and the other devices from which the user is trying to use the system. The project is developed as a website allowing easy access to multiple users. The system is carefully designed to make it possible to be operable in most of the environment, hence the project can be considered operationally feasible.

3.7.5. Scheduling Feasibility

Any project is considered to fail if it is not completed on time. So, scheduling feasibility estimates the time required for the system to fully develop and whether that time is feasible or not according to the current trend in the market. As the scheduling of the project is consistent with the available time of the project, the project can be considered feasible.

4. RESULTS AND DISCUSSION

User can register and login through home page. Both the patient and the physiotherapist must enter their username, address, e-mail address, age, gender, contact number and password during the registration procedure. They must also add their location with the help of marker. In addition, physiotherapists must provide their citizenship number, license number, qualification, experience and consultation charge.

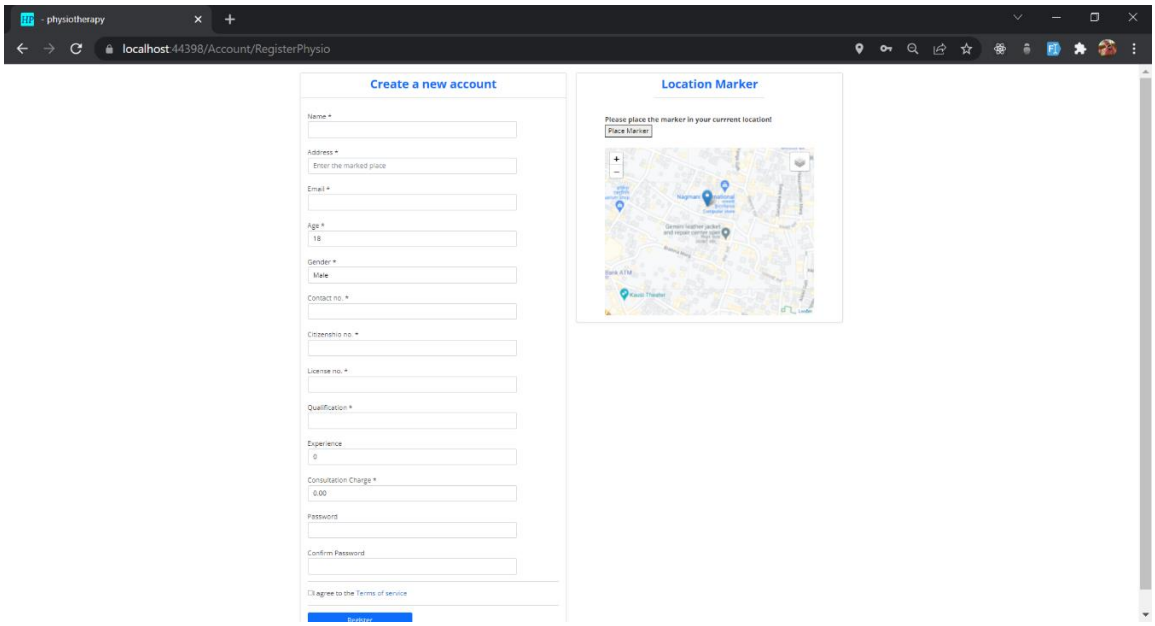

Figure 4. 1 Physiotherapist Registration Page

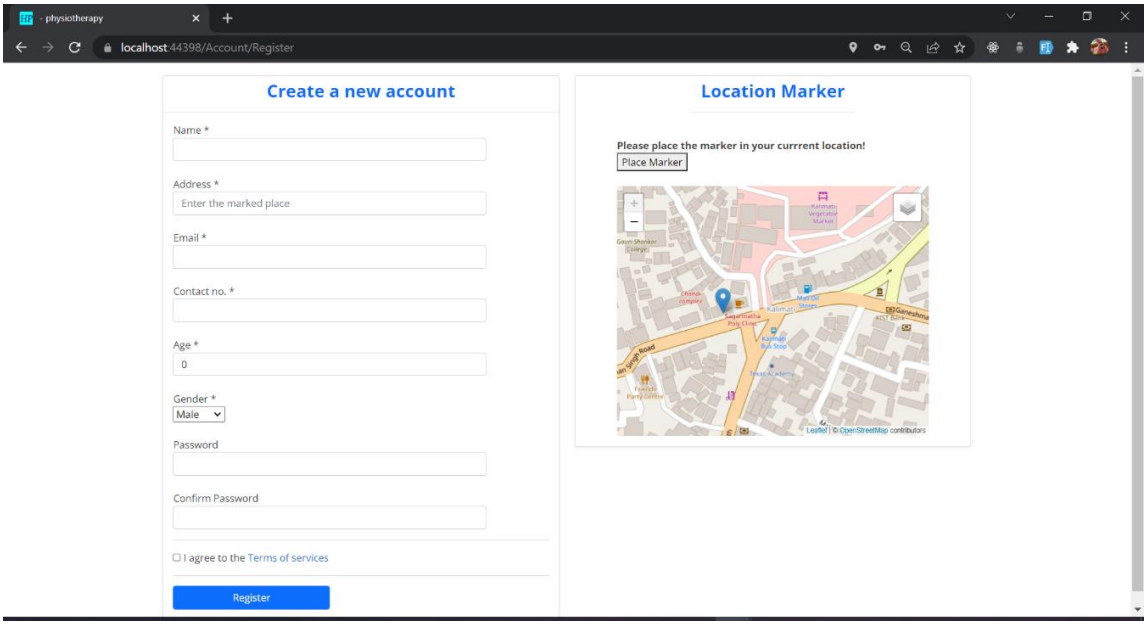

Figure 4. 2 Patient Registration Page

The system requires registered users to login using an authenticated username and password. The system database will hold all login and registration information. Users can also reset and remember their password.

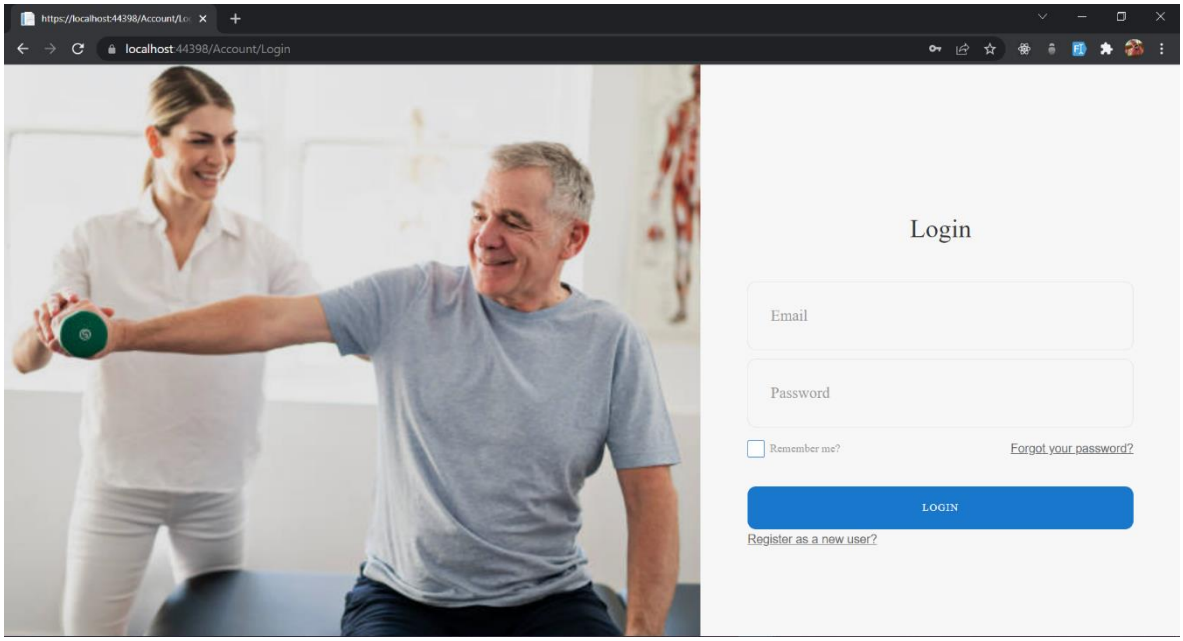

Figure 4. 3 Login Page

After logging in separate dashboards will be displayed for both patients and physiotherapists. Physiotherapists will be able to choose their preferred time slots to provide therapy. An appointment checklist will be prepared as they get appointments from patients for confirmation. Based on the patient's details, they can either confirm or cancel the appointment.

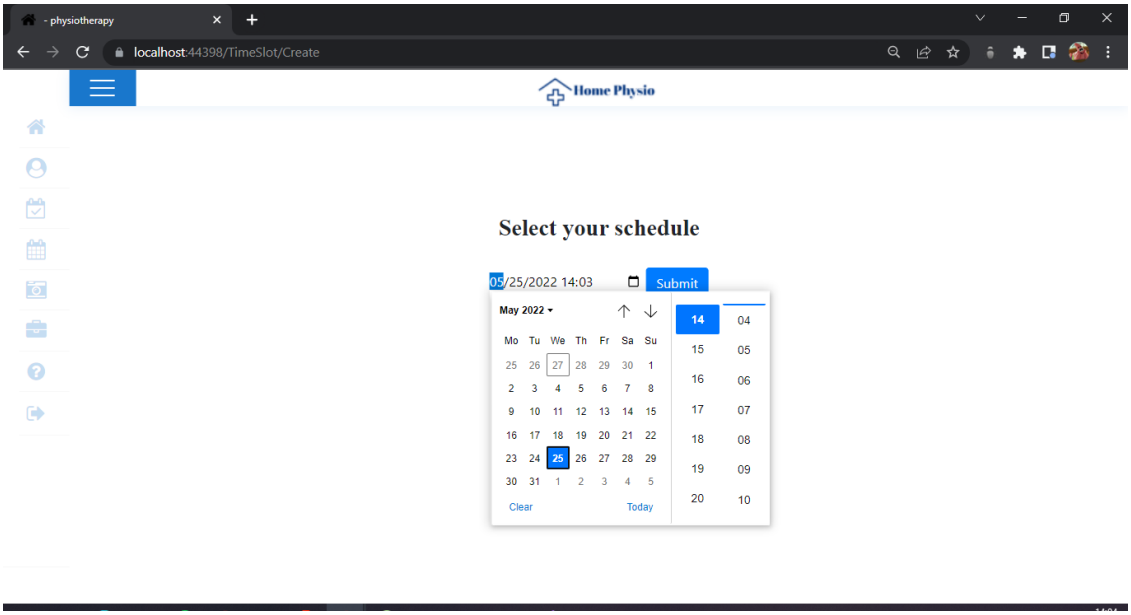

Figure 4. 4 Time slot selection page

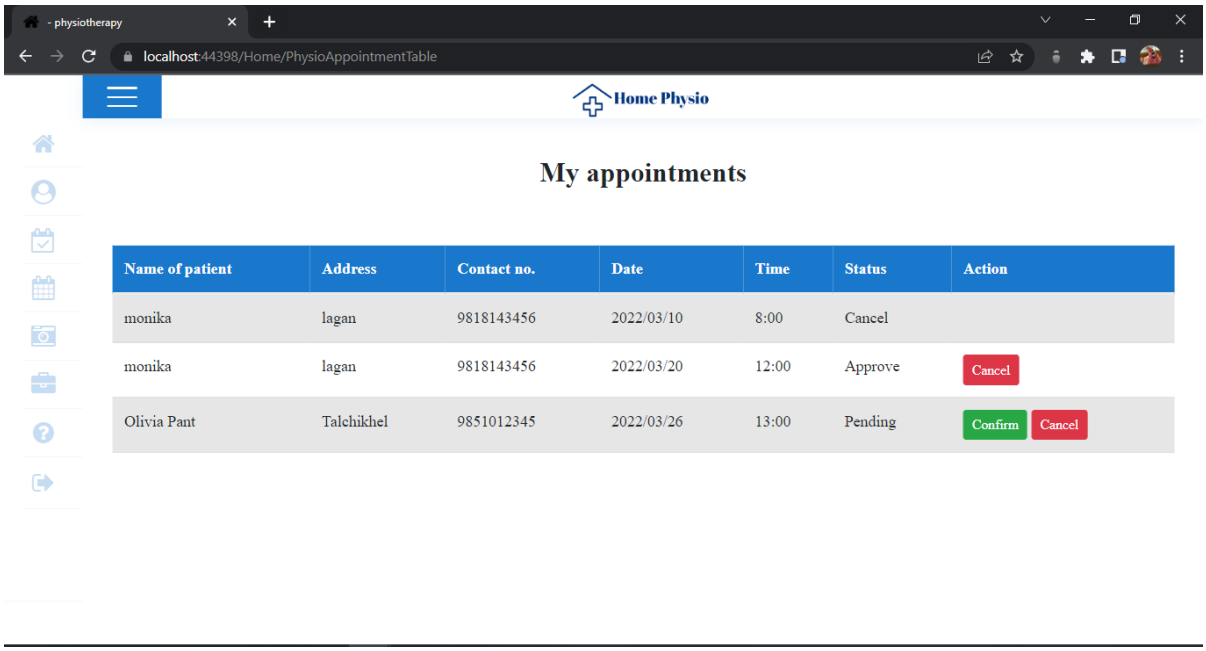

Figure 4. 5 Appointment table for physiotherapists

Furthermore for patients, Physiotherapists, Symptoms, and Near Me are the three services available. Patients can search for physiotherapists by gender, specialty, and name. Patients can make an appointment and view the physiotherapists' profiles. Patients can also look for physiotherapists within 5 kilometers of their area. Patients can even choose their health concerns to get a list of physiotherapists who can treat them.

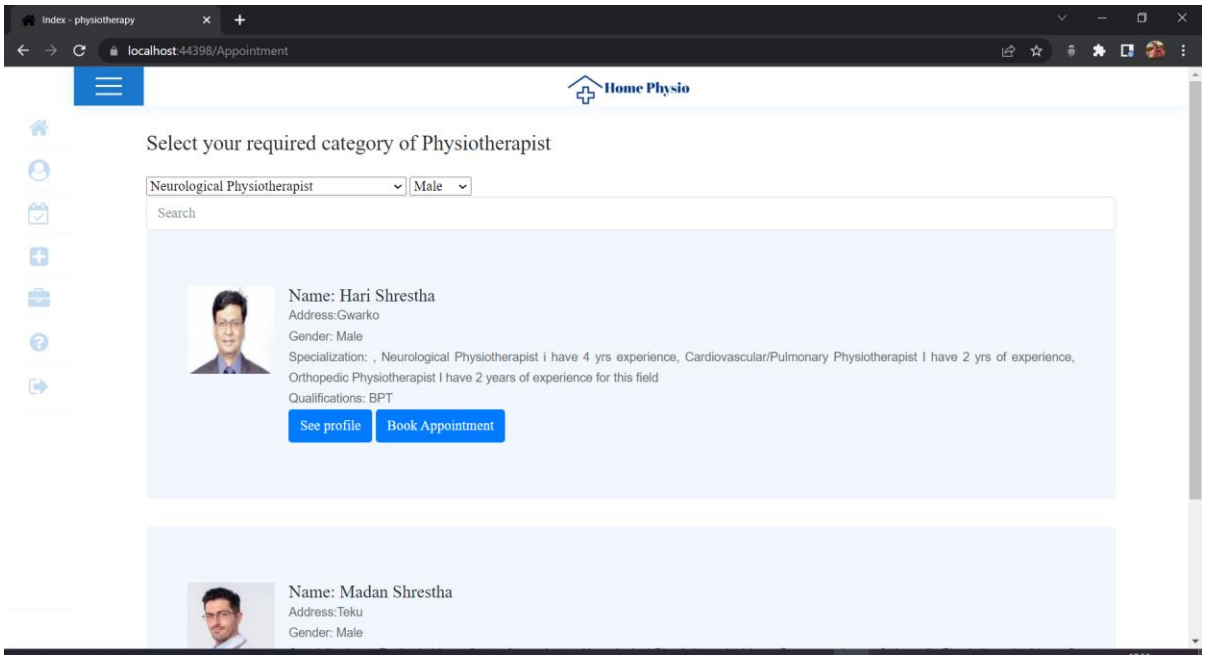

Figure 4. 6 Physiotherapist Search Page

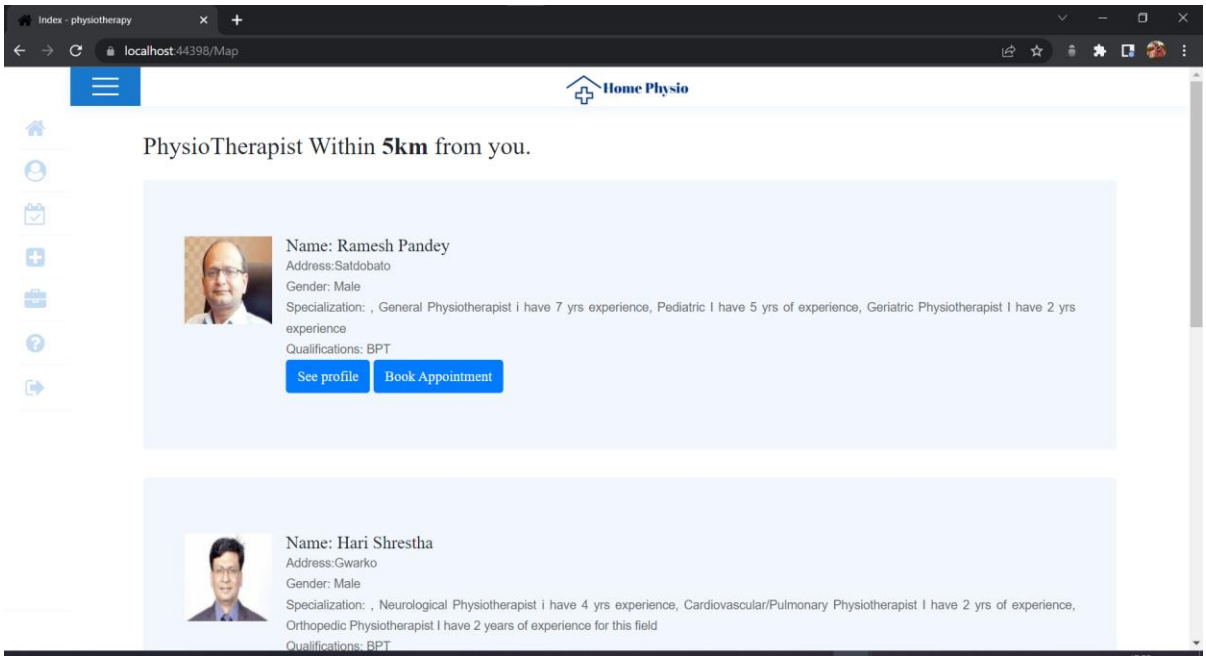

Figure 4. 7 Physiotherapist within 5 km

When booking an appointment, the available time window will be displayed after clicking the book appointment button which will include the scheduled date and time as in Figure 4.8. If a slot has already been reserved, it is no longer available for booking and is removed from the schedule. Once booked slots cannot be rebooked by the same user and are indicated as pending.

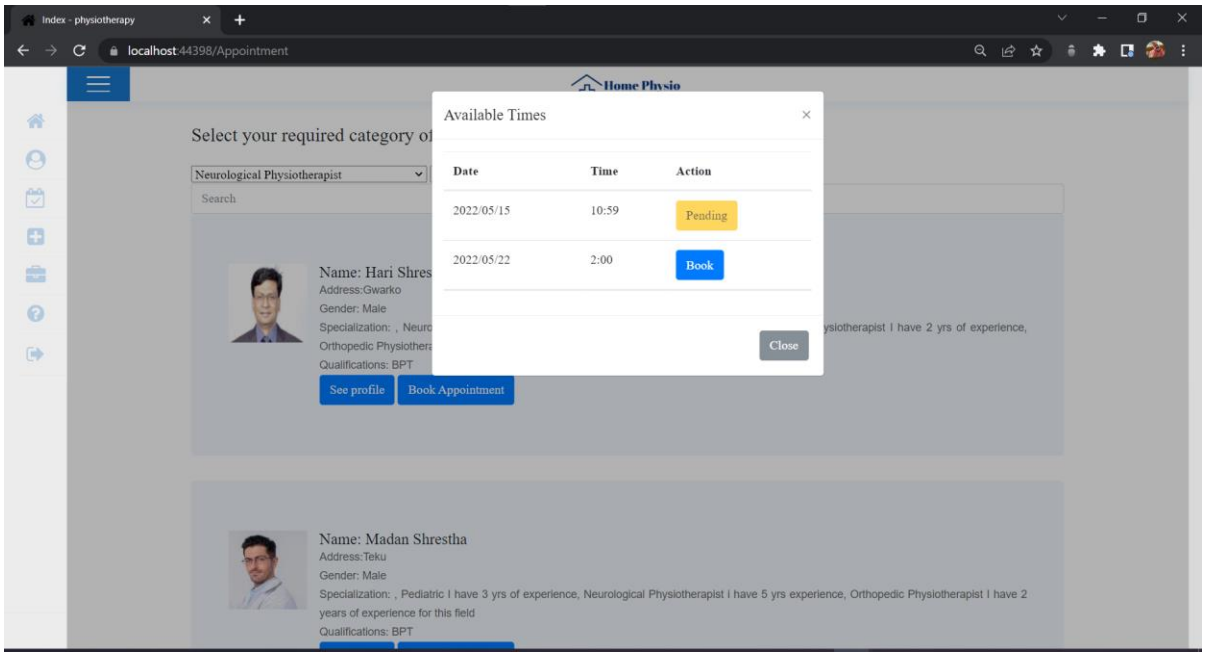

Figure 4. 8 Booking modal

Patients are able to view their appointments, as well as the physiotherapist's response, consultation fee, and distance fee. After the physiotherapist's approval, the patient has the

option of paying with Khalti or canceling the appointment. The total payment is shown on the Khalti wizard.

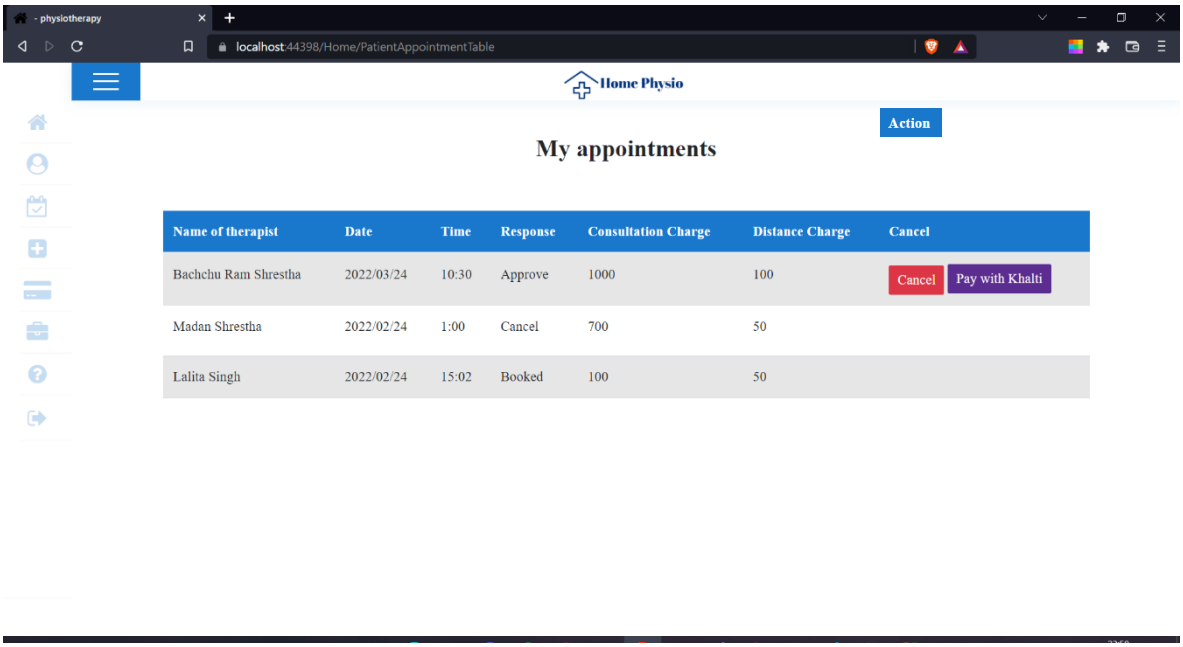

Figure 4. 9 Patient Appointment Table

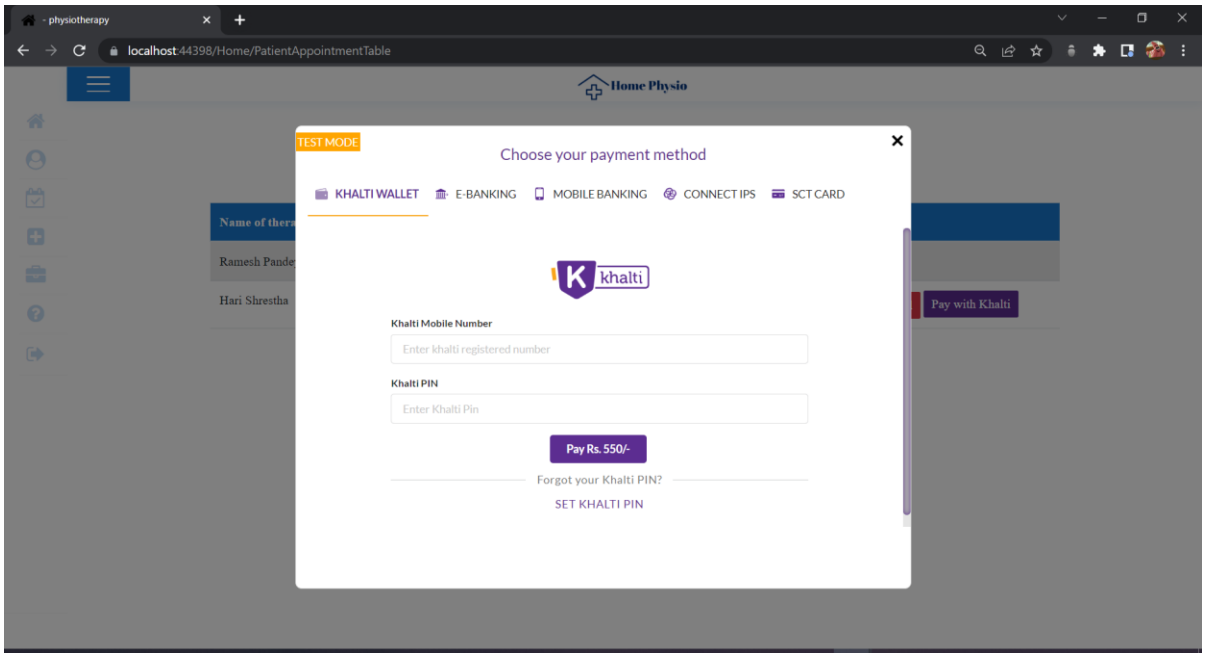

Figure 4. 10 Khalti Wizard

5. TESTING

Test Case #	Test Case Description	Test Steps	Test Data	Expected Result	Actual Result	Pass/ Fail
TC_ Register_ 01	Check response when all required fields are filled and conditions are met	1. Enter • name • address • email • contact no. • age • gender • password • confirm password 2. Place marker 3. Agree to terms and services 4. Click Register	Name: Patient1 Address: Harishiddhi Email: patient123@gmail.com Contact no: 9856023150 Age:21 Gender: Female Password: Patient1@123 Confirm password: Patient1@123 Place marker: Marker is placed Agree to terms and services	Patient should be able to create an account	As expected	Pass
TC_ Register_ 02	Check response when name field is empty	Don't enter name	Name: Null	Show 'The Name Field is required'	As expected	Pass
TC_ Register_ 03	Check response when address field is empty	Don't enter address	Address: Null	Show 'The address field is required'	As expected	Pass
TC_ Register_ 04	Check response when email field is empty	Don't enter email	Email: Null	Show 'The Email field is required'	As expected	Pass
TC_ RegisterPt_05	Check response when contact no. field is empty	Don't enter contact no.	Contact no: Null	Show 'The Contact Number field is required'	As expected	Pass

TC_Register_06	Check response when age is less than 18	Enter age less than 18	Age:4	Show 'Value must be greater or equal to 18'	As expected	Pass
TC_Register_07	Check response when age is greater than 100	Enter age greater than 100	Age:500	Show 'Value must be less than or equal to 100'	As expected	Pass
TC_Register_08	Check response when age field is empty	Don't enter age	Age: Null	Show 'The value " is invalid.'	As expected	Pass
TC_Register_09	Check response when password field is null	Don't enter password	Password: Null	Show 'The Password field is required'	As expected	Pass
TC_Register_10	Check response when password field is less than 6 characters	Enter password less than 6 characters	Password:3333	Show 'The Password must be at least 6 character long'	As expected	Pass
TC_Register_12	Check response when terms and conditions is not accepted	Don't agree to terms and services	Don't tick on checkbox of terms and services	Show 'You must agree to terms and conditions'	As expected	Pass
TC_Register_13	Check response if marker is not placed	Don't place marker	Place marker: Marker is not placed	Show 'Place marker in your location'	As expected	Pass
TC_Register_PH_01	Check response if license no, citizenship no, qualification and experience	Don't enter license no, qualification, citizenship no, experience	License no: Null Citizenship no: Null Qualification: Null Experience: Null	Show The Qualification field, License No field, Citizenship		

	is not placed			Number field, valid value is required.		

Table 5. 1 Test cases 1

Test Case #	**Test Case Description**	**Test Steps**	**Test Data**	**Expected Result**	**Actual Result**	**Pass/ Fail**
TC_Login_01	Check response when valid email and password is entered	1.Enter email 2.Enter password 3.Click login	Email: patient123@gmail.com Password: Patient1@123	User should login into application	As expected	Pass
TC_Login_02	Check response when valid email and invalid password is entered	1.Enter email 2.Enter password 3.Click login	Email: patient123@gmail.com Password: patient1@123	Show 'Invalid login attempt'	As expected	Pass
TC_Login_03	Check response when invalid email and valid password is entered	1.Enter email 2.Enter password 3.Click login	Email: ranjila12@gmail.com Password: Patient1@123	Show 'Invalid login attempt'	As expected	Pass
TC_Login_04	Check response when invalid email and invalid password is entered	1.Enter email 2.Enter password 3.Click login	Email: ranjila12@gmail.com Password: patient1@123	Show 'Invalid login attempt'	As expected	Pass

Table 5. 2 Test cases 2

Test Case #	Test Case Description	Test Steps	Expected Result	Actual Result	Pass/ Fail
TC_Book_01	Check response when appointment is booked	1.Click book appointment 2.Select time 3.Click book	Show 'Your Appointment is pending' and display on appointment list	As expected	Pass
TC_NearMe_01	Check response when near me is clicked	1.Click on Near Me	Show the physiotherapists who are within 5km	As expected	Pass
TC_Schedule_01	Create schedule	1.Click on Create Schedule 2. Select time 3. Click on Submit	Show the schedule on the list	As expected	Pass
TC_Categories_01	Select categories	1.Click on Select specialization 2. Choose specialization 3. Write your experience 4. Click on Select	Show the specialization on the list	As expected	Pass

Table 5. 3 Test cases 3

6. CONCLUSION

In this project, we have applied knowledge of programming and SDLC (Software Development Life Cycle) process to build a web application system that caters both physiotherapists as well as patients. Although it was a challenging task to tackle the real-world problems and find effective solutions, this project has met its objectives. The patients were able to book appointments whereas physiotherapists were able to approve the appointments. The login module was designed for the users and database was created for both physiotherapists and patients. The patients were able to view physiotherapists within 5km from them and select therapists based on gender and specialization.

This web application for home visit appointments has the potential to revolutionize the current medical appointment system, which is now limited to hospitals and clinics. This website is useful for both patients and physiotherapists, and it can be used anywhere if there is an internet connection.

7. FUTURE ENHANCEMENT

For future enhancements, the following points have been considered:

- This project is solely web-based, but it could be expanded to include desktop and mobile applications in the future.
- Verifying the authenticity of the physiotherapist's citizenship number and license number.
- To broaden the spectrum of services, online consultations, packages, and workout sessions can be included.
- In the future, payment gateways such as Esewa could be integrated to make payments easier.
- OTP (One Time Password) can be implemented to improve validation process.

REFERENCES

[1] J. Cameron, (2020), "*What is Allied Health?*", Association of Schools of Allied Health Professionals, Internet Journal of Allied Health Sciences and Practice.

[2] I. Apostolakis, (2020), "*The Evolution of Healthcare Applications in the Web 2.0 Era."*

[3] S. Bassett & H. Prapavessis, (2007), "*Home-Based Physical Therapy Intervention With Adherence-Enhancing Strategies Versus Clinic-Based Management for Patients With Ankle Sprains"*, *Physical Therapy*, Volume 87, Issue 9,Pages 1132–1143

[4] L. Hale, D. Bennett, M. Bentley, A. Crawshaw & H. Davis, (2003), "*Stroke Rehabilitation-Comparing hospital and home-based physiotherapy: the patient's perception",* New Zealand Journal of Physiotherapy

[5] J. Moffatt & D. Eley, (2010), "*The reported benefits of tele-health for rural Australians",* Australian health review

[6] G.M. Wali, & A. Islam, (2017), "*A Case Study on Pathao: Technology Based Solution to Dhaka's Traffic Congestion Problem*", Case Studies in Business and Management

[7] M. Alam. (2017), "*Smart Doctors Appointment and Prescription System*", IOSR Journal of Computer Engineering

[8] S. Malik, N. Bibi, S. Khan, R. Sultana & S. Rauf. (2016), "*Mr. Doc: A Doctor Appointment Application System",* International Journal of Computer Science and Information Security

APPENDIX

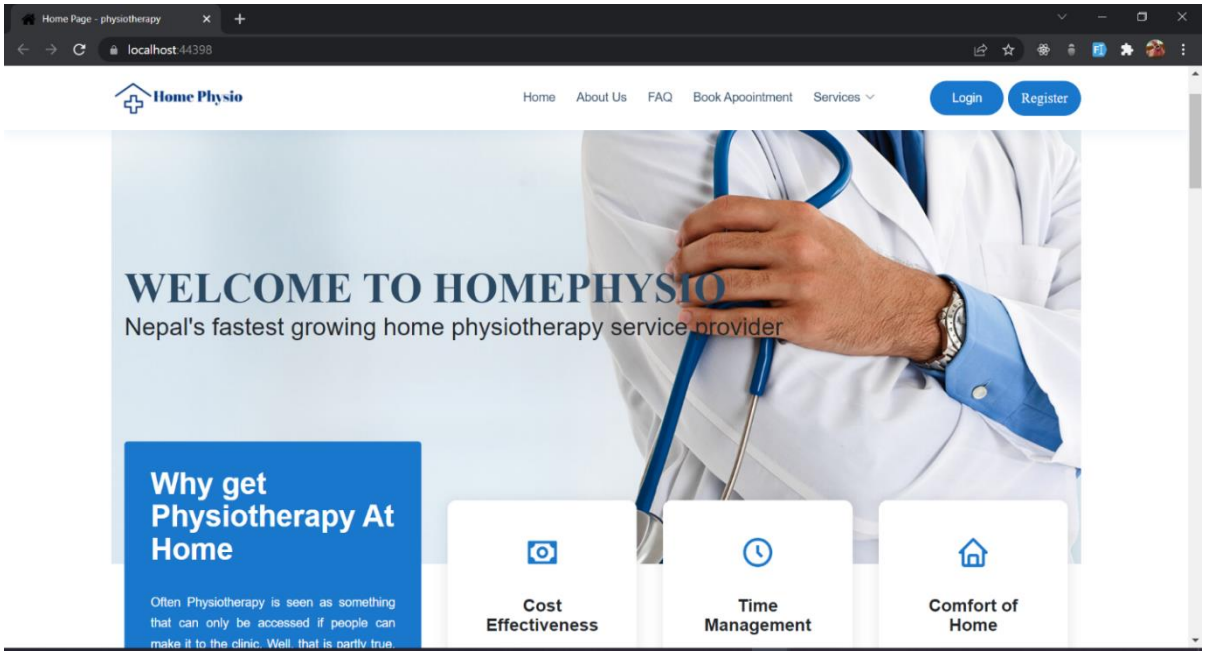

Figure Appendix.1 Home Page

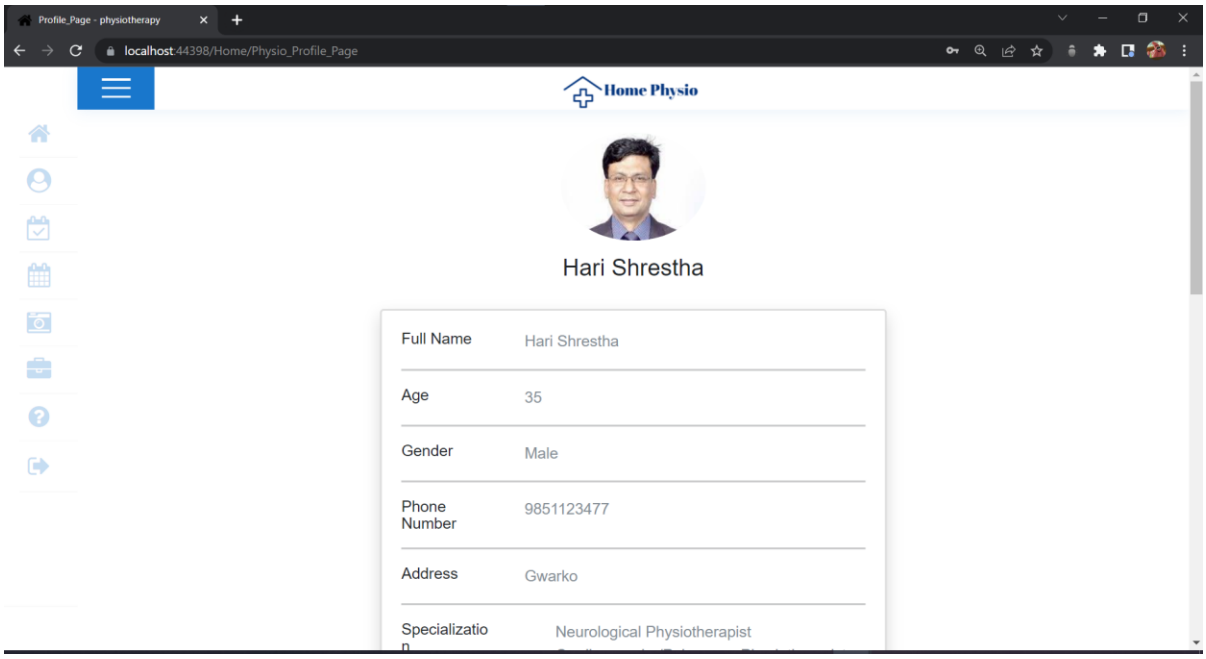

Figure Appendix.2 Physiotherapist Profile Page

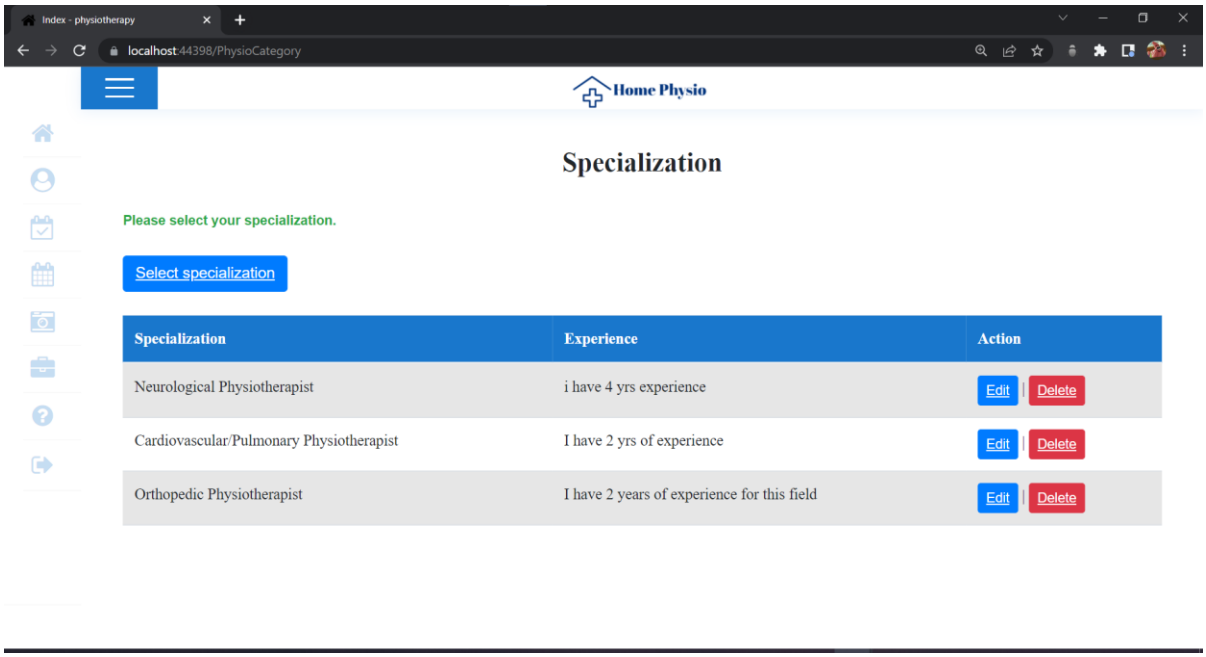

Figure Appendix.3 Specialization and Experience Page

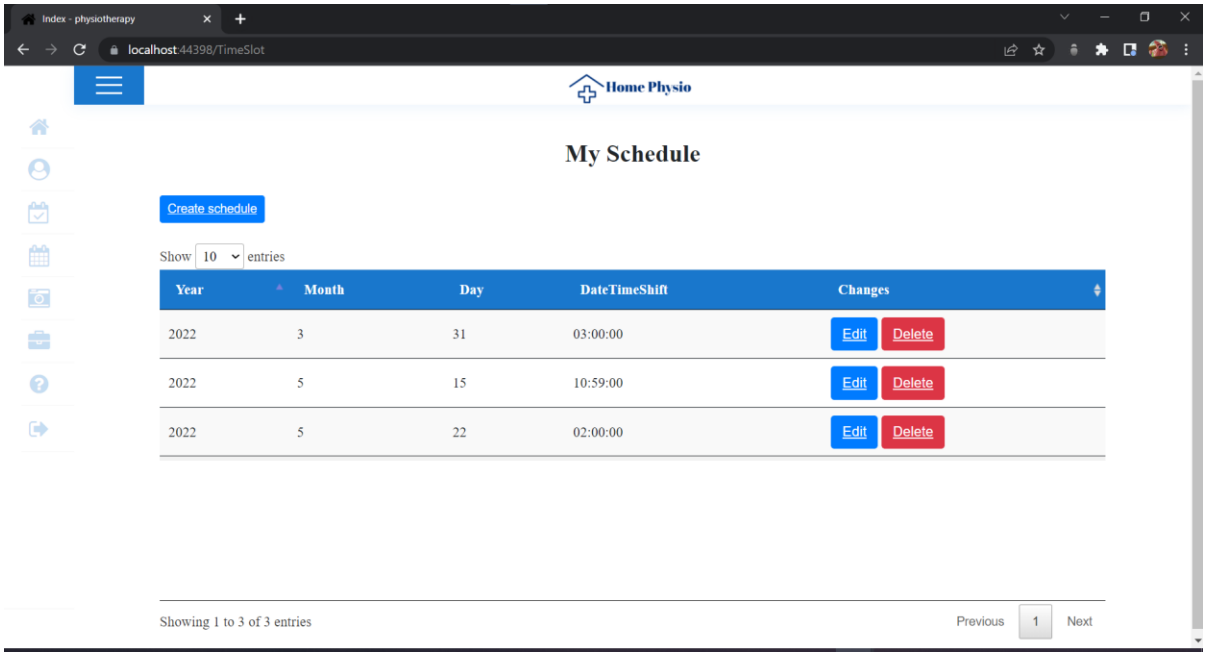

Figure Appendix.4 Timeslot edit and delete page

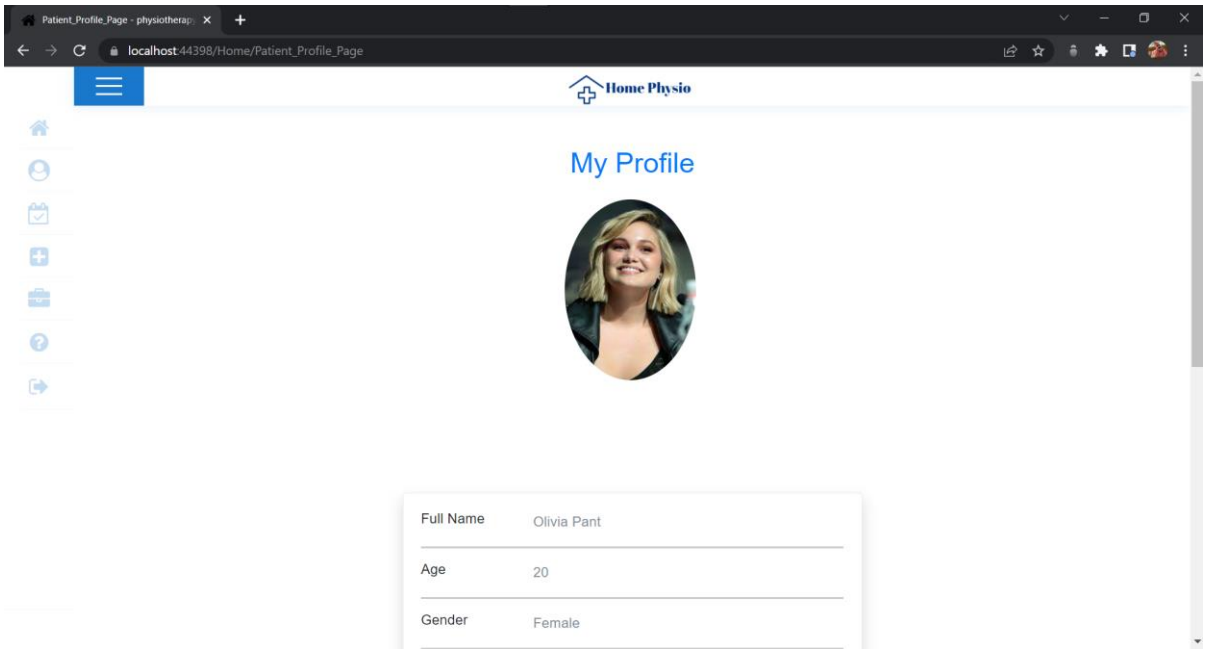

Figure Appendix.5 Patient Profile Page

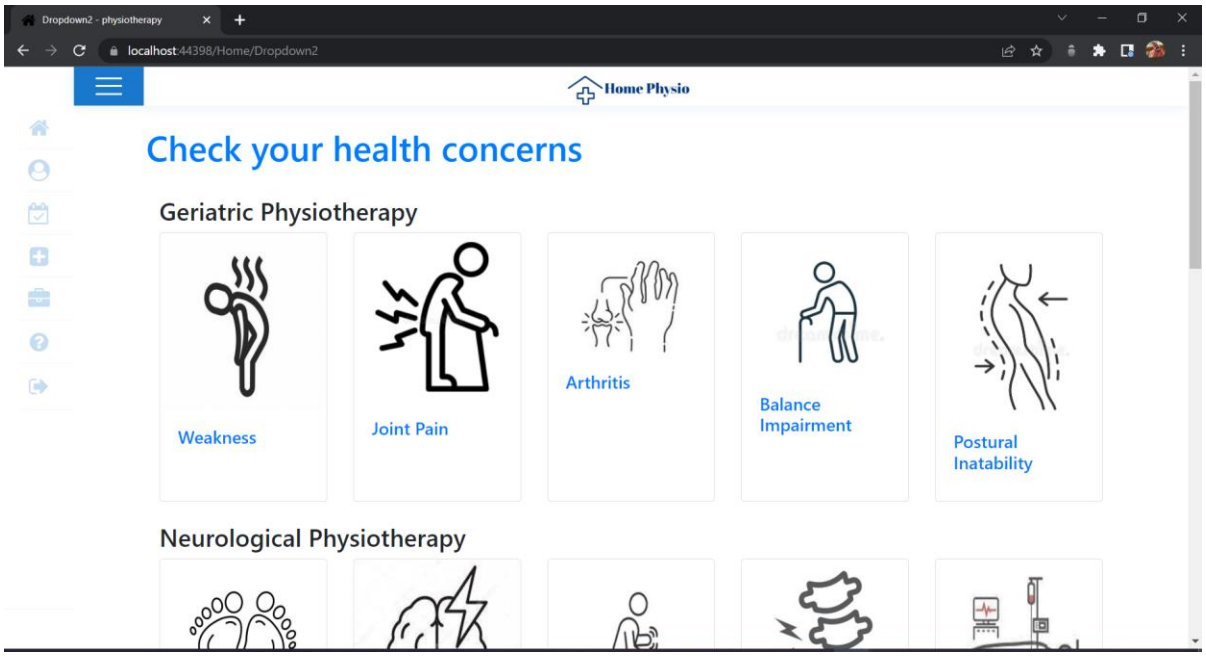

Figure Appendix. 6 Symptoms selection page

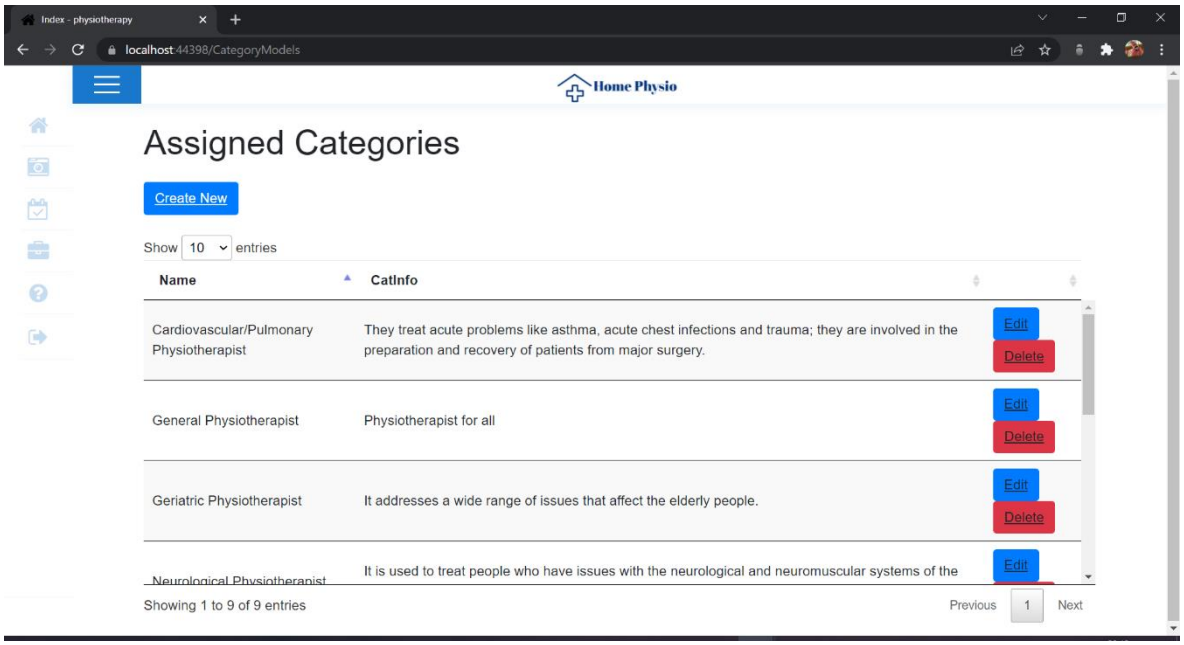

Figure Appendix. 7 Admin Category creation view

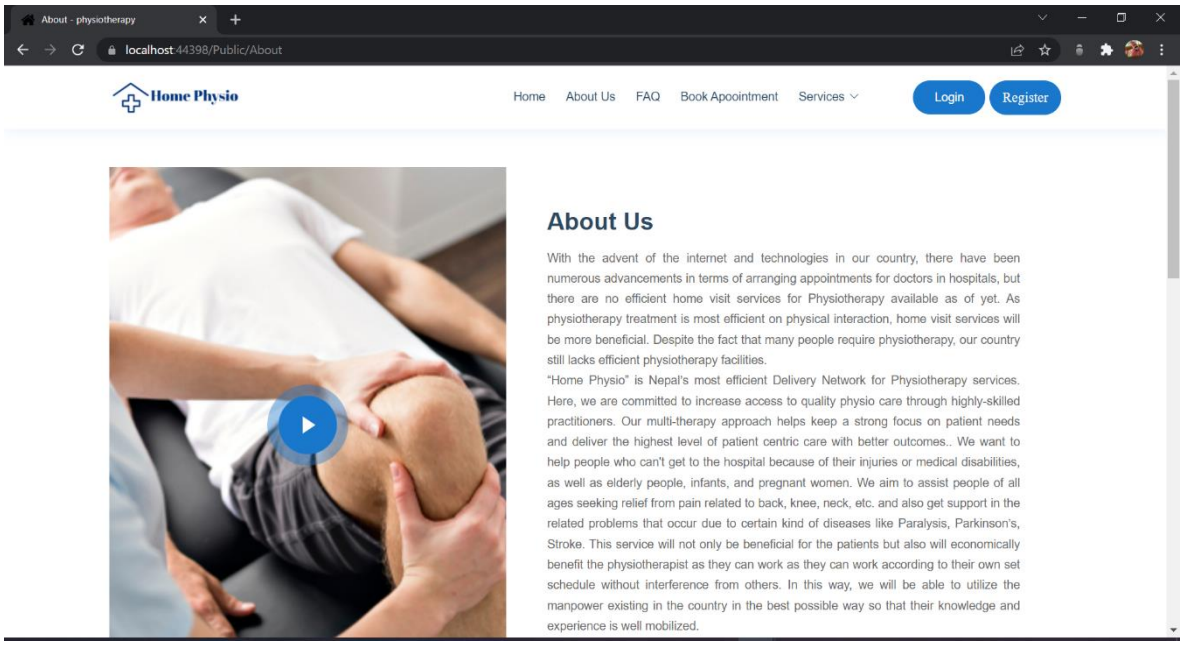

Figure Appendix. 8 About Us page

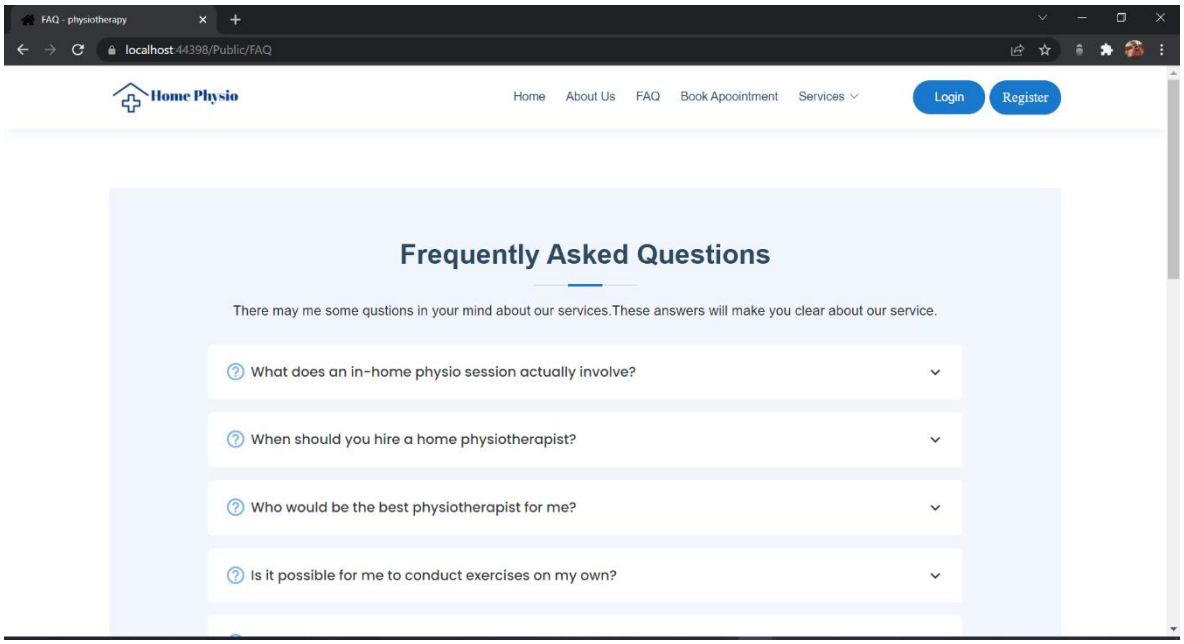

Figure Appendix. 9 FAQ page