Medical Appointment Booking Platform

Applied Database Technologies (DSCI - D532)

Technical Report

by

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1. Publishing Application

The application has been deployed and is publicly available for use. Apart from that, the source code of the application is made available on public git repository.

1.1. Application Deployment

The application has been built using R Shiny, and there are several options for deploying R Shiny web applications, such as R Studio Connect, Shiny Server Open Source, and shinyapps.io. For hosting this application, shinyapps.io is chosen, as it is a shared hosting environment managed by RStudio, providing the deployment of up to 5 applications for 25 hours in the Free Tier. The application uses the rsconnect package, which supports deployment of applications to various platforms in R. Additionally, it is integrated with R Studio, allowing any application to be easily deployed and monitored with minimal configurations. Moreover, the application can be scaled later, depending on the requirement since it is a cloud-based platform.

URL: https://ameyaparab1996.shinyapps.io/bookmydoc/

1.2. Version Control

GitHub is used for version control and collaboration for this project. All the source code files of the application, including the initial SQL files for schema design and data insertion, are present in the repository.

URL: https://github.iu.edu/adparab/bookmydoc

2. Project Implementation

2.1. Project Summary

The project focuses on developing a data-driven web application that follows best practices and standards for database design and development. BookMyDoc is a web-based medical appointment booking platform that provides patients with assistance in selecting a suitable doctor or clinician based on their treatment and specific needs. The application presents detailed information and multiple visual graphs and analytics to help patients make informed decisions when booking appointments with doctors.

2.2. Purpose and Usefulness

The primary objective of the application is to offer a user-friendly interface for appointment booking and management. By leveraging visualization features and providing comprehensive information on doctors and clinicians, the platform enables patients to make informed decisions and choose the most suitable medical professionals for their needs. The user interface design is intuitive and easy to use, requiring no additional learning for the users to navigate the platform.

Below are the objectives of the project:

- Design and develop a patient oriented website which will not only provide appointment booking but also help in choice of the Doctor.
- Present various easy to interpret visualizations to the users which can influence in making a right decision.
- Provide data filtering, search and sort capabilities on the information displayed.

2.3. Data

The data used to create this project was obtained from the Doctors and Clinicians section of The Centers for Medicare & Medicaid Services website (https://data.cms.gov/provider-data/dataset/mj5m-pzi6), which is a U.S. government website for obtaining healthcare-related data about health services, physicians, Medicare services, hospitals, and facilities. The National Downloadable File contains all the raw data in CSV format that was utilized for this project.

2.4. Database

MySQL is chosen as the database management system for this project due to its compatibility with various technologies and ability to handle large data and transactions. The raw dataset of Doctors and Clinicians information is obtained from The Centers for Medicare & Medicaid Services website, which is a U.S. government website for healthcare-related data. This dataset contains 31 columns with various data types and is normalized to third normal form (3NF) to ensure consistency and facilitate database maintenance.

Before inserting the dataset into the database tables, preprocessing is performed to remove duplicate information, standardize zip and phone number formats, and derive new columns from the existing columns. To maintain accuracy and integrity of the data, several constraints such as Primary Key, Foreign Key, Check, and Not Null are enforced on the fields in the tables. CRUD operations are performed on the database tables, and views are created to retrieve data from multiple tables. Various queries involving Joins, aggregate functions, and retrieval of data from views are also performed.

An instance of MySQL is created on Google Cloud Platform to securely host the database. This provides an added advantage of scaling the database as per need and making the database server highly available.

2.5. Web Application

BookMyDoc is developed using R Shiny, which enables the creation of interactive web applications. It comprises a user interface for designing the web page and a server for implementing the backend logic. Additionally, the application is built following the MVC (Model-View-Controller) software development architecture pattern, which helps to organize the codebase and ensure efficient development and maintenance of the application.

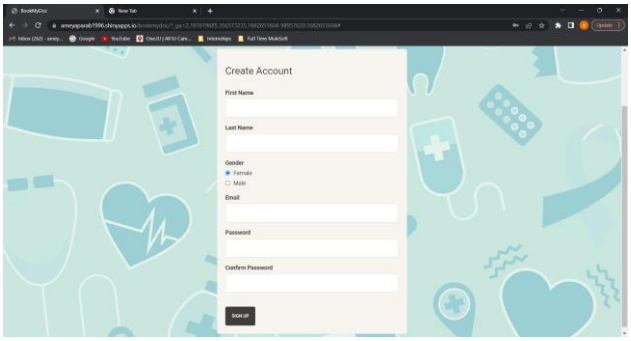
- Model: It represent the data and the business logic which in this case is stored in the MySQL database using data manipulations and processing in R.
- View: It is the user interface used to take input and display information to the users. R Shiny's UI component is segregated from the backend logic that is used for creation of the web page components to display output and receive input data.
- Controller: It is responsible for the communication between the model and view. In this scenario R Shiny's Server component does this job which has various functions to process the input data and insert into the database as well as retrieve data from the database to send it to the View component for displaying.

2.6. Functionalities

The BookMyDoc application includes all the essential features required for an appointment booking platform, along with some additional capabilities.

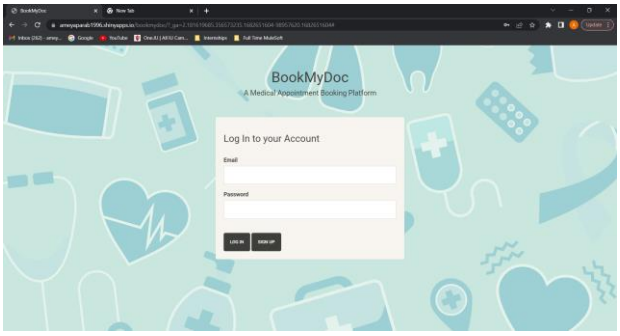
2.6.1. User Account Creation/ Sign Up

The initial web page of the BookMyDoc application includes a Sign Up form that collects basic details from the patient to create an account in the platform and insert their user data into the database. The form also includes data validation capabilities for email, password, and confirm password fields, to ensure that invalid data or an empty form is not submitted, which could lead to errors in the database. Upon successful account creation, the user is redirected to the Log In form.



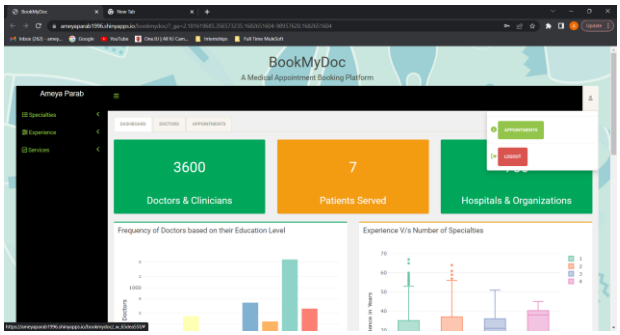
2.6.2. User Log In

The initial web page of BookMyDoc features a Log In form that allows users to enter their credentials and validates if the account exists in the database. If the entered credentials do not match the ones in the database, a pop-up message is displayed to notify the user.



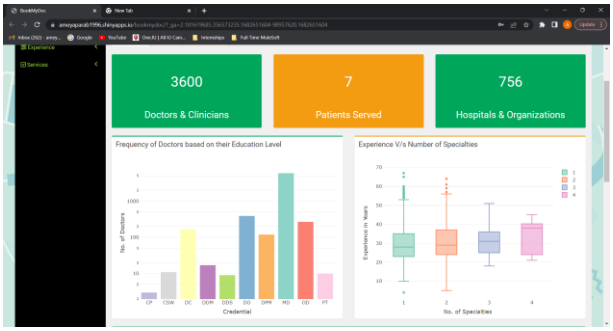
2.6.3. Main Page

After successfully logging in, the user will be directed to the main page, which features three tabs: Dashboard, Doctors, and Appointments. The name of the user will be displayed on the header of the dashboard. There will also be a logout option available. The user can easily switch between the tabs.



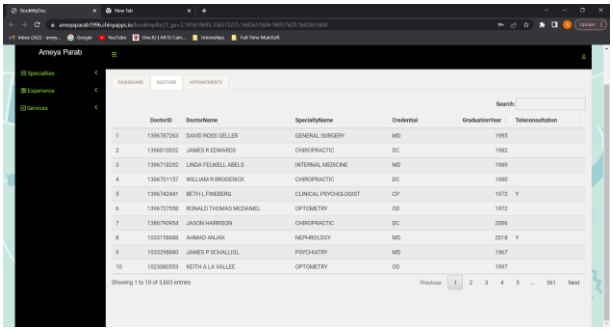
2.6.4. Dashboard Tab

When the user logs in, they are directed to the Dashboard tab, which showcases statistics and interactive visualizations created using Plotly library from the data stored in the database. The user can customize the data being displayed and the graphs being shown on the dashboard by modifying the filters in the sidebar. With the help of these filters, the user can make informed decisions and gain valuable insights from the displayed data.



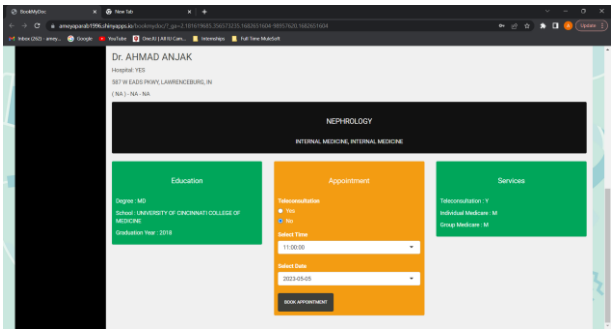
2.6.5. Doctors Tab

On the Doctors tab, users can proceed to book appointments after visualizing the data on the Dashboard tab. Here, basic information of all the doctors is displayed in a table that can be sorted on various fields and has search capability. The filters present on the sidebar also work here, allowing users to apply conditions on the data fetched from the database.



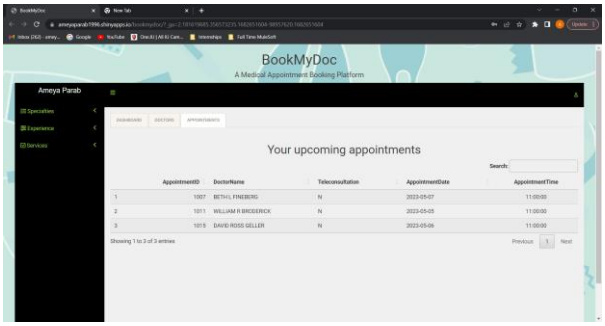
2.6.6. Appointment Booking

When the user clicks on any row of the table in the Doctors tab, another section opens up at the bottom displaying detailed information about that particular doctor, including education, specialties, address, services, and more. From here, the user can book an appointment by selecting a suitable date, time slot, and teleconsultation option (if provided by that Doctor). This will insert the appointment details of that patient into the database. Once the appointment is successfully booked, the user is redirected to the Appointments tab.



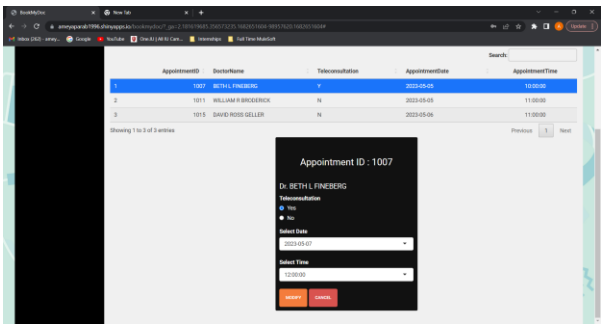
2.6.7. Appointments Tab

The Appointments tab presents a table that lists all the appointments made by the user after logging in. The table has search and sort functionalities to make it easier for the user to navigate through the appointments.



2.6.8. Appointment Modification/ Cancellation

When a user clicks on any appointment from the table in the Appointments tab, a box appears at the bottom of the table with options to either modify or cancel the appointment. If the user chooses to modify the appointment, they can select a new suitable date and time slot. If the user chooses to cancel the appointment, it is removed from the database. Upon successful cancellation or modification, the table is updated with the new information without refreshing the page.



3. Team Work

3.1. Ameya's Evalutaion:

Since most of the application's backend was completed during the mock UI submission week, it was easier for us to build and integrate the remaining parts. Standardizing the UI was one of the major tasks, although having a good-looking UI was not necessary. The major focus was on the database functionalities, but Trishna and I tried to enhance and standardize the UI with a uniform color scheme throughout the application.

I had experience writing code in R, but creating the Shiny UI component was something new I had to learn. We divided the functions in the server component for each functionality and started working on it. I worked on the visualization and part of the project because of my previous experience with creating a dashboard of graphs using Plotly. Moreover, dynamically displaying sections on the webpage, filtering information when input in the sidebar is changed, and rendering the table without refreshing the webpage were challenging parts. There were a few issues in displaying information and inserting/updating data in the database that were highlighted during integration testing done by Trishna. I worked to resolve these issues and collaborated with Trishna to retest those scenarios. Once all the bugs were fixed, we moved on to deploy our application on Shinyapps.io, where our TA, Aman, assisted us by sharing resources for choosing an appropriate deployment platform.

Overall, it was a great experience in learning and collaborating for the development of a full-scale web application. This will definitely enhance our portfolio for database and software development.

3.2. Trishna's Evaluation

I had no prior experience working with R shiny and limited exposure to MySQL so I had to learn these technologies while implementing the project and my teammate Ameya helped me a lot to get a good hold of these tools and concepts. We had completed most of the backend during our mock submission itself so we had enough time in hand to enhance the look and feel of the project and work on creating a good user-friendly UI and include more informative KPIs and visualizations. Ameya and I worked collaboratively on this project and communicated well to keep the UI uniform and consistent. We divided and wrote the queries for CRUD operations on MySQL for the appointment booking, update and deletion. Since I had no prior experience writing code in R, I relied on Ameya for helping me with my doubts and eventually we were able to successfully run and deploy our project. I also helped in the end to end testing of our entire application and wrote multiple unit tests for the same. Ameya and I also performed integration testing and solved the bugs together.

Overall, I had a great learning experience while working on this project and I feel confident that the skills and technologies that I have learnt throughout this course will greatly help me in my future endeavours.