

# **Team 86 Final Report**

## **“TravelPlanner”**

Plans are nothing; Planning is everything. -Dwight D. Eisenhower

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# Table of Contents

<b>1. Background.....</b>	<b>4</b>
1.1 Aim.....	4
1.2 Value Positioning Statement.....	4
1.3 Literature.....	4
1.4 Sources of Information.....	5
1.5 Scope.....	5
1.6 Summary of Group and Process.....	6
1.7 Summary of Background.....	6
<b>2. Planning &amp; Research.....</b>	<b>7</b>
2.1 Resource & Time Allocation (Timeline).....	7
2.2 Resource & Time Allocation (Budgeting).....	8
2.2.1 API Cost.....	8
2.2.2 Web Hosting.....	8
2.3 Frontend Development.....	8
2.4 Backend Development.....	8
2.5 Breakdown of the Team.....	9
2.6 Project Management Tools.....	10
2.7 Dataset.....	10
2.8 User Stories.....	11
2.9 Persona Board.....	12
<b>3. Prototyping and Iteration.....</b>	<b>13</b>
3.1 User Research.....	13
3.1.1 Positive Feedback.....	13
3.1.2 Improvement 1: Omitting the socials feature.....	14
3.1.3 Improvement 2: Allowing users to add their bookings to their itinerary.....	15
3.2 User Testing.....	15
3.2.1 Improvement 1: Enhancement on add-to-itinerary feature.....	15
3.3 Functional Testing.....	16
3.3.1 Register Page.....	16
3.3.2 Login Page.....	18
3.3.3 Hotel Search Page.....	19
3.3.4 Hotel Results Page.....	20
3.3.5 Hotel Information Page.....	21
<b>4. Design.....</b>	<b>22</b>
4.1 UML Use Case Diagram.....	22
4.2 UML Class Diagram.....	23
4.3 Initial Design.....	24
4.4 Finalised Design.....	31
<b>5. System Development.....</b>	<b>46</b>

5.1 Agile Approaches.....	46
5.2 Components of Software.....	47
5.2.1 GitHub Repository Overview.....	47
5.2.2 Directory Structure.....	47
5.2.3 Github Repository Workflow.....	49
5.2.4 Display Tier.....	50
5.2.5 Node Package Manager (NPM) Packages.....	51
5.2.6 Firestore Database.....	52
5.2.7 Application Programming Interfaces (APIs).....	53
<b>6. Analysis.....</b>	<b>59</b>
6.1 Introduction to the Analysis.....	59
6.2 Framework for Analysis.....	59
6.3 Analysis of the Solution.....	59
6.3.1 Effectiveness.....	59
6.3.2 User Experience.....	59
6.3.3 Alignment with Literature.....	59
6.3.4 Sustainability.....	60
6.4 Summary of Analysis.....	60
<b>7. Evaluation.....</b>	<b>61</b>
7.1 Development Process.....	61
7.1.1 Team Collaboration.....	61
7.1.2 Methodologies Employed.....	61
7.2 Built Product: The Travel Planner Website.....	61
7.2.1 User Experience (UX).....	61
7.2.2 Functionalities.....	62
7.2.3 Scalability and Performance.....	62
7.2.4 Future Work.....	62
<b>8. Conclusion.....</b>	<b>63</b>
<b>9. Individual Reflection.....</b>	<b>64</b>
<b>10. Bibliography.....</b>	<b>66</b>

# 1. Background

## 1.1 Aim

The aim of this project is to develop a travel planner website that offers users convenience in booking or planning their travel itineraries efficiently. This platform will provide features such as flight booking, airbnb booking, hotel booking and an itinerary planner. The ultimate goal is to simplify travel planning, enhance user experience and improve the efficiency of booking/planning travel related services.

## 1.2 Value Positioning Statement

Value Positioning Statement			
<b>For</b>	Users that are either non-tech savvy and tech savvy		
<b>Who</b>	Want to plan their travels with ease		
<b>The</b>	Travel Planning Web	<b>is a</b>	Travel Itinerary Maker
<b>That</b>	Functions as a one-stop shop for users, allowing them to easily book lodgings and flights while also assisting in the creation of a full vacation plan. Users may easily browse and book a variety of hotel and flight alternatives, ensuring a hassle-free booking experience. At the same time, the website provides comprehensive itinerary design features, allowing travellers to methodically plan and organise their journeys from a single, convenient location. This website streamlines the entire process, making travel planning simple, whether it's finding the perfect hotel, booking the best flight, or building a complete travel itinerary.		

Figure 1: Value positioning statement

## 1.3 Literature

In this digital era, travel planning has undergone transformation with the advent of online travel agencies such as (Trip.com, Booking.com, TripAdvisor), review platforms, and personalised travel planning tools. The literature review for this project encompasses key topics related to the development of the travel planner website:

1. **Integration with Third-Party APIs:** Effective travel platforms often integrate multiple services such as flight booking and accommodation booking, to create a seamless user experience (Codetheorem, 2022). Through seamlessly connections to services, travel planners can offer a comprehensive and convenient experience to users. For this project, this insight influenced our decision to integrate APIs from renowned providers like Skyscanner, Airbnb, Booking.com, ensuring the users have access to a wide range of travel-related services within the platform.

2. **User Experience and Usability:** Examining the importance of user-centric design principles, responsive web design, and intuitive user interfaces to ensure a positive experience for travel website users (RamSys, 2018). This project recognises the importance of user-centric design principles, responsive web design, and intuitive user interfaces in ensuring positive experience for travel website users. The travel planner website places a strong emphasis on usability and responsive design, offering intuitive navigation and clear information presentation to enhance user experiences.
3. **Online Travel Business Trends:** As noted by Charlton (2023), the project's methodology is directly impacted by the changing environment of online travel business trends. The team chose to focus on improving the desktop user experience because of Charlton's observation that consumers show a higher desire to complete purchases on desktop devices with a lower abandonment rate compared to mobile users. This strategy follows current market trends and seeks to increase conversion rates on the platform.

## 1.4 Sources of Information

This project's information will be acquired from a number of reliable sources, including:

1. **Online Resources:** Integration will be facilitated by using developer documentation for the flights, airbnb, hotel, and firebase APIs.
2. **User Feedback:** The results of the Google forms will be utilised to direct the creation process.
3. **Web Development Communities:** To get assistance, find answers to technical problems, and learn about the best practices in web development, use online forums and developer communities.
4. **Academic Journals:** To make knowledgeable decisions while creating, scholarly articles and research papers on subjects relating to trip planning web development, user experience, and the travel industry will be used.

## 1.5 Scope

The scope of this project encompasses the design, development, testing and deployment of a travel planning website with these features:

1. **Login/Sign Up Page:** A landing page which requires users to log in to gain access to the main sections.
2. **Home Page:** A page providing an overview of the website.
3. **Flight Page:** A flight booking page which allows users to search and book flights.
4. **Airbnb Page:** An Airbnb booking page which allows users to search and book Airbnb accommodations.
5. **Hotel Page:** A hotel booking page which allows users to search and book hotels.
6. **Bookings Page:** A section whereby users can view and manage all their bookings such as flights, Airbnbs and hotels.
7. **Itinerary Page:** A tool for creating, editing and saving travel itineraries.

## 1.6 Summary of Group and Process

The team is divided by assigning each page to the respective team member. The pages are split up into Login/Signup/Itinerary, Home/Footer, Flight/Bookings, Airbnb/Bookings, Hotel/Bookings. The team will also be working together to ensure the webpage has a clear and concise way of presenting its information. This project will be developed in accordance with the original report's technical needs, requirements, specifications, and prototyping.

## 1.7 Summary of Background

In summary, this project aims to address the evolving needs of modern travellers by creating a user-friendly travel planner platform. It will prioritise user experience and incorporate the latest technologies to provide a comprehensive and efficient travel planning platform. The literature review and information sources will serve as a guidance for the team and ensure that the website aligns with industry best practices and user expectations. The project's scope will focus on the creation of the specified web pages and associated functionalities.

## 2. Planning & Research

### 2.1 Resource & Time Allocation (Timeline)

Week 12 started as the team members focused on the midterm of other modules.

Week 12-13: Initial Design and Prototyping

- Sketching initial design concepts.
- Developing a basic clickable prototype for user testing.
- Receiving feedback from potential users and stakeholders.

Week 14-15: Backend Development

- Setting up the Node.js environment.
- Integrating the selected APIs.
- Building the core backend logic.

Week 16-17: Frontend Development

- Implementing the basic frontend using EJS.
- Frontend-backend integration.
- Initial tests of user flow and functionalities.

Week 18-19: Backend and Frontend Development

- Enhancing the functionalities based on initial tests.
- Fine-tuning the integration of frontend and backend components.
- Extensive functional testing.

Week 20: Testing and Iteration

- User testing with a broader audience.
- Feedback collection and iteration based on the feedback.
- Addressing technical challenges and bugs.

Week 21: Finalisation

- Finalising the design and functionalities.
- Updating the report.
- Preparing for submission.

## 2.2 Resource & Time Allocation (Budgeting)

The total amount spent on this project was SGD\$118.60 and was split evenly between team members.

### 2.2.1 API Cost

Skyscanner's flight function was one of the first to be developed, and it was estimated that it would be safe to use the API until the results were released. As a result, we decided on a seven-month plan that costs SGD\$66.50. Afterwards, we shifted our attention to the Airbnb API and opted for a five-month plan that costs SGD\$47.10. The total cost used for API totals up to SGD\$113.60.

### 2.2.2 Web Hosting

Our team used Heroku as our web hosting platform due to a team member's previous positive experience. Although we also considered Firebase hosting, its cost was significantly higher than Heroku. We hosted the website from weeks 17 to 20 to gather user feedback, which incurred a total expense of SGD\$5.00. ("Heroku Pricing") ("Firebase Pricing")

## 2.3 Frontend Development

After a thorough discussion, the team unanimously decided on the tools to be used for the project. Bootstrap and EJS were chosen for their superior advantages. Bootstrap was preferred because of its user-friendly nature and the ability to apply its classes across the entire website with inline scripts. Although tailwind CSS was also considered, its complexity led the team to select Bootstrap. EJS was seamlessly integrated with NodeJS and required no convoluted rules or setup, making it a familiar and agreeable choice for all members. ("NodeJS") (Eernisse)

## 2.4 Backend Development

Node.js was chosen because it is a lightweight and efficient open-source server environment that allows multiple users to plan trips simultaneously. Additionally, the team can use JavaScript, a language familiar to us, for server-side scripting and writing command line tools. ("NodeJS")

To enrich our travel planner with reliable data and functionalities, we incorporated several APIs:

- **Skyscanner API:** Provides users with live prices, quotes for specific dates, and browse prices over various timeframes.
- **Airbnb API:** Provides users with detailed searches about property types, available rooms, pricing, and customer reviews.
- **Bookings.com API:** Provides property and available rooms.
- **Google Maps API:** Provides embedding Google Maps on webpages.

## 2.5 Breakdown of the Team

Khee Hing

- **Login Mechanism:** Developed a robust and secure login system to ensure users have a personalised experience using our platform.
- **Firebase Integration:** Integrated Firebase to handle user authentication, ensuring a secure environment where user data is stored and accessed safely.
- **Itinerary Management:** Engineered the itinerary feature, allowing users to craft, modify, and store travel plans. This essential feature offers users an intuitive way to plan and visualise their trips from start to finish.

Qi Xuan

- **Flight Integration:** Responsible for integrating the Skyscanner API, Qixuan ensured users could access live flight data, price comparisons, and booking options.
- **Flight Interface:** Developed the user interface for flight search and results, ensuring information is presented clearly and organised.

Raziq

- **Hotel Data Integration:** Through RapidAPI's Booking.com API, Raziq managed the integration of comprehensive hotel data, including available rooms, pricing, and user reviews.
- **Hotel Search Mechanism:** Designed the hotel search functionalities, enabling users to filter and sort accommodations based on various criteria such as price, location, and rating.

Jingling

- **Airbnb Data Fetching:** Ensured users have an alternative accommodation option by integrating data related to Airbnb listings. This includes details on availability, pricing, and property descriptions.
- **Listing Interface Design:** Created a user-friendly interface for browsing Airbnb properties, making it easy for travellers to find unique stays.
- **Bookings Management:** Created a bookings page for users to view and manage their flight, hotel and Airbnb bookings.

Gabrielle

- **Homepage Design:** Crafted an engaging and welcoming homepage that captures the essence of travel and adventure.
- **Consistent Styling:** Ensured that all website pages, whether focused on flight, hotel, or Airbnb listings, maintain a consistent and visually appealing design. Gabby's work guarantees users a smooth, aesthetically pleasing browsing experience across the platform.

## 2.6 Project Management Tools

Our team efficiently communicated using Telegram as our primary platform, ensuring that member was always in the loop. We maximised the platform's potential with its message-pinning feature, highlighting vital information. GitHub served as our reliable repository and version control system, allowing team members to easily upload their code, review contributions, and merge features. This platform's collaboration features, such as pull requests and code reviews, enabled us to integrate new features quickly and maintain high-quality code. Moreover, GitHub's issue-tracking capabilities were crucial in identifying and resolving bugs. To manage our tasks effectively, we utilised GitHub Projects, allowing us to create boards for each project phase. Each task or feature was represented by a card containing details on progress, deadlines, and the responsible team member. With its drag-and-drop functionality, tasks could be seamlessly moved across columns to organise better and track our project's overall status.

## 2.7 Dataset

An extensive dataset enumerating global airport names was procured from the Kaggle platform and presented in the structured JSON format. This dataset has been integrated into our web application's flight search and itinerary planning segments. The primary utilisation of this data is manifested in the form of a dropdown list designed to optimise user experience by facilitating an efficient and intuitive airport or country search mechanism.

## 2.8 User Stories

As a traveller, I want to search for flights so that I can compare different options for my desired travelling period.

- Implement flight search functionality based on destinations and dates.
- Display a list of available flights, including airline information, departure/arrival timings, and pricing.
- Allow users to book their flight of choice.

Figure 2: Flight user story

As a traveller, I want to search for hotels and airbnbs so that I can compare different options for my desired travelling period.

- Make it possible to search for accommodations depending on destination, check-in, and check-out dates.
- Display a list of available accommodations, together with information such as room kinds, pricing, and guest reviews.
- Allow consumers to choose and book accommodations for their desired dates.

Figure 3: Hotel and airbnb user story

As a traveller, I want to plan my itinerary by adding places and activities.

- Implement a feature that allows users to add places and activities to their schedule.
- Allow for the selection of dates and hours for each activity in the agenda.
- Allow users to save and change their travel plans.

Figure 4: Itinerary user story

## 2.9 Persona Board

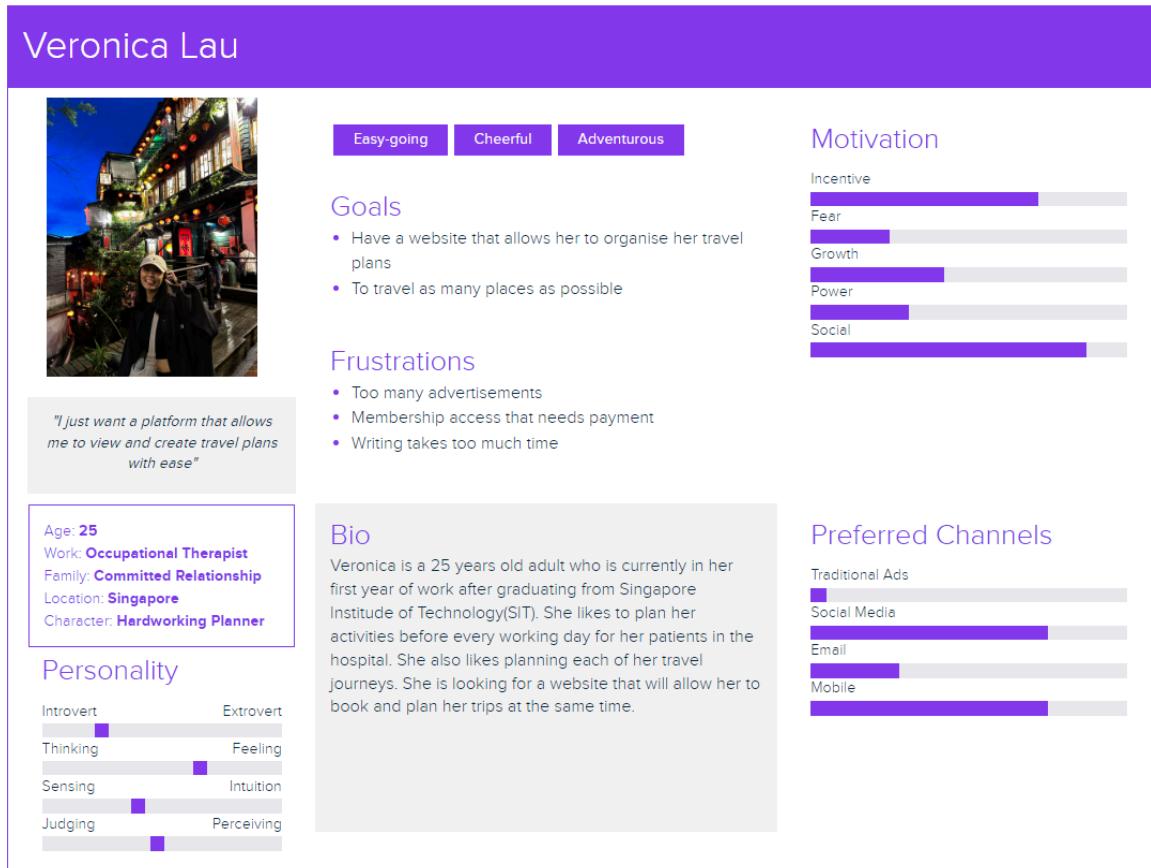


Figure 5: Persona board

### 3. Prototyping and Iteration

#### 3.1 User Research

Before beginning our development work, we conducted simple user research to gather feedback on our vision of the travel planner website. We created a [questionnaire](#) using Google Forms and asked our users how useful our features would be in helping them plan their overseas trips.

##### 3.1.1 Positive Feedback

For the majority of our planned features, most users found them to be useful in aiding with their travel planning. These features include flight and accommodation booking, as well as itinerary planning.

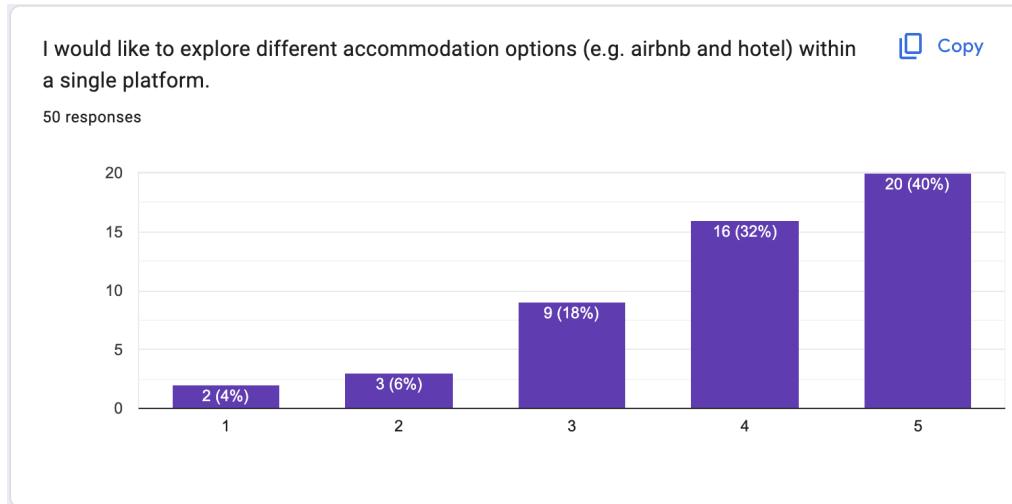


Figure 6: Positive feedback on airbnb and hotel features

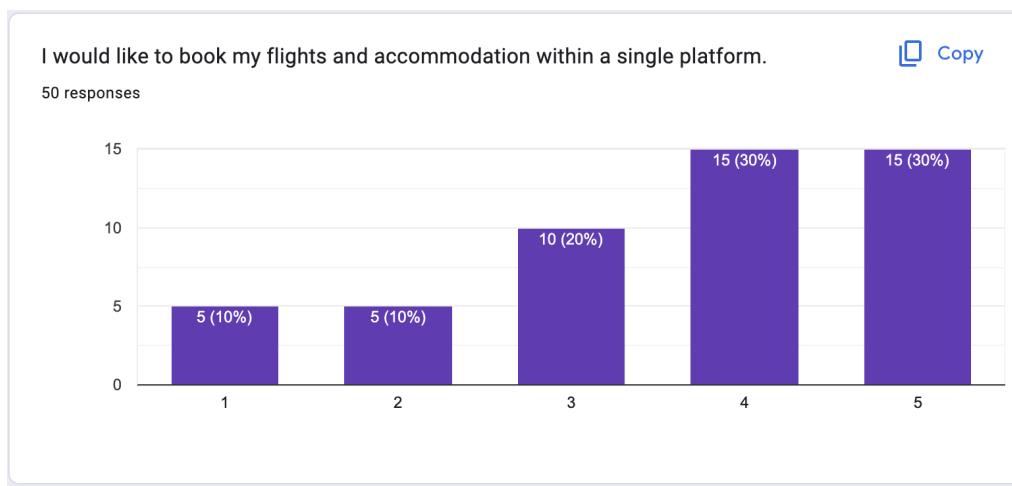


Figure 7: Positive feedback on flight feature

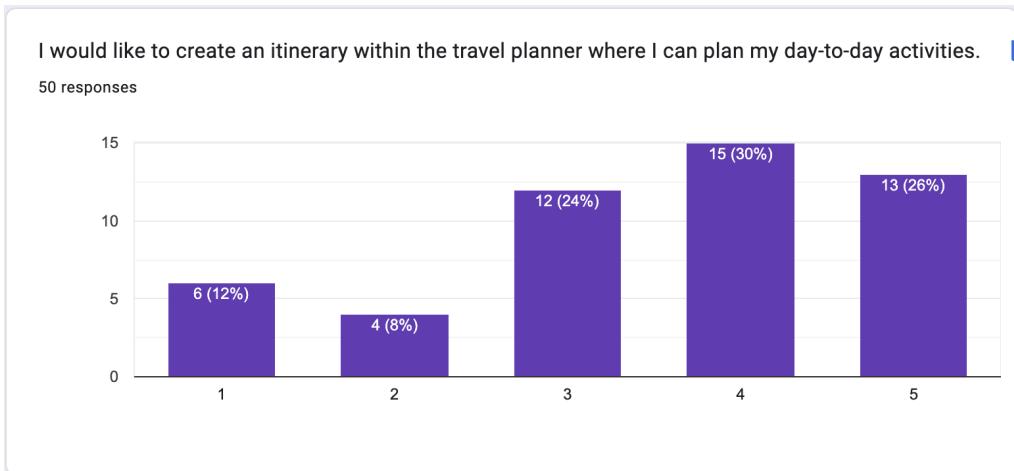


Figure 8: Positive feedback on itinerary feature

### 3.1.2 Improvement 1: Omitting the socials feature

One of our initial ideas for the travel planner was to create a socials page for users to interact with one another and share their itineraries. However, feedback from our user research suggested that this was not a very useful feature, thus we decided to omit this feature entirely.

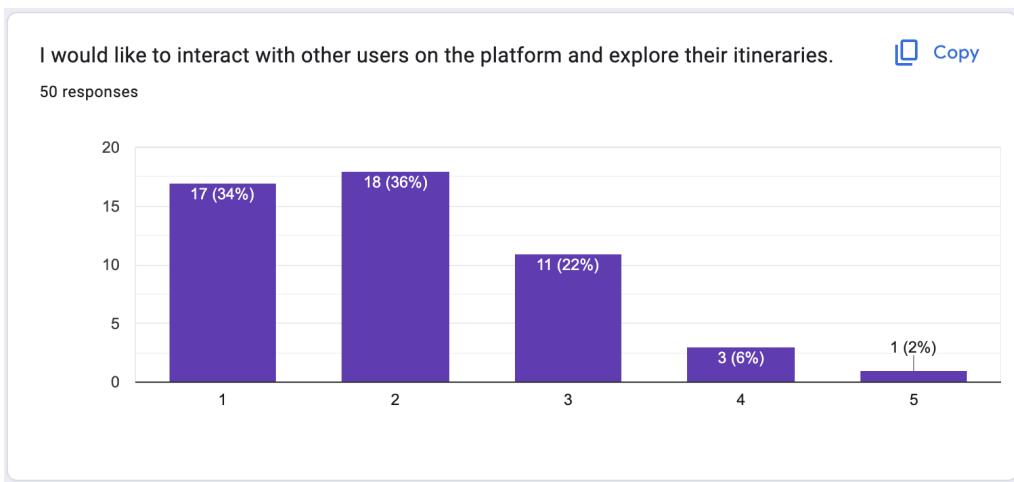


Figure 9: Negative feedback on socials feature

### 3.1.3 Improvement 2: Allowing users to add their bookings to their itinerary

Out of the 50 responses, a few suggested that it would be useful if users can include their flight and accommodation bookings in their itineraries. Hence, we decided to implement this feature in our website as well.

Is there a feature not mentioned above that you think may be useful?

It would be good if I can add my bookings to my itinerary

display my flights and accommodation in my itinerary :)

Link the bookings to the itinerary somehow

Figure 10: Additional feedback on adding bookings to itinerary

## 3.2 User Testing

After the first prototype of our travel planner was completed, we hosted our website and carried out a user testing exercise to collect feedback on further improvements that could be made. We created another [questionnaire](#) on Google Forms and asked our users to comment on the features that had been implemented.

### 3.2.1 Improvement 1: Enhancement on add-to-itinerary feature

In our first prototype, users could add their bookings to their itinerary through the bookings page. However, some users felt that they would prefer to add their booking to their itinerary directly from the flight/hotel/airbnb page.

would be good if I can add my booking to itinerary immediately after booking is made

Needed to navigate to the bookings page to add my booking to itinerary, a bit troublesome

Figure 11: Feedback on adding bookings to itinerary

As a result, we implemented a modal that would be displayed after the user clicks on the book button in the flight/hotel/airbnb page, giving them the option to add that booking to an itinerary if they wish to do so.

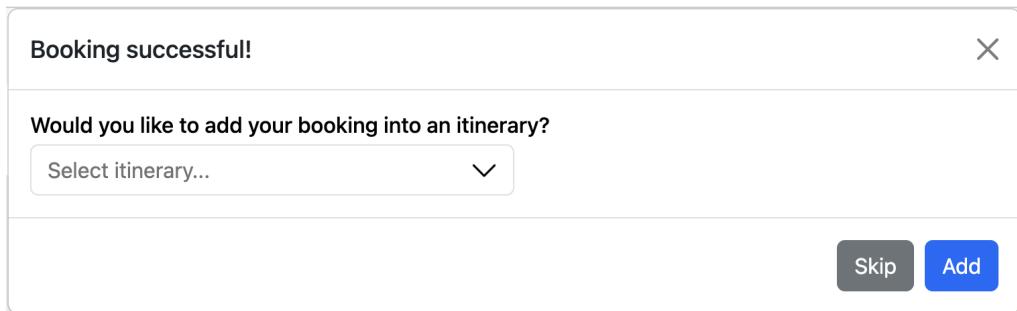


Figure 12: Add-to-itinerary modal

### 3.3 Functional Testing

In addition to user testing, we also carried out our own functional testing, to make sure that all functions were working as expected. Due to the word count restriction, only a few examples are provided below.

#### 3.3.1 Register Page

<b>Test Scenario ID</b>	Register-1	<b>Test Case ID</b>	Register-1A		
<b>Test Case Description</b>	Register-Positive test case	<b>Test Priority</b>	High		
<b>Pre-Requisite</b>	Does not have account	<b>Post-Requisite</b>	NA		
Test Execution Steps:					
S.No	<b>Actions</b>	<b>Inputs</b>	<b>Expected Output</b>	<b>Actual Output</b>	<b>Test Result</b>
1	Load website	No input needed	Login page	Login page	Pass
2	Click on sign up	No input needed	Register page	Register page	Pass
3	Enter valid Email, Password, Confirm Email and password, and hit register button	Email: <a href="mailto:test@gmail.com">test@gmail.com</a> Confirm Email: <a href="mailto:test@gmail.com">test@gmail.com</a> Password: 123456 Confirm password: 123456	Login page	Login page	Pass

Figure 13: Positive test case for register page

<b>Test Scenario ID</b>	Register-1	<b>Test Case ID</b>	Register-1B		
<b>Test Case Description</b>	Register-Negative test case (invalid input)	<b>Test Priority</b>	High		
<b>Pre-Requisite</b>	Does not have account	<b>Post-Requisite</b>	NA		
Test Execution Steps:					
S.No	<b>Actions</b>	<b>Inputs</b>	<b>Expected Output</b>	<b>Actual Output</b>	<b>Test Result</b>
1	Load website	No input needed	Login page	Login page	Pass
2	Click on sign up	No input needed	Register page	Register page	Pass
3	Enter valid Email, Password, Confirm with wrong Email or password, and hit register button	Email: <a href="mailto:test@gmail.com">test@gmail.com</a> Confirm Email: <a href="mailto:test@gmail.com">test@gmail.com</a> Password: 123456 Confirm password: 1234	Password and confirm password does not match	Password and confirm password does not match	Pass

Figure 14: Negative test case for register page (invalid input)

### 3.3.2 Login Page

<b>Test Scenario ID</b>	Login-1	<b>Test Case ID</b>	Login-1A		
<b>Test Case Description</b>	Login-Positive test case	<b>Test Priority</b>	High		
<b>Pre-Requisite</b>	Must have an account	<b>Post-Requisite</b>	NA		
Test Execution Steps:					
S.No	Actions	Inputs	Expected Output	Actual Output	Test Result
1	Load website	No input needed	Login page	Login page	Pass
2	Enter valid email and password, and click "Login"	Email: <a href="mailto:test@gmail.com">test@gmail.com</a> Password: 123456	Home page	Home page	Pass

Figure 15: Positive test case for login page

<b>Test Scenario ID</b>	Login-1	<b>Test Case ID</b>	Login-1B		
<b>Test Case Description</b>	Login-Negative test case (invalid input)	<b>Test Priority</b>	High		
<b>Pre-Requisite</b>	Must have an account	<b>Post-Requisite</b>	NA		
Test Execution Steps:					
S.No	Actions	Inputs	Expected Output	Actual Output	Test Result
1	Load website	No input needed	Login page	Login page	Pass
2	Enter valid email and invalid password, and click "Login"	Email: <a href="mailto:test@gmail.com">test@gmail.com</a> Password: 1234	The password is invalid or the user does not have a password.	The password is invalid or the user does not have a password.	Pass

Figure 16: Negative test case for login page (invalid input)

### 3.3.3 Hotel Search Page

<b>Test Scenario ID</b>	Hotel-1	<b>Test Case ID</b>	Hotel-1A		
<b>Test Case Description</b>	Hotel search page-Positive test case	<b>Test Priority</b>	High		
<b>Pre-Requisite</b>	Must be logged in	<b>Post-Requisite</b>	NA		
Test Execution Steps:					
S.No	Actions	Inputs	Expected Output	Actual Output	Test Result
1	Go to hotel page	No input needed	Hotel search page	Hotel search page	Pass
2	Enter destination, check-in, check-out and guests, and click "Search"	Destination: Kuala Lumpur Check-in: 26/10/2023 Check-out: 31/10/2023 Guests: 2	Hotel results page	Hotel results page	Pass

Figure 17: Positive test case for hotel search page

<b>Test Scenario ID</b>	Hotel-1	<b>Test Case ID</b>	Hotel-1B		
<b>Test Case Description</b>	Hotel search page-Negative test case (invalid input)	<b>Test Priority</b>	High		
<b>Pre-Requisite</b>	Must be logged in	<b>Post-Requisite</b>	NA		
Test Execution Steps:					
S.No	Actions	Inputs	Expected Output	Actual Output	Test Result
1	Go to hotel page	No input needed	Hotel search page	Hotel search page	Pass
2	Enter destination, check-in, check-out and guests, and click "Search"	Destination: Seoul Check-in: 10/11/2023 Check-out: 02/11/2023 Guests: 4	Check-out date must be after the check-in date.	Check-out date must be after the check-in date.	Pass

Figure 18: Negative test case for hotel search page (invalid input)

<b>Test Scenario ID</b>	Hotel-1	<b>Test Case ID</b>	Hotel-1C		
<b>Test Case Description</b>	Hotel search page-Negative test case (missing fields)	<b>Test Priority</b>	High		
<b>Pre-Requisite</b>	Must be logged in	<b>Post-Requisite</b>	NA		
Test Execution Steps:					
S.No	<b>Actions</b>	<b>Inputs</b>	<b>Expected Output</b>	<b>Actual Output</b>	<b>Test Result</b>
1	Go to hotel page	No input needed	Hotel search page	Hotel search page	Pass
2	Leave fields empty and click "Search"	Destination: Check-in: Check-out: Guests:	Please fill out this field.	Please fill out this field.	Pass

Figure 19: Negative test case for hotel search page (missing fields)

### 3.3.4 Hotel Results Page

<b>Test Scenario ID</b>	Hotel-2	<b>Test Case ID</b>	Hotel-2A		
<b>Test Case Description</b>	Hotel results page-Positive test case	<b>Test Priority</b>	High		
<b>Pre-Requisite</b>	Must be logged in, must search in hotel query	<b>Post-Requisite</b>	NA		
Test Execution Steps:					
S.No	<b>Actions</b>	<b>Inputs</b>	<b>Expected Output</b>	<b>Actual Output</b>	<b>Test Result</b>
1	Click on any populated hotel result	No input needed	Hotel information page	Hotel information page	Pass

Figure 20: Positive test case for hotel results page

### 3.3.5 Hotel Information Page

<b>Test Scenario ID</b>	Hotel-3	<b>Test Case ID</b>	Hotel-3A		
<b>Test Case Description</b>	Hotel information page-Positive test case	<b>Test Priority</b>	High		
<b>Pre-Requisite</b>	Must be logged in, must search in hotel query, must click on any populated hotel result	<b>Post-Requisite</b>	NA		
Test Execution Steps:					
S.No	<b>Actions</b>	<b>Inputs</b>	<b>Expected Output</b>	<b>Actual Output</b>	<b>Test Result</b>
1	Go to rooms section	No input needed	Room contents	Room contents	Pass
2	Click “Book”	No input needed	Modal is displayed	Modal is displayed	Pass
3	Select itinerary and click “Add”	Would you like to add your booking into an itinerary?: Create new itinerary  Trip name: Tokyo May 2024  Destination: Tokyo  From: 01/05/2024  To: 17/05/2024	Booking added to itinerary	Booking added to itinerary	Pass

Figure 21: Positive test case for hotel information page

## 4. Design

### 4.1 UML Use Case Diagram

This use case diagram shows the users' interactions with the system, and the different actions they can perform on our website.

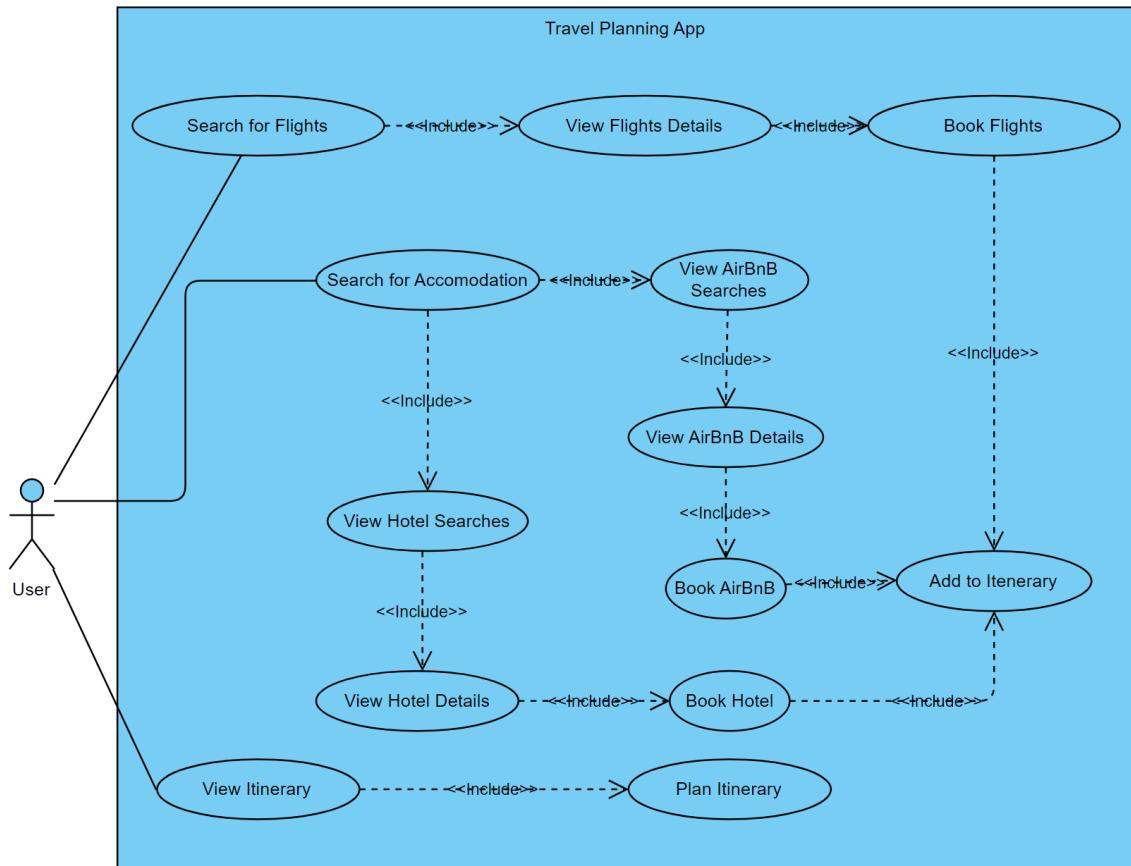


Figure 22: UML use case diagram

## 4.2 UML Class Diagram

This class diagram illustrates the different classes in our application, as well as their attributes. It also shows the relationships between each of the classes.

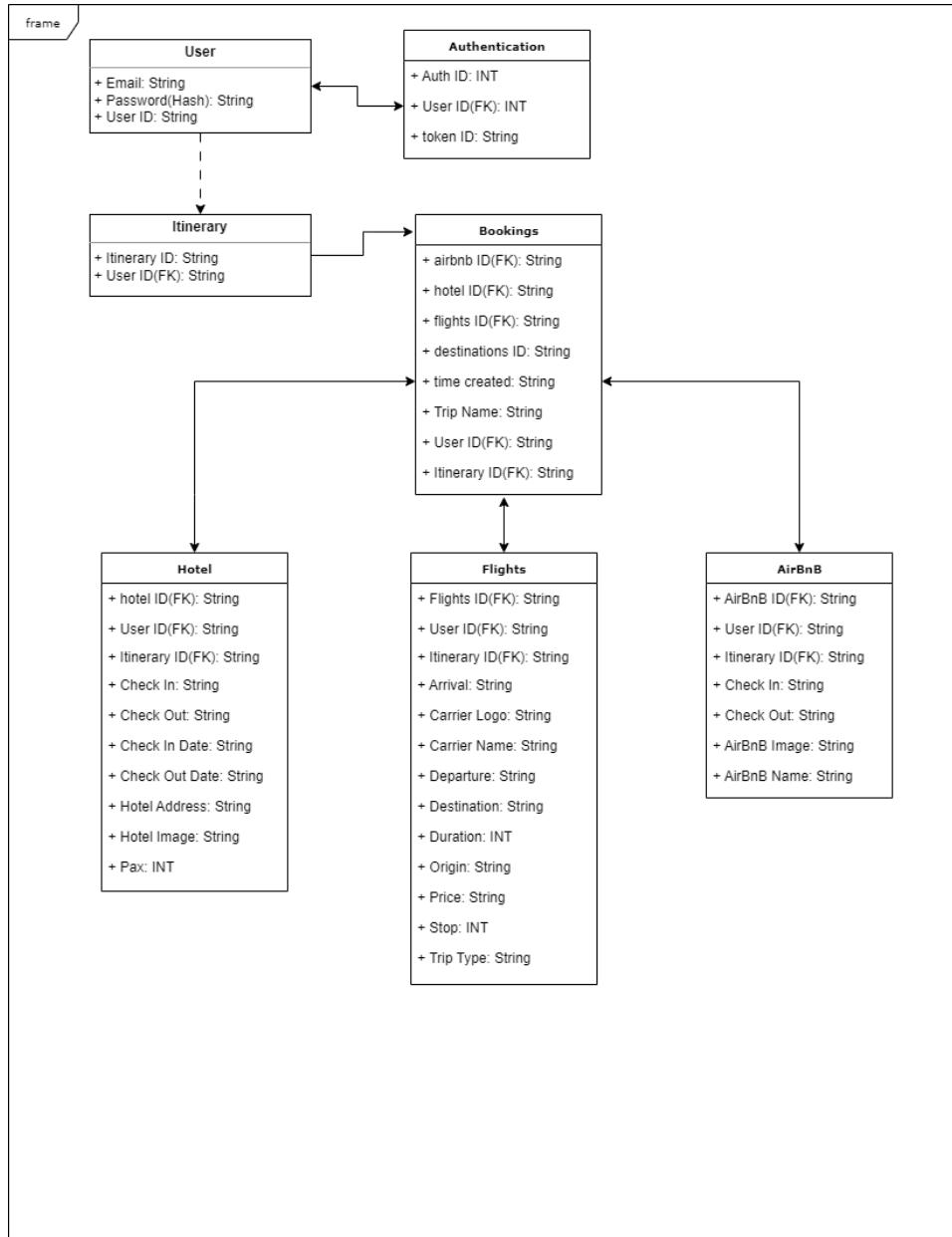
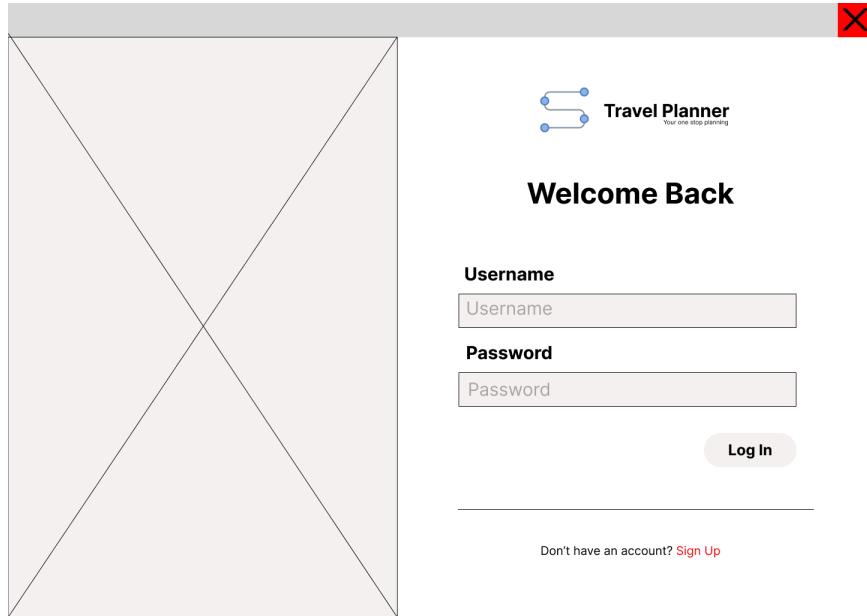


Figure 23: UML class diagram

## 4.3 Initial Design

The initial design is the rough UI/UX design and also based on the wireframe design that we created in the 1st half of the project.

### Login Page



A wireframe of a login page. The left side features a large, light gray rectangular area with a large 'X' drawn through it. The right side contains a header with a logo and text, followed by a 'Welcome Back' message, two input fields for 'Username' and 'Password', a 'Log In' button, and a link for new users.

**Welcome Back**

**Username**

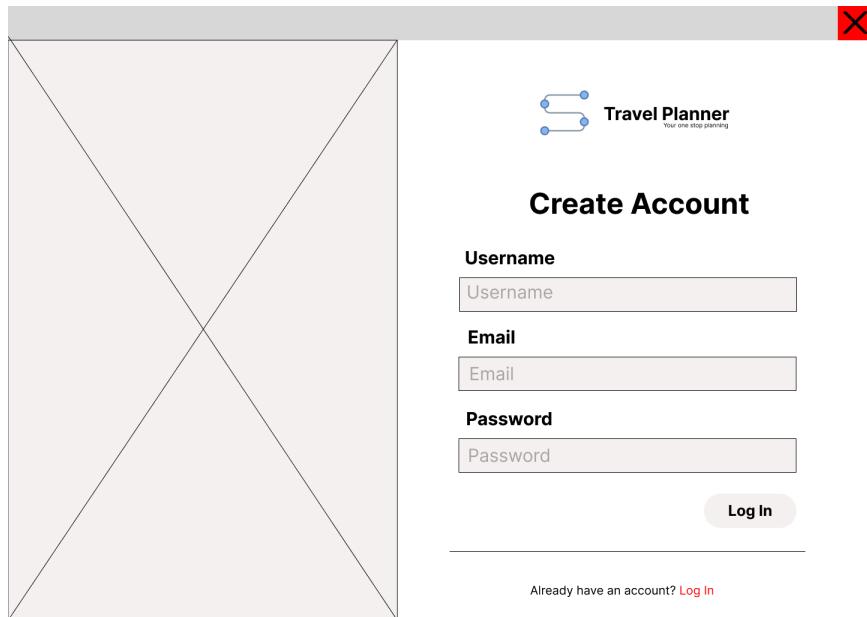
**Password**

**Log In**

Don't have an account? [Sign Up](#)

Figure 24: Wireframe of the login page

### Register Page



A wireframe of a register page. Similar to the login page, it has a large 'X' on the left and a header with a logo and text. The main content is titled 'Create Account' and includes three input fields for 'Username', 'Email', and 'Password', followed by a 'Log In' button and a link for existing users.

**Create Account**

**Username**

**Email**

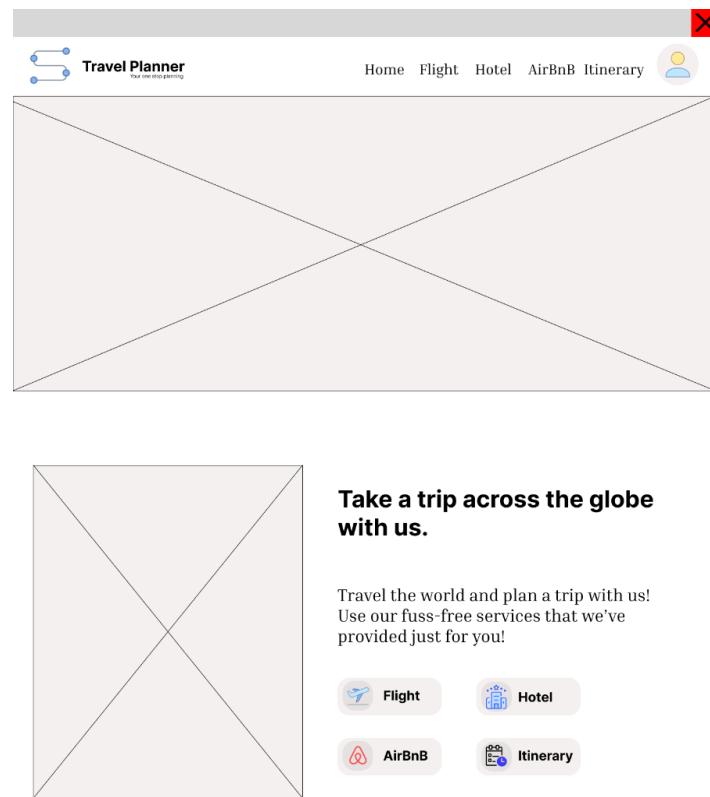
**Password**

**Log In**

Already have an account? [Log In](#)

Figure 25: Wireframe of the register page

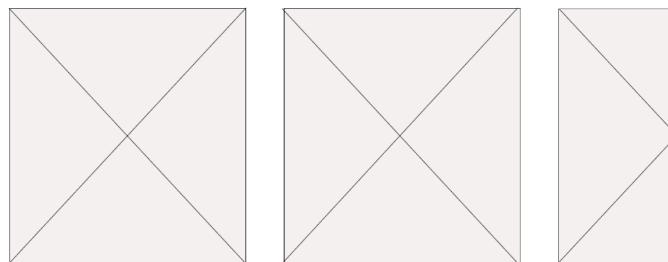
## Home Page



### Your Socials

Explore the world around you

[View All](#)



### Quick Link

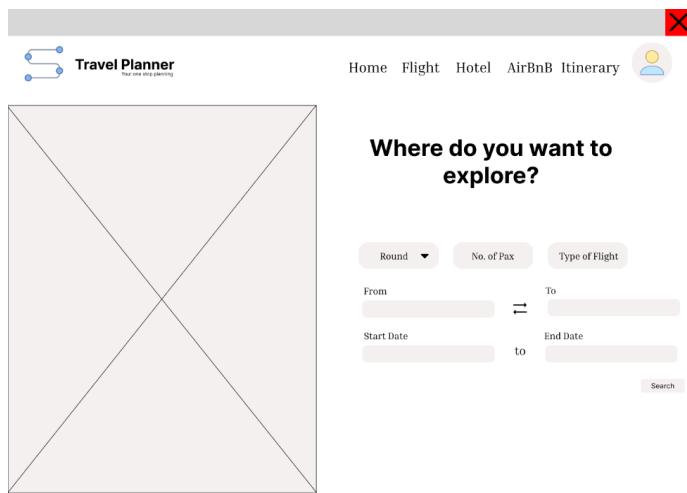
Home      Flight  
Hotel      AirBnB  
Itinerary

### Contact Us

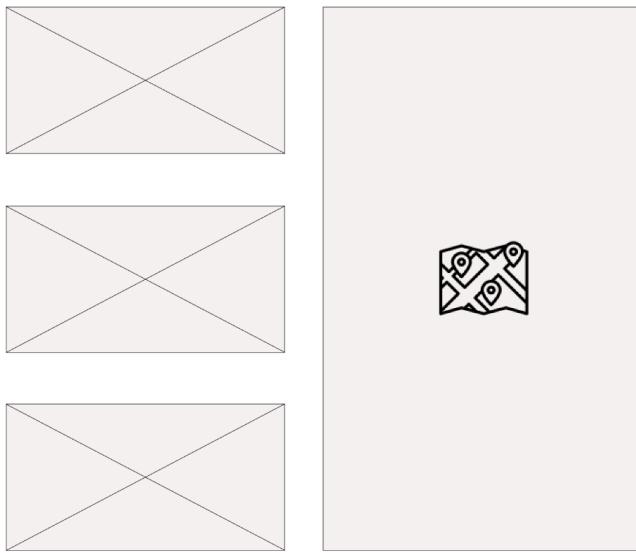
Call +65 1234 5678  
Email xxxxxx@mail.com

Figure 26: Wireframe of the home page

## Flight Search Page



### Trips from SG



### Quick Link

Home      Flight  
Hotel      AirBnB  
Itinerary

### Contact Us

📞 +65 1234 5678  
✉️ xxxxx@mail.com

Figure 27: Wireframe of the flight search page

## Airbnb/Hotel Search Page

The wireframe shows a search interface. At the top right is a red close button. Below it is a navigation bar with links: Home, Flight, Hotel, AirBnB, Itinerary, and a user icon. A large placeholder area contains a large 'X' and the text 'Where do you want to stay?'. Below this are three input fields: 'Location', 'No. of Pax', and 'Date', each with a corresponding placeholder text. A 'Search' button is located at the bottom right of the input area.

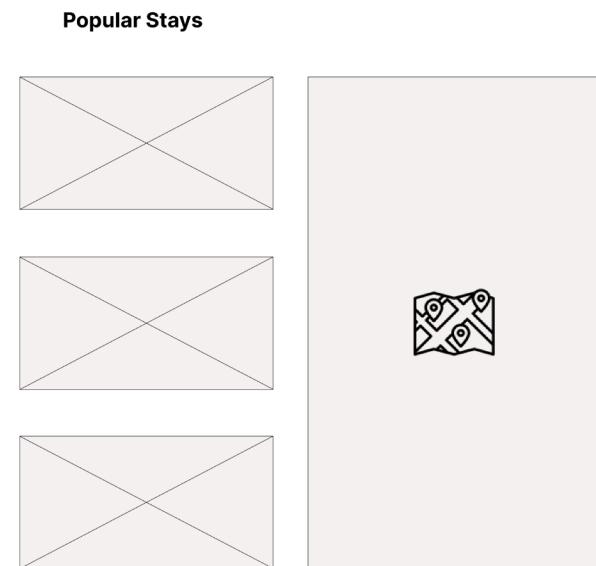
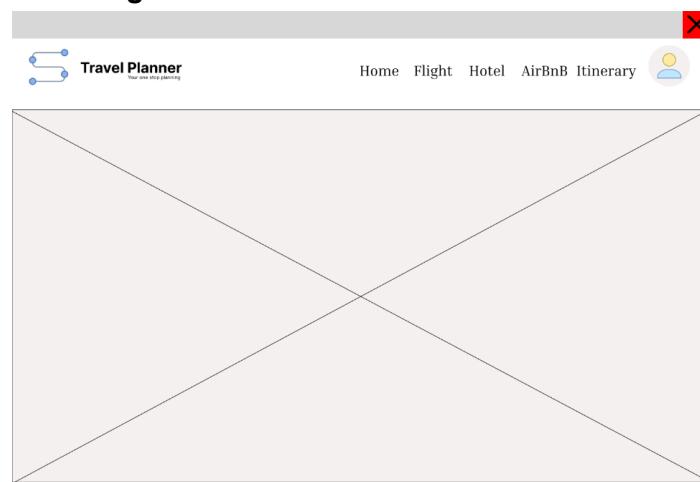


Figure 28: Wireframe of the Airbnb/hotel search page

## Airbnb/Hotel Information Page



Overview      Rooms      Location      Amenities      Gallery

### Overview

This is the description of the hotel page. It will include all the location, sight seeing spot, popular tourist spot near the hotel stay. It will also describe what the hotel provides, the price of the stay of each night and such.

- ✓ \_\_\_\_\_
- ✓ \_\_\_\_\_
- ✓ \_\_\_\_\_
- ✓ \_\_\_\_\_
- ✓ \_\_\_\_\_
- ✓ \_\_\_\_\_
- ✓ \_\_\_\_\_



**Book**



**Travel Planner**  
Your one stop planning

### Quick Link

Home      Flight  
Hotel      AirBnB  
Itinerary

### Contact Us

📞 +65 1234 5678  
✉️ xxxx@mail.com

Figure 29: Wireframe of the Airbnb/hotel information page

## Itinerary Page

The wireframe shows a top navigation bar with the Travel Planner logo, a red 'X' button, and links for Home, Flight, Hotel, AirBnB, Itinerary, and a user icon. Below this is a large search form titled 'Plan a trip with us'. It includes fields for Country, No. of Pax, Budget, Start Date, and End Date, with a 'Go' button at the bottom right. To the left of the search form is a large placeholder area with three overlapping 'X' icons.

**Plan a trip with us**

Country

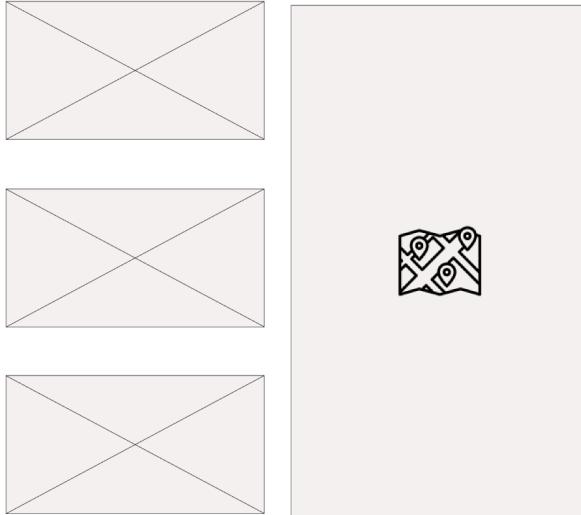
No. of Pax

Budget

Start Date  to  End Date

**Go**

### Most Popular Plans



### Quick Link

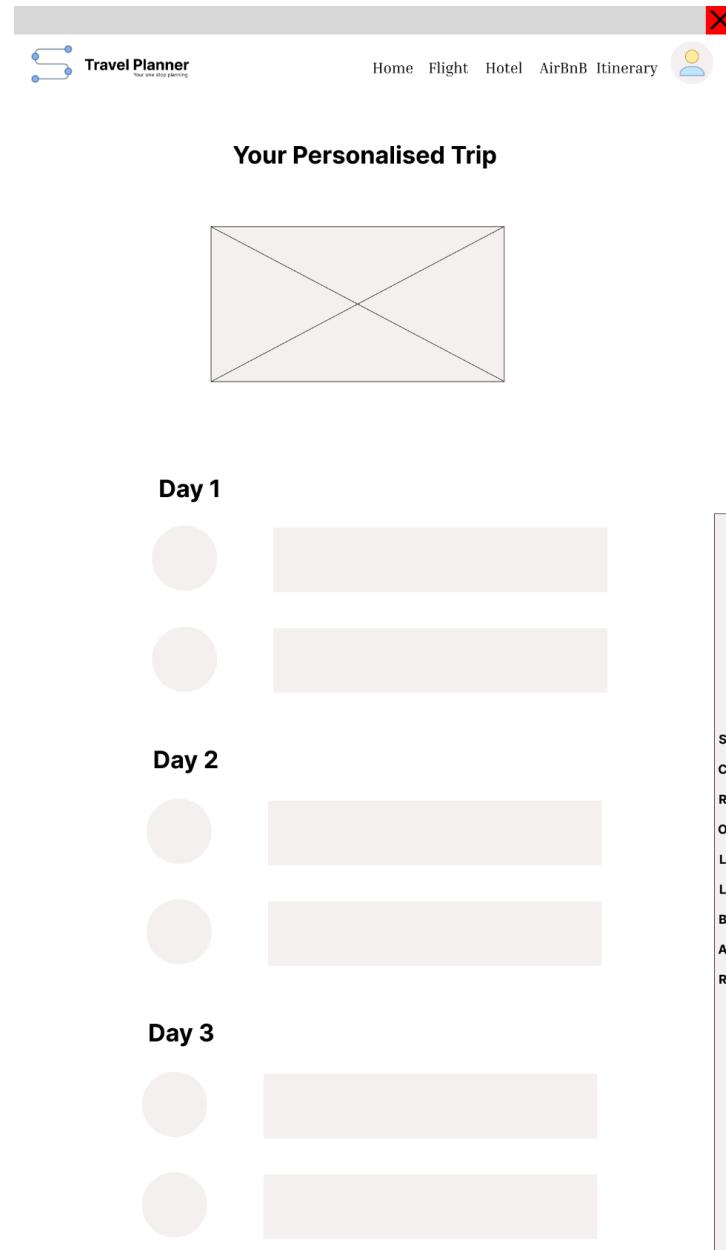
[Home](#) [Flight](#)  
[Hotel](#) [AirBnB](#)  
[Itinerary](#)

### Contact Us

+65 1234 5678  
 xxxxx@mail.com

Figure 30: Wireframe of the itinerary page

## Itinerary Planning Page



Travel Planner  
Your one-stop planning

### Quick Link

Home      Flight

Hotel      AirBnB

Itinerary

### Contact Us

📞 +65 1234 5678

✉️ xxxx@mail.com

Figure 31: Wireframe of the itinerary planning page

## 4.4 Finalised Design

The finalised design includes editing some of the pages to give the website more travel website feels for the user to feel that they would want to use the website to plan for their travel.

### Login/Register Page

The login and register pages now have a more streamlined, tidy and visually appealing look for users.

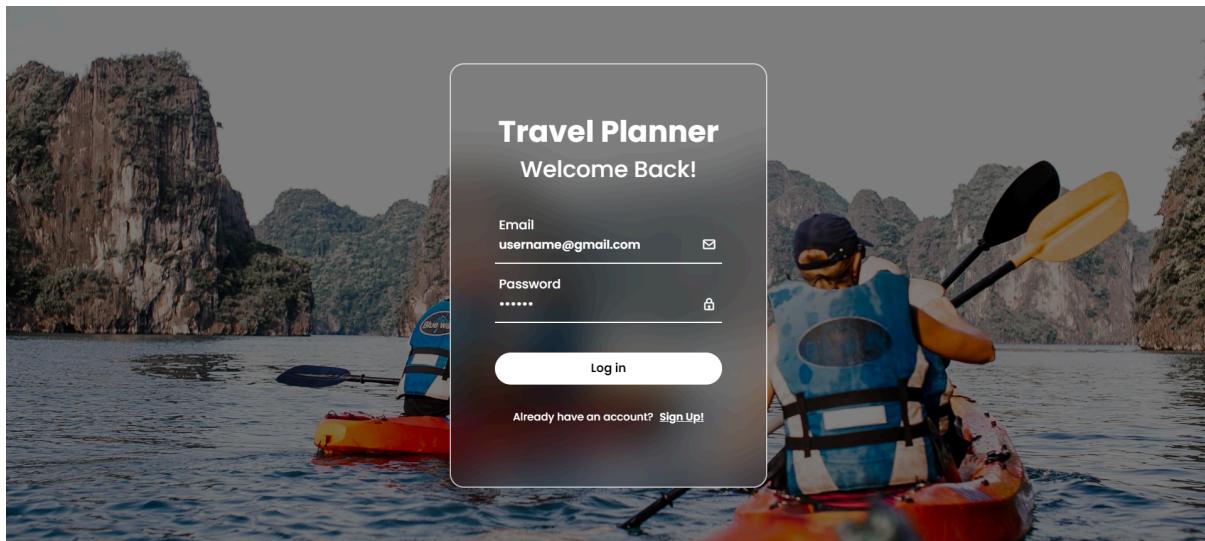


Figure 32: Login page design

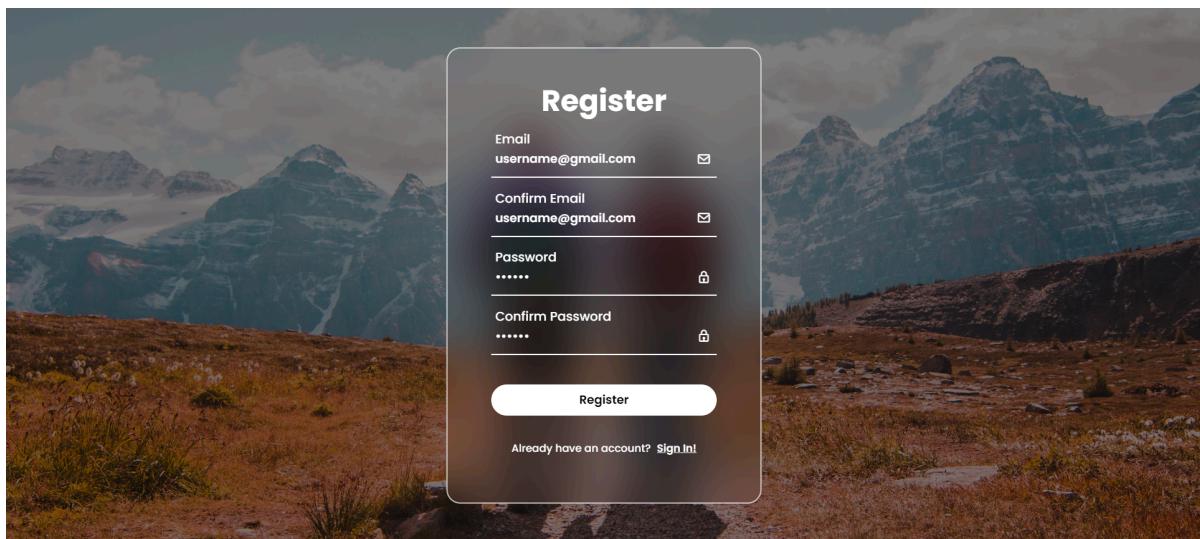


Figure 33: Register page design

## Home Page

The home page now includes interactive elements when the user hovers over buttons or cards.

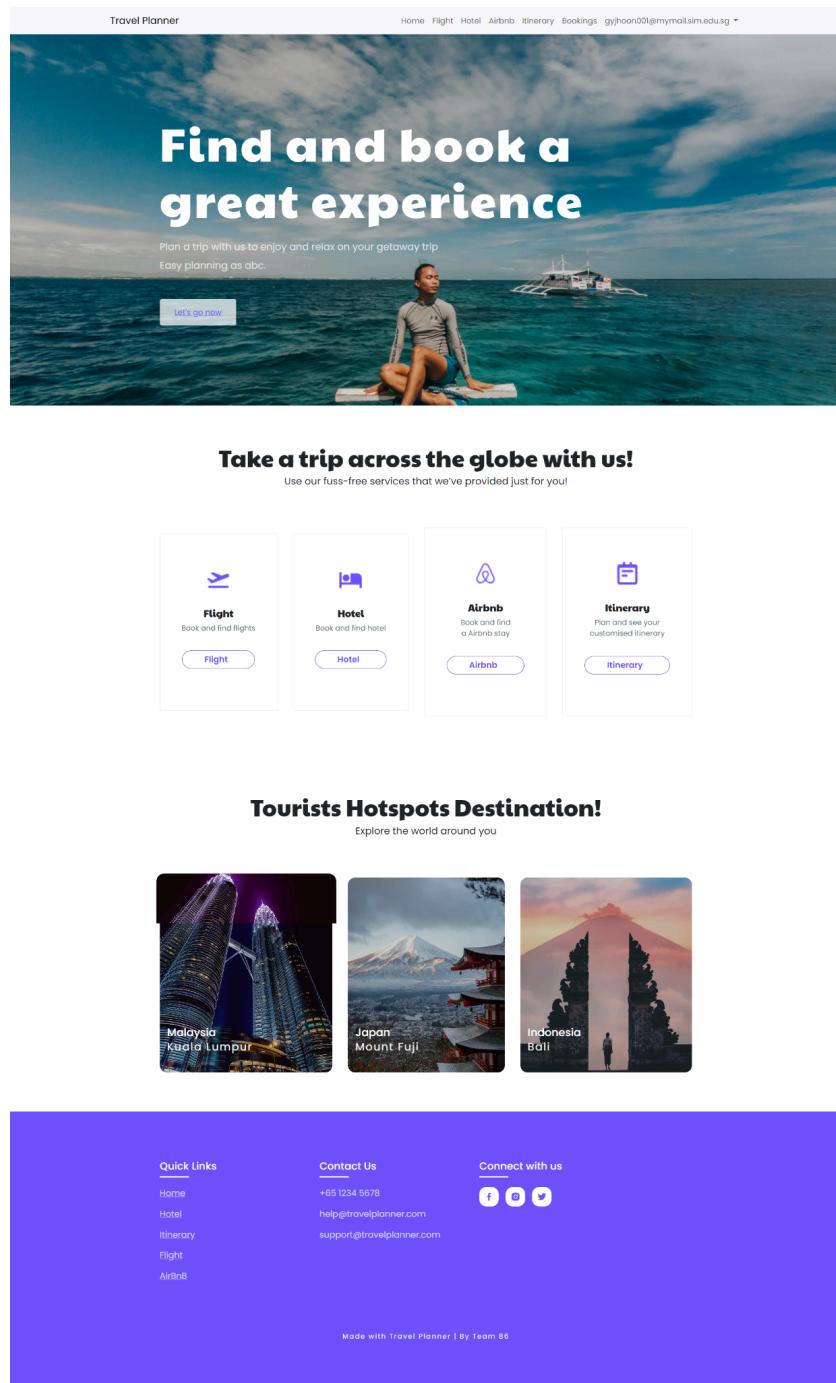


Figure 34: Home page design

## Flight Search Page

The flight search page now includes more eye-catching images to attract the users.

The screenshot displays the 'Travel Planner' website's flight search interface. At the top, there is a banner featuring night scenes of the Cologne Cathedral and the Sydney Harbour Bridge, with the text 'Book a trip with us today!'. Below the banner, a call-to-action button says 'Start your exciting trip here:'. To the right, a search form is shown with fields for 'Origin' and 'Destination', and dropdowns for 'Adults', 'Children', 'Infants', 'Date', and 'Cabin Class' (set to 'Economy'). A 'SEARCH' button is at the bottom right of the form. Below the search area, there are two rows of travel destination thumbnails. The first row shows 'Indonesia Bali', 'Thailand Bangkok', and 'Hong Kong Hong Kong'. The second row shows 'Indonesia Bali', 'Thailand Bangkok', and 'Hong Kong Hong Kong'. At the very bottom, a purple footer bar contains 'Quick Links' (Home, Hotel, Itinerary, Bookings, Flight, Airbnb), 'Contact Us' information (phone number +65 1234 5678, email help@travelplanner.com, support@travelplanner.com), and social media links for Facebook, Instagram, and Twitter. The footer also includes a small note: 'Made with Travel Planner | By Team 88'.

Figure 35: Flight search page design

## Flight Results Page

The flight results page has been designed to display the flight results in a minimalistic and visually appealing way.

The screenshot displays a travel search interface for flights from Singapore Changi to Kuala Lumpur International. At the top, there's a navigation bar with 'Travel Planner' and links for Home, Flight, Hotel, Airbnb, Itinerary, Bookings, and a user account (kh33hing@gmail.com). Below the navigation, a section titled 'Flights from Singapore Changi to Kuala Lumpur International' lists five flight options:

- Scoot**: Departure 09/19/2023, 19:30:00, Arrival 09/19/2023, 20:35:00, 1h 5m, 0 Stops, USD \$50. Includes 'Book on Website' and 'Add to Bookings' buttons.
- AirAsia**: Departure 09/19/2023, 23:25:00, Arrival 09/20/2023, 00:30:00, 1h 5m, 0 Stops, USD \$52. Includes 'Add to Bookings' button.
- AirAsia**: Departure 09/19/2023, 19:10:00, Arrival 09/19/2023, 20:15:00, 1h 5m, 0 Stops, USD \$53. Includes 'Add to Bookings' button.
- AirAsia**: Departure 09/19/2023, 21:20:00, Arrival 09/19/2023, 22:25:00, 1h 5m, 0 Stops, USD \$53. Includes 'Add to Bookings' button.
- AirAsia**: Departure 09/19/2023, 11:20:00, Arrival 09/19/2023, 12:25:00, 1h 5m, 0 Stops, USD \$53. Includes 'Add to Bookings' button.

Figure 36: Flight results page design

## Airbnb Search Page

The Airbnb search page has been designed in a simple and elegant manner to make it easy to use for the users.

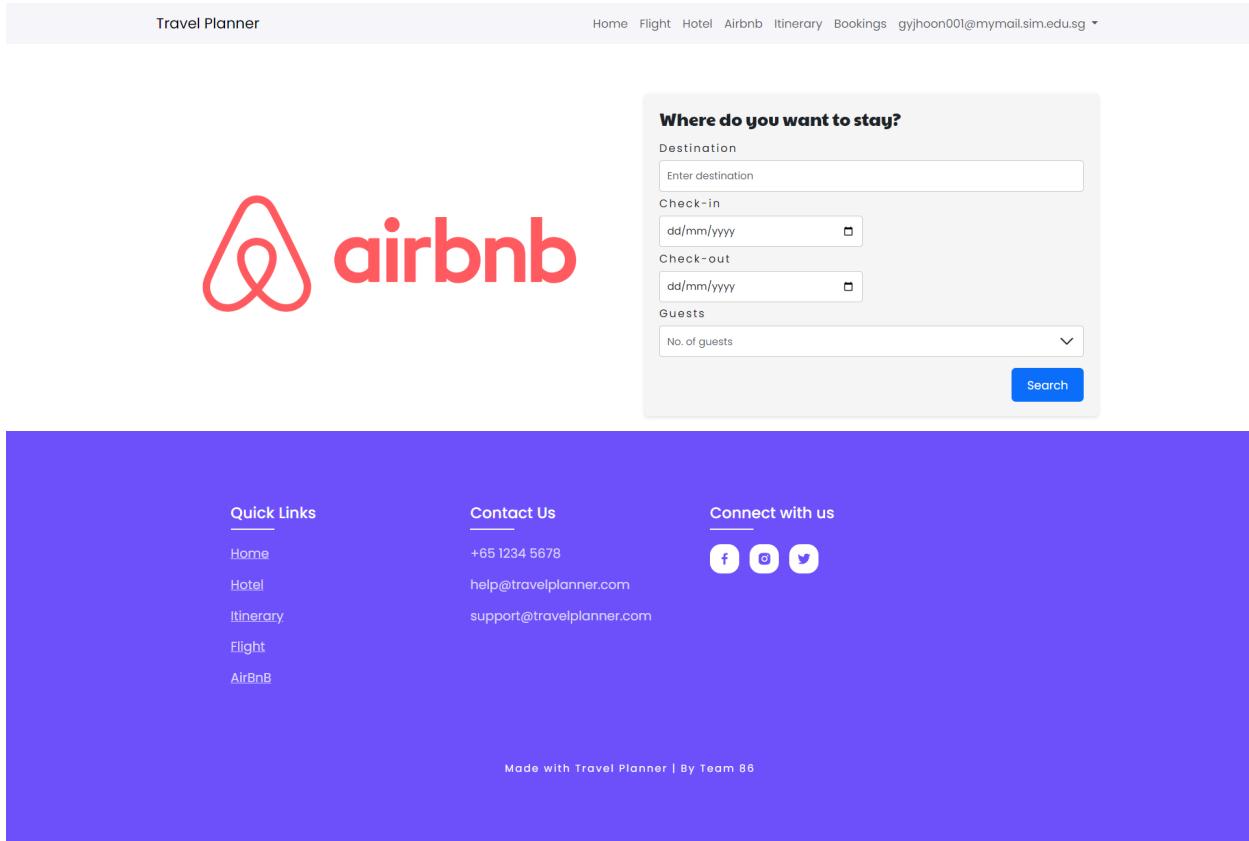


Figure 37: Airbnb search page design

## Airbnb Results Page

A search bar has been added to the Airbnb results page which is populated with the values entered by the user in the Airbnb search page. The user can now adjust their destination, check-in/check-out dates and number of guests and search again if they wish to do so.

Travel Planner

Home Flight Hotel Airbnb Itinerary Bookings jzjcheng001@mymail.sim.edu.sg ▾

Destination	Check-in	Check-out	Guests
myeongdong	13/10/2023	15/10/2023	3 guests

**Search Results for Airbnbs in myeongdong**



**Wecostay Dongdaemun D**  
서울특별시, 서울특별시, South Korea  
5.0 (13)  
\$384 SGD per night



**Two floor BBQ Private Terrace K-Drama Filming**  
Myeong-dong, Jung-gu, Seoul, South Korea  
4.73 (330)  
\$285 SGD per night



**#full-option residence for 4p, metro 3**  
Jung-gu, Seoul, South Korea  
4.88 (16)  
\$143 SGD per night

Figure 38: Airbnb results page design

## Airbnb Information Page

A scrollable image gallery has been added for the user to view the property images with ease. The property's host, amenities and reviews have also been added to provide the user with additional information.

Rental unit in 서울특별시 · ★5.0 · 3 bedrooms · 4 beds · 2 baths



Hosted by Wecostay  
Joined in February 2023

### What this place offers

- Bathtub
- Free washer – In unit
- 50" HDTV
- Pack 'n play/Travel crib – available upon request
- AC – split type ductless system
- Smoke alarm
- Wifi
- Kitchen
- Private entrance
- Private hot tub
- Luggage dropoff allowed

Show all amenities

\$385 SGD per night

Check-in

13/10/2023

Check-out

15/10/2023

Guests

3 guests

Book

\$385 SGD x 2 nights

\$770 SGD

★ 5.0 · 15 reviews

Cleanliness	<div style="width: 5px;"></div>	5
Communication	<div style="width: 5px;"></div>	5
Check-in	<div style="width: 4.93px;"></div>	4.93

 Yav  
August 2023

Very happy with our stay here. The accommodation was clean, spotless even. We were close to a train station and two next door coffee shops. The Airbnb was roomy, had great lighting, in-unit laundry and dryer. Common area felt cozy, but lots of seating and a nice TV. The neighborhood in Seoul we were in was unique with lots of Eastern European and central Asian restaurants. Overall, excellent stay. Thank you!

 Vincent  
August 2023

Great location, very responsive, and the room looks new! Highly recommend!

Figure 39: Airbnb information page design

## Hotel Search Page

An interactive map has been added for the user to view the locations of the popular hotel stays.

The screenshot displays the 'Travel Planner' website's hotel search feature. At the top, a navigation bar includes links for Home, Flight, Hotel, Airbnb, Itinerary, Bookings, and a user account section. Below the navigation is a search form titled 'Where do you want to stay?'. The form contains fields for Destination (with placeholder 'Enter destination'), Check-in (dd/mm/yyyy), Check-out (dd/mm/yyyy), Guests (No. of guests), and a blue 'Search' button. To the left of the search form is a photograph of a hotel entrance with a sign that reads 'HOTEL DELLA CONCESSIONE'. Below the search area is a section titled 'Popular Stays' featuring three smaller images: a night view of a modern building along a river, the interior lobby of a hotel, and the exterior of a modern hotel building. To the right of these images is a detailed map of Singapore, highlighting various neighborhoods and landmarks such as Novena, Little India, Chinatown, Marina Bay, and the National Stadium. Numerous red location markers are placed on the map, indicating the specific locations of popular hotel stays across the city.

Travel Planner

Home Flight Hotel Airbnb Itinerary Bookings gyhooon001@mymailsim.edu.sg

HOTEL DELLA CONCESSIONE

Where do you want to stay?

Destination  
Enter destination

Check-in  
dd/mm/yyyy

Check-out  
dd/mm/yyyy

Guests  
No. of guests

Search

Popular Stays

Map Satellite NOVENA Novena Street Moulmein Rd United Square Shopping Mall Pek Kio Market & Food Centre Sri Srinivasa Perumal Temple City Square Mall Mustafa Centre Sri Veeramakaliamman Temple Jalan Besar Sultan Mosque KALLANG Lavender Road Kallang River Park OCBC Aquatic Centre National Stadium TANJ Plaza Singapura Kwan Im Thong Hood Cho Temple Bugis Junction KAMPONG GLAM Haji Lane Ngee Highway ECDA CHIJMES Fort Canning Park National Gallery Singapore Clarke Quay Central Asian Civilisations Museum Clarke Quay Boat Quay Raffles Place Marina Bay Sands Singapore OCBC Skyway Flower Dome Far East Organisation Children's Garden Marina East P Marina East Road

Quick Links

Home Hotel Itinerary Flight Airbnb

Contact Us

+65 1234 5678 help@travelplanner.com support@travelplanner.com

Connect with us

Facebook Instagram Twitter

Made with Travel Planner | By Team 88

Figure 40: Hotel search page design

## Hotel Results Page

Similar to the Airbnb page, users can alter their destination, check-in/check-out dates and number of guests at the top of the hotel results page.

**Travel Planner**

Home Flight Hotel Airbnb Bookings Itinerary gyjhoon001@mymail.sim.edu.sg ▾

**Where do you want to stay?**

**Destination**  
Singapore, Singapore

**Check-in** 20/09/2023 **Check-out** 23/09/2023

**Guests** 2

**Search**

**Search Results for Hotels in Singapore, Singapore**



[Village Hotel Bugis by Far East Hospitality](#)  
390 Victoria Street, Singapore  
**7.6 Good**  
[Price per night: SGD\\$ 451.44](#)



[Somerset Bencoolen Singapore](#)  
51 Bencoolen Street, Singapore  
**8.6 Fabulous**  
[Price per night: SGD\\$ 648.00](#)



[lyf Farrer Park Singapore](#)  
2 Perumal Road, Unit 01-01, Singapore  
**8.4 Very good**

Figure 41: Hotel results page design

## Hotel Information Page

A second navigation bar has been added to the hotel information page to divide the vast information into different sections.

The screenshot shows a hotel information page for 'Village Hotel Bugis by Far East Hospitality'. At the top, there's a large banner with the text 'Book a hotel stay with us today!' overlaid on a background image of a hand opening a hotel room door. Below the banner, a navigation bar includes links for Overview, Rooms, Reviews, and Gallery. The main content area starts with a section titled 'Overview' containing a brief description of the hotel's location and amenities. It also lists basic information such as address, rating, review score, languages spoken, check-in/check-out times, and a large image of the hotel building and surrounding area. At the bottom of the page is a purple footer with 'Quick Links' (Home, Hotel, Itinerary, Flight, Airbnb), 'Contact Us' information (phone number, email addresses for help and support), and social media icons for Facebook, Google+, and Twitter. A small note at the very bottom center states 'Made with Travel Planner | By Team 86'.

Figure 42: Hotel information page design (overview)

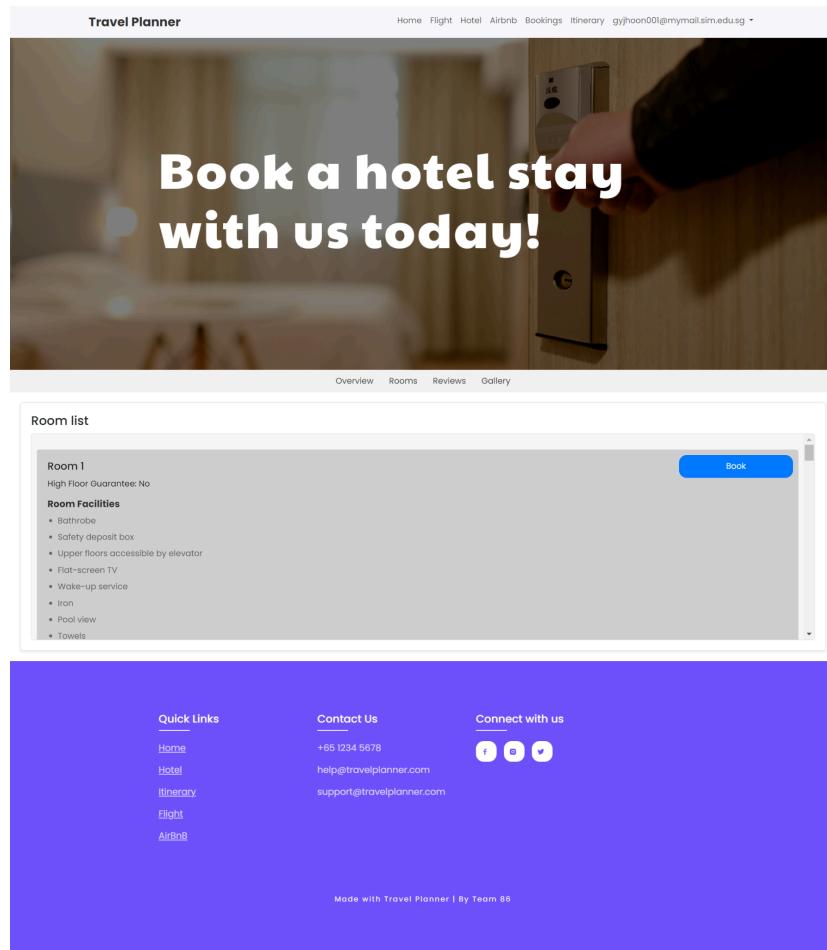


Figure 43: Hotel information page design (rooms)

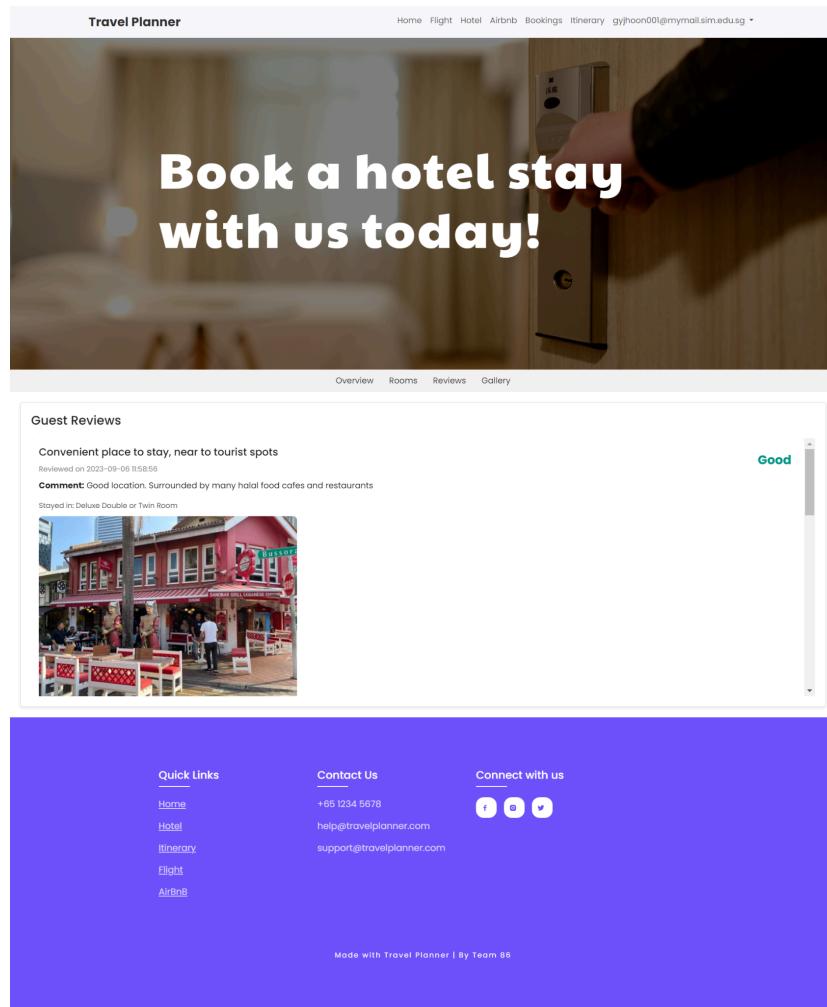


Figure 44: Hotel information page design (reviews)

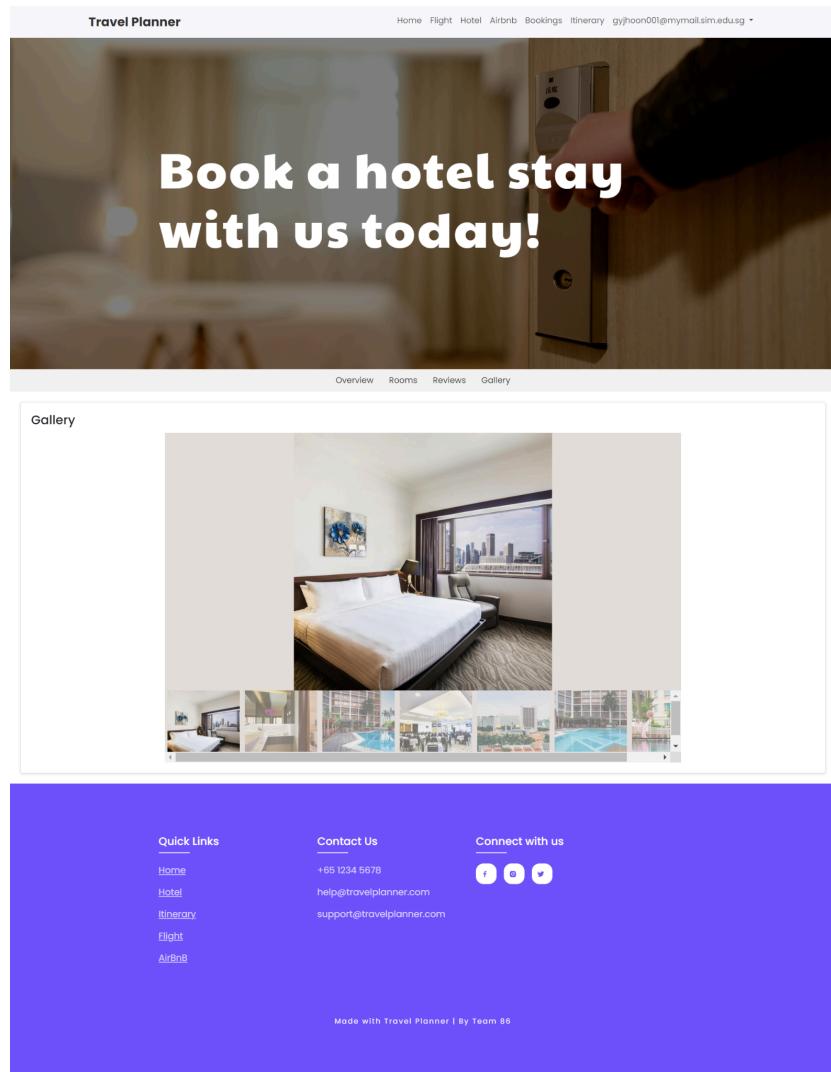


Figure 45: Hotel information page design (gallery)

## Itinerary Page

The itinerary page has been changed to display a list of the user's itineraries. Buttons have also been added for the user to add, view and delete their itineraries.

The screenshot shows the 'Travel Planner' application interface. At the top, there is a navigation bar with links for Home, Flight, Hotel, Airbnb, Itinerary, Bookings, and an email address (gyjhoon001@mymail.sim.edu.sg). Below the navigation bar, a button labeled 'Add Trip' is visible. The main content area is titled 'Current Trips' and displays a single trip entry for 'Malaysia'. The trip details include 'Trip to Kuala Lumpur, Malaysia'. Below the trip title are two buttons: 'View' (blue) and 'Delete' (red). At the bottom of the page, there is a footer section with 'Quick Links' (Home, Hotel, Itinerary, Flight, Airbnb), 'Contact Us' information (phone number +65 1234 5678, email help@travelplanner.com, support@travelplanner.com), and social media icons for Facebook, Instagram, and Twitter. A small note at the bottom right of the footer says 'Made with Travel Planner | By Team 86'.

Figure 46: Itinerary page design

## Itinerary Planning Page

The user can now view and edit their itinerary details, as well as plan their trip by adding daily activities.

The screenshot shows the 'Travel Planner' application interface. At the top, there's a navigation bar with links for Home, Flight, Hotel, Airbnb, Bookings, Itinerary, and a user email (jzjcheng001@mymail.sim.edu.sg). Below the navigation is the title 'Seoul April 2023' and an 'Edit Trip' button. A 'Destinations:' section lists 'Seoul, South Korea'. The 'Trip Length:' is '5 days' from 'From: 1 Oct 2023' to 'To: 5 Oct 2023'. A 'Trip's Schedule and Agenda' section shows five days of travel:

Day	Date	Time Range	Activity	Description
Day 1	1 Oct 2023	12:00 – 13:00	Lunch	BBQ meat is good!
Day 2	2 Oct 2023			
Day 3	3 Oct 2023	13:00 – 15:00	Shopping	Buy gifts for friends!
Day 4	4 Oct 2023			
Day 5	5 Oct 2023			

Below the schedule is a purple footer section containing 'Quick Links' (Home, Hotel, Itinerary, Flight, AirBnB), 'Contact Us' information (+65 1234 5678, help@travelplanner.com, support@travelplanner.com), and social media icons for Facebook, Instagram, and Twitter.

Figure 47: Itinerary planning page design

# 5. System Development

## 5.1 Agile Approaches

The adoption of Agile principles was an informed choice influenced by the project's dynamic nature and the need for a development process that could adapt to changing requirements.

**Improved Collaboration:** Agile practices encouraged our team to communicate openly and frequently. Daily stand-up meetings were the foundation of our work, promoting an open atmosphere in which we could discuss progress, issues, and solutions. This dynamic teamwork increased our problem-solving abilities substantially.

**Progress in Minor Advances:** The gradual approach of Agile completely altered our development process. We demonstrated early success to both our team and users by providing product increments in each sprint. This permitted early user participation and important feedback, which helped to polish features and align the project with user expectations.

Time management was a challenge in our Agile journey, since combining flexibility and reaching sprint targets within established timescales required careful planning and resource allocation. We developed an open communication environment through daily stand-up meetings, allowing us to discuss project progress, confront difficulties, and devise solutions together. This dynamic teamwork really improved our problem-solving abilities. The iterative concept of Agile dramatically changed our development process. We gained early success by providing product increments at the end of each sprint, receiving input from both our team and users. This early user participation was helpful in refining features and matching the project with user expectations.

## 5.2 Components of Software

### 5.2.1 GitHub Repository Overview

**GitHub Repository:** <https://github.com/kheehing/Agile-Software-Project>

The entire programming for our travel planning programme resides in this GitHub repository. The programme is made up of three major components, each of which contributes to the application's functionality and user experience. The web app's key functionality is to provide an intuitive and interactive platform for trip planning, including UI/UX design and smooth connection with numerous travel agencies. Users can simply search for and book flights, hotels, and Airbnb accommodations, as well as maintain their travel preferences, access recommendations, and plan their itineraries. We have also integrated API for accommodation and flight bookings. This API is strongly connected with Firebase, and it provides essential functions for user authentication, user management, and giving personalised experiences.

Commit History		
jongzzz	Fixed bugs in add-to-itinerary function	4 abeb88 10 hours ago
.github	updated to use ejs	2 months ago
public	Fixed bugs in add-to-itinerary function	10 hours ago
routes	added flights to itinerary	yesterday
views	Fixed bugs in add-to-itinerary function	10 hours ago
.firebaserc	added firebase-admin	3 months ago
.gitignore	created .env file to store the flight api	last month
README.md	changed the api token	last month
firebase.json	added firebase-admin	3 months ago
firebaseAdmin.js	update firebaseAdmin	last month
index.js	Bookings page	3 weeks ago
package-lock.json	Server check for authentication	last month
package.json	Server check for authentication	last month

Figure 48: GitHub repository

### 5.2.2 Directory Structure

The structure of the repository is organised for clarity and efficiency, with major directories and files listed below:

**public:** Contains static assets such as images, fonts, and stylesheets used in the front-end of the web app.

**routes:** Stores route handlers for various application capabilities, such as Airbnb, bookings, flights, and hotels.

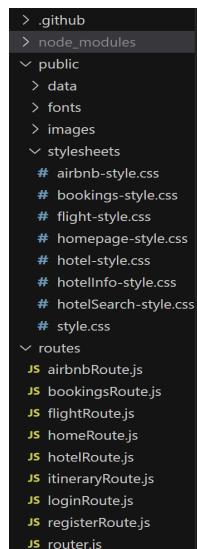


Figure 49: Directory 1

**views:** A collection of EJS templates for displaying dynamic content in response to user interactions

**.gitignore:** Specifies which files and directories Git should ignore in order to keep the repository clean.

**README.md:** This file contains important information and documentation about the repository.

**firebase.json:** Firebase deployment configuration.

**package.json and package-lock.json:** Manage project dependencies and scripts.

**index.js:** The application's entry point.

**router.js:** Defines the application's routing logic.

**firebaseAdmin.js:** Configuration for Firebase admin access.

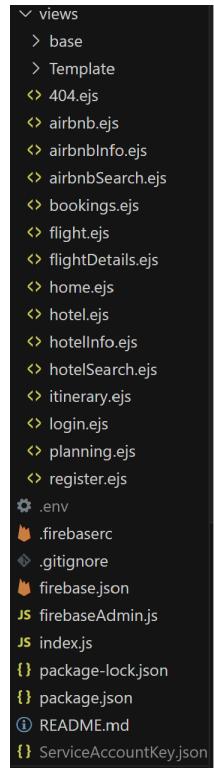


Figure 50: Directory 2

### 5.2.3 Github Repository Workflow

Agile principles were useful in project management on our GitHub repository, particularly in the context of pull requests(Figure 53) and code reviews. Pull requests acted as crucial milestones for code quality, functionality, and consistency, encouraging team members to collaborate continuously. Every work that was performed resulted in a pull request, which enabled code reviews that facilitated feedback and ensured a shared understanding of the evolving codebase. This iterative process not only preserved code integrity, but also encouraged good communication and information exchange among team members, aligning us with Agile's key values.

86 workflow runs			
		Event ▾	Status ▾
Actor	Branch	Time Ago	...
homepage	main	yesterday 25s	...
updating to work for local hosting	main	yesterday 32s	...
Fix Firebase credential issue	main	yesterday 35s	...
fix missing service accountkey	main	yesterday 22s	...
update	main	yesterday 22s	...
Merge branch 'main' of https://github.com/kheehing/Agile-Software-Pro...	main	yesterday 29s	...
hotel update	main	2 days ago 28s	...
added (add to itinerary in flight details)	main	2 days ago 20s	...
Revert "test deploy"	main	2 days ago 23s	...
test deploy	main	2 days ago 22s	...
Merge branch 'main' of https://github.com/kheehing/Agile-Software-Pro...	main	2 days ago 19s	...
added footer	main	2 days ago 26s	...
Fixed bugs in add-to-itinerary function	main	3 days ago 24s	...
booking.ejs update	main	4 days ago 34s	...
added flights to itinerary	main	4 days ago 26s	...
Update bookings.ejs	main	5 days ago 20s	...

Figure 51: GitHub workflow pull requests

## 5.2.4 Display Tier

Our web application's display layer serves as the user interface, where users interact with the system. This critical component is built with **HTML, JavaScript, CSS, and Bootstrap 5** to provide an engaging and visually pleasing user experience.

The core of our presentation layer is **HTML (HyperText Markup Language)**. It defines the elements and structures the content, and presentation of web pages. HTML5 capabilities are heavily used to ensure compatibility with newer web browsers such as Google Chrome which can be seen in **Figure 54**.

**JavaScript**, a powerful and dynamic scripting language, improves our web application's interaction and functionality. It is responsible for features such as real-time updates, form validation, and dynamic content production, resulting in a smooth and responsive user experience.

**CSS (Cascading Style Sheets)** is used to establish the look and feel of our websites. It allows for customisation of fonts, colours, layouts, and responsive designs, delivering a consistent and visually pleasing appearance across multiple devices.

**Bootstrap 5**, a strong front-end framework, is essential in the construction of our online applications. It includes a library of pre-designed components and responsive layout utilities that help to speed up development while maintaining a current and consistent design look. We can rapidly develop web pages that adjust to different screen sizes by leveraging the features of Bootstrap 5, resulting in a user-friendly experience on both desktop and mobile platforms.

Our online application has been carefully tested on Google Chrome, one of the most widely used web browsers, in terms of browser support and testing. The extensive developer tools and debugging features of Google Chrome enable it to be easier to identify and resolve any compatibility issues. Furthermore, the use of HTML5, JavaScript, CSS, and Bootstrap 5 conforms to Chrome's latest browser standards, assuring a smooth and dependable user experience for the vast majority of our users.

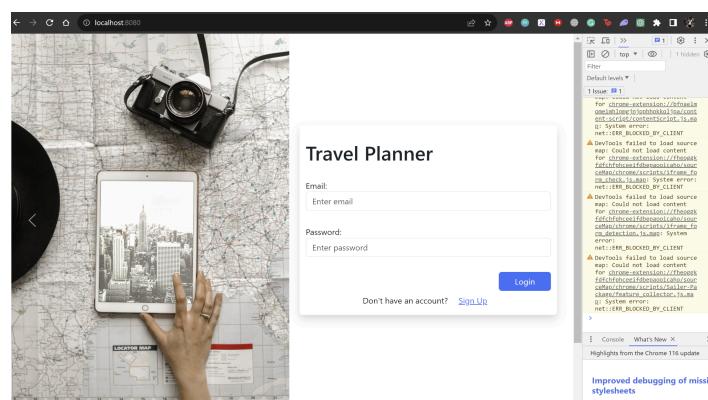


Figure 52: Web application in Google Chrome

## 5.2.5 Node Package Manager (NPM) Packages

The following are the essential NPM packages utilised in our project:

Package name	Description and application
<b>axios 1.4.0</b>	Axios is used to simplify HTTP requests, allowing our web application to communicate with external APIs or services in real time. It improves the real-time functioning of our programme by making data retrieval easier.
<b>bcrypt 5.1.0</b>	Bcrypt is a secure password hashing and authentication algorithm. It protects user data by securely storing user credentials in our database.
<b>bootstrap 5.3.0</b>	Bootstrap 5 is an essential part of our front-end development. It includes a set of CSS and JavaScript components that make it easier to create responsive, visually appealing web pages. Bootstrap guarantees that our application has a uniform and current design style.
<b>cookie-parser 1.4.6</b>	Cookie-parser makes it easier to manage HTTP cookies in our web application. It is vital for preserving user sessions.
<b>dotenv 16.3.1</b>	Dotenv allows us to manage environment variables securely in our application. It aids in the confidentiality of sensitive information such as API keys and configuration data.
<b>ejs 3.1.9</b>	EJS (Embedded JavaScript) is our templating engine, allowing us to build HTML content dynamically based on data. EJS improves the interaction and flexibility of our websites.
<b>express-session 1.17.3</b>	We use Express-session to manage user sessions. It ensures that users can save their login state and access personalised features without difficulty.
<b>express 4.18.2</b>	Express is the core framework that powers the backend of our web application. It makes routing, middleware administration, and request handling easier, making it a necessary component of our server architecture.
<b>firebase-admin 11.9.0</b>	Firebase-admin is incorporated into our application for seamless integration with Firebase services. It enables user authentication, real-time data synchronisation, and secure access to Firebase resources.
<b>nodemon 3.0.1</b>	Nodemon is a development dependency that improves the development workflow greatly. It restarts the server immediately when a file is changed, saving time and effort during development and testing.
<b>fs 0.0.1-security and http 0.0.1-security</b>	These packages enhance the security of our application by addressing security vulnerabilities in the file system and HTTP-related operations.

Figure 53: List of NPM packages in our application

## 5.2.6 Firestore Database



Firebase, a strong cloud-based platform, is the foundation for storing bookings and itineraries in our travel planning web application, with a primary dependence on Firestore (Figure 55), Firebase's NoSQL cloud database. We used Firestore's features to manage user data and provide a personalised experience. We were able to securely authenticate users using Firebase's authentication system, assuring the security of their data during interactions with the application. Users could easily book hotels, Airbnb, and flights after they were authenticated. Firestore's NoSQL database format facilitated data modelling and administration, allowing us to swiftly respond to changing data requirements without requiring extensive database reconfiguration. The scalability of Firestore ensured that our application could grow in line with rising user demand while still providing a responsive experience.

A screenshot of the Firebase Firestore web interface. At the top, there is a header bar with the user handle 'uolagile86'. Below the header, there is a button labeled '+ Start collection'. The main area displays a list of collections: 'airbnb' (which is highlighted with a blue background), 'flights', 'hotel', 'itinerary', and 'user'. Each collection name is preceded by a small blue square icon.

Figure 54: Firestore database collection

## 5.2.7 Application Programming Interfaces (APIs)



RapidAPI.com is a comprehensive API marketplace that provides a diverse range of application programming interfaces for a variety of businesses and functionalities. The following sections explain why RapidAPI.com was chosen as the preferred source for accommodation APIs:

**Diverse Selection of APIs:** RapidAPI.com stands out for its vast choice of APIs, which include numerous sectors of the tourism sector, such as hotels, vacation rentals, and housing possibilities. This vast diversity provides flexibility, guaranteeing that the web application has broad data coverage.

**Security and Authentication:** RapidAPI.com offers strong authentication mechanisms, such as API keys and token-based security. This ensures the safe retrieval of data, which is especially important when accessing sensitive or proprietary accommodation information from third-party suppliers.

**Cost-effectiveness:** The straightforward pricing structure of RapidAPI.com corresponds well with academic restraints. It frequently provides free or low-cost access levels, making it a cheap option for students. This affordability guarantees that access to accommodation-related APIs remains within cost constraints, which is important for academic initiatives.

**Booking.com**

**airbnb**

**Booking.com**, known for its enormous global network of hotel listings, was an obvious choice for our hotel-related API requirements. Its powerful and well-documented API offers integration effortlessly into our web application, allowing us to access a massive collection of hotel information such as availability, pricing, and complete property descriptions. The choice to work with Booking.com was motivated by the platform's reputation in the hotel industry for dependability and comprehensiveness.

**Airbnb** came out as the appropriate API provider for vacation rentals and the search for unique lodging experiences. The Airbnb API allows our application to do property searches, receive detailed property information, and determine availability. This option matches with our goal of providing consumers with a diverse range of lodging options, from typical hotels to uncommon and personalised ones.



The aviation industry is a complicated and dynamic sector with constantly changing flight schedules, pricing dynamics, and the interplay of multiple airlines and airports throughout the world. Obtaining accurate, up-to-date, and complete flight data is essential to our web application in this scenario. While other API providers provide access to flight data, Skyscanner was chosen due to its higher offerings in the key areas below:

**Comprehensive Data Coverage:** Skyscanner provides one of the most comprehensive and up-to-date databases of flight-related information. This enormous library contains flight schedules, availability, pricing, and airline and airport characteristics, guaranteeing that the web application has access to a lot of trustworthy data.

**Real-time Updates:** Skyscanner offers real-time updates on flight availability, price variations, and other key data factors. This feature is important for our web application since it allows our web application to catch the most recent aviation industry trends and insights.

**Authentication and Data Security:** Skyscanner prioritises authentication and data security. Robust API key-based authentication procedures enable secure data access and the protection of critical flight information throughout the development process and the finalised web application.

The integration of necessary APIs for hotel, Airbnb, and flights searches and booking can be simply discovered in our web application's codebase under our 'route' folder (figure 56) in the Git repository. These API interactions are specifically contained in the JavaScript files for the hotel, Airbnb, and flight routes. We used the RapidAPI (booking.com API) to facilitate hotel searches, obtain hotel details, and manage bookings in the 'hotelRoute.js' module. The 'airbnbRoute.js' file uses RapidAPI (AirBnB API) to execute property searches, receive property details, and check availability for Airbnb-related actions. The 'flightsRoute.js' module, on the other hand, makes use of the Skyscanner API to provide extensive flight-related functionality.

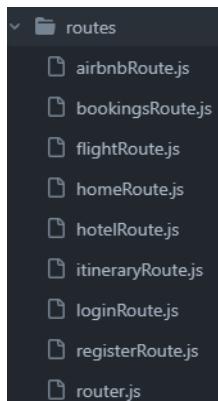


Figure 55: Routes folder in the repository

The table below provides a quick description of the primary API endpoints for external interactions and Internal Processes (Server-Side Operations) used in our web application. These endpoints serve as important data interfaces, allowing for seamless connectivity with other services and systems. The table provides information on the name, HTTP method, necessary parameters, response format, and authentication requirements for each endpoint.

Endpoint Name	HTTP Method	Description	Request Parameters	Authentication
/v1/hotels/search	GET	Get available hotels by the filter.	<ul style="list-style-type: none"> <li>checkin_date</li> <li>dest_type</li> <li>units</li> <li>checkout_date</li> <li>adults_number</li> <li>order_by</li> <li>dest_id</li> <li>filter_by_currency</li> <li>locale</li> <li>room_number</li> <li>children_number</li> <li>children_ages</li> <li>categories_filter_ids</li> <li>free_cancellation</li> <li>page_number</li> <li>include_adjacency</li> </ul>	API Key
/v1/hotels/locations	GET	Search locations or hotels by name.	<ul style="list-style-type: none"> <li>name</li> <li>checkin_date</li> <li>checkout_date</li> <li>adults_number</li> <li>locale</li> </ul>	API Key
/v1/hotels/photos	GET	Get all photos of the hotel by hotel_id.	<ul style="list-style-type: none"> <li>hotel_id</li> <li>locale</li> </ul>	API Key
/v1/hotels/data	GET	Get hotel data by hotel_id.	<ul style="list-style-type: none"> <li>hotel_id</li> <li>locale</li> </ul>	API Key

/v1/hotels/reviews	GET	Get reviews of the hotel by hotel_id.	<ul style="list-style-type: none"> <li>• sort_type</li> <li>• hotel_id</li> <li>• locale</li> <li>• language_filter</li> <li>• customer_type</li> </ul>	API Key
/v1/hotels/room-list	GET	Get room list of the hotel by hotel_id. Room prices, photos and full room descriptions.	<ul style="list-style-type: none"> <li>• hotel_id</li> <li>• currency</li> <li>• checkout_date</li> <li>• locale</li> <li>• checkin_date</li> <li>• adults_number_by_rooms</li> <li>• units</li> </ul>	API Key
/:id/book(Hotels)	POST	Book a hotel room.	<ul style="list-style-type: none"> <li>• JSON data containing booking details</li> </ul>	None
/:id(Hotels)	GET	Get hotel information by ID.	<ul style="list-style-type: none"> <li>• Path parameter 'id'</li> </ul>	None
/get-suggestions	GET	Get autocomplete suggestions for locations.	<ul style="list-style-type: none"> <li>• Query parameter 'query'</li> </ul>	API Key
/flightDetails	GET	Displays flight search results with details.	<ul style="list-style-type: none"> <li>• None</li> </ul>	None
/oneWay	POST	Performs a one-way flight search based on user input.	<ul style="list-style-type: none"> <li>• origin</li> <li>• destination</li> <li>• date</li> <li>• adults</li> <li>• children</li> <li>• infants</li> <li>• cabinClass</li> </ul>	API Key

/roundTrip	POST	Performs a round-trip flight search based on user input.	<ul style="list-style-type: none"> <li>• origin</li> <li>• destination</li> <li>• from (dateFrom)</li> <li>• to (dateTo)</li> <li>• adults</li> <li>• children</li> <li>• infants</li> <li>• cabinClass</li> </ul>	API Key
/addToDatabase (Flights)	POST	Adds flight booking data to a Firestore database.	<ul style="list-style-type: none"> <li>• Data JSON object containing flight details</li> </ul>	None
/v1/searchDestination (under /searchResults for Airbnb)	GET	Search list of Airbnb places around the specific location.	<ul style="list-style-type: none"> <li>• query (location)</li> </ul>	API Key
/v1/searchPropertyByPlace (under /searchResults for Airbnb)	GET	Shows detailed information about a specific Airbnb property.	<ul style="list-style-type: none"> <li>• id (Property ID)</li> <li>• currency</li> <li>• checkin</li> <li>• checkout</li> <li>• adults</li> <li>• children</li> <li>• infants</li> <li>• pets</li> </ul>	API Key
/v1/getPropertyDetails (under /:id for Airbnb)	GET	Get property details for a specific Airbnb.	<ul style="list-style-type: none"> <li>• id (Property ID)</li> <li>• currency</li> <li>• checkin</li> <li>• checkout</li> <li>• adults</li> <li>• children</li> <li>• infants</li> <li>• pets</li> </ul>	API Key
/v1/getPropertyReviews (under /:id for Airbnb)	GET	Get all the reviews for the specific Airbnb.	<ul style="list-style-type: none"> <li>• id (Property ID)</li> <li>• totalRecords</li> </ul>	API Key
/v1/checkAvailability (under /:id for Airbnb)	GET	Check for availability of the Airbnb.	<ul style="list-style-type: none"> <li>• id (Property ID)</li> </ul>	API Key

/:id/book	POST	Books an Airbnb property and adds booking data to Firestore database.	<ul style="list-style-type: none"> <li>• airbnbId (Property ID)</li> <li>• airbnbImage</li> <li>• airbnbName</li> <li>• checkIn</li> <li>• checkOut</li> <li>• userId</li> </ul>	None
/trip/:userId/destinations	POST	Create a new trip.	<ul style="list-style-type: none"> <li>• userId</li> <li>• destinations</li> <li>• fromDate</li> <li>• toDate</li> <li>• tripName</li> <li>• sharedWith</li> <li>• bookings</li> </ul>	None
/trip/:userId/destinations/:tripId	PUT	Update a trip.	<ul style="list-style-type: none"> <li>• userId</li> <li>• tripId</li> <li>• updatedTripData</li> </ul>	None
/trip/:userId/destinations/:tripId	DELETE	Delete a trip.	<ul style="list-style-type: none"> <li>• userId</li> <li>• tripId</li> </ul>	None
/trip/:userId/destinations/:tripId/day/:dayNumber	PUT	Update or add a place for a specific day in a trip.	<ul style="list-style-type: none"> <li>• userId</li> <li>• tripId</li> <li>• dayNumber</li> <li>• startTime</li> <li>• endTime</li> <li>• placeOfInterest</li> <li>• location</li> <li>• notes</li> </ul>	None
/trip/places/:tripId/day/:dayNumber	GET	Retrieve places for a specific day in a trip.	<ul style="list-style-type: none"> <li>• tripId</li> <li>• dayNumber</li> </ul>	None

Figure 56: List of API endpoints in our application

# 6. Analysis

## 6.1 Introduction to the Analysis

In this section, the team will conduct a comprehensive analysis of the proposed travel planner website solution in the context of relevant literature and industry best practices. The analysis aims to assess the effectiveness and alignment of the solution with established standards and research findings.

## 6.2 Framework for Analysis

**Effectiveness:** How well does the travel planner website address the needs of the user?

**User Experience:** How does the website impact the user experience?

**Alignment with Literature:** To what extent does the solution align with findings and recommendations in relevant literature?

**Sustainability:** Can the website be maintained and improved, in line with sustainable software development practices found in literature?

## 6.3 Analysis of the Solution

### 6.3.1 Effectiveness

By offering users a variety of tools to effectively plan their vacations, including the ability to book hotels, flights, and Airbnbs, the travel planner website proves its usefulness. According to a recent study by (Vagabond Journey, 2023), it's critical to guarantee a smooth experience while making travel arrangements. These ideas are incorporated into the travel planner website, which increases its overall efficiency.

### 6.3.2 User Experience

Websites for booking trips must prioritise the user experience. The literature, including studies by (Elixirr, 2022) and (Altexsoft, 2017), demonstrates the importance of good information presentation and usability. The user experience is directly enhanced by the website's strong emphasis on responsive interfaces and user-friendly design.

### 6.3.3 Alignment with Literature

The recommendations mentioned in the linked material are closely aligned with the travel planner website. It includes the user-centric design, personalization, usability, and scalability guidelines backed by numerous authors and industry reports.

#### **6.3.4 Sustainability**

Any software project should be particularly concerned with long-term viability. Plans for maintenance and enhancement are included in the development process, which adheres to the sustainable software development best practices advised by (Paliychuk, 2023).

### **6.4 Summary of Analysis**

In summary, the analysis shows that the travel planner website's solution successfully meets user needs, improves the user experience, and is in line with well-recognized academic research and industry best practices. The solution's sustainability prepares it for continued growth in the competitive trip planning sector.

## 7. Evaluation

### 7.1 Development Process

#### 7.1.1 Team Collaboration

**Strengths:** Our team displayed commendable cohesion and collaborative spirit. Using tools like Telegram and GitHub Projects, we ensured real-time communication and seamless task management.

**Areas for Improvement:** We sometimes faced challenges in decision-making, leading to longer meeting durations. In future projects, adopting a structured decision-making strategy might streamline discussions.

#### 7.1.2 Methodologies Employed

**Strengths:** Employing the Agile methodology greatly facilitated an environment of continuous feedback and iterative development. Regular check-ins ensured that we were on track and made necessary course corrections promptly.

**Areas for Improvement:** While the Agile approach proved beneficial in many aspects, there were instances where our planning phase was somewhat vague, leading to some uncertainties during development. In the future, adopting a more detailed planning strategy, possibly integrating tools like use-case diagrams or detailed task breakdowns, could provide clearer guidelines for our team.

### 7.2 Built Product: The Travel Planner Website

#### 7.2.1 User Experience (UX)

**Strengths:** Based on the feedback received during the user testing, many users commented that our website was easy to use and that the user interface was aesthetically pleasing. Integrating the Kaggle airport dataset as a dropdown list simplified the airport search process, enhancing the UX. The consistent styling across pages gave the website a cohesive look.

**Areas for Improvement:** The itinerary planning page, while functional, could benefit from a more intuitive design. Feedback suggested users would appreciate a drag-and-drop feature to reorder their plans.

## 7.2.2 Functionalities

**Strengths:** Our website successfully integrated flight, hotel, and Airbnb options, providing users with a one-stop solution for their travel needs. The Firebase-backed login ensured security and personalised user experiences.

**Areas for Improvement:** While our search mechanisms are robust, we can consider integrating more advanced filtering options, allowing users to sort flight, hotel, or Airbnb options based on criteria such as duration, amenities, or stopover durations. The itinerary planning tool, while functional, could be enriched with more interactive features, such as visual mapping integrations or recommendations based on a user's past choices. Also, leveraging existing user data and preferences to create more personalised recommendations for each user improves user engagement and experience.

## 7.2.3 Scalability and Performance

**Strengths:** The website is hosted on Heroku, using one dyno at the moment and can scale up depending on usage by demand.

**Areas for Improvement:** As the user base grows, we might need to consider transitioning to more scalable cloud solutions to handle increased traffic. Moreover, load testing under heavy traffic scenarios will be critical.

## 7.2.4 Future Work

- **Integration with More APIs:** Integrating with more diverse travel-related APIs can make our platform even more comprehensive.
- **Mobile Responsiveness:** Given the increasing reliance on mobile devices, optimising our platform for mobile users is a foreseeable next step.
- **Enhanced User Personalization:** Machine learning algorithms can suggest travel options based on user history and preferences.

Our travel planner website has achieved its fundamental objectives, but there is room for improvement. To determine the project's future direction, we will need to consider user feedback, technological advancements, and team reflections.

## 8. Conclusion

Creating this travel planner website has allowed our team to explore and execute different Agile methods in an actual project. Through creating user stories, attending sprint events and conducting surveys with our users, we could better understand our consumers' needs and stay on schedule with our work progress. Our team is now well-equipped to tackle future projects and use the Agile processes learnt in this group assignment.

## 9. Individual Reflection

### Raziq

Adopting Agile techniques in our travel planning web application project was an important choice, especially as the person in charge of hotel and hotel booking functions. Our daily stand-up meetings, where we openly shared progress, concerns, and solutions, demonstrated Agile's ability in promoting collaboration. To standardise booking functionality across all JavaScript code modules, I needed to work closely with team members. This provided consistency and a unified user experience. Despite the benefits, Agile presented obstacles, particularly in terms of time management and evolving scope. Meeting sprint deadlines was occasionally challenging, and I struggled to strike a balance between flexibility and staying on track. To address these issues, we tightened sprint planning, and kept a well-documented backlog.

### Gabrielle

I feel like I've learned a lot as I reflect back on the process of creating this project. I had the opportunity to re-use CSS and HTML for my website design, which I had not done in a while, to hone my technical skills. I appreciate all of my team's patience with me. It can be challenging for me to stay on top of my studies and time management because I have numerous obligations both within and outside of school. However, I want to thank my teammates for always being so understanding and helping me with this project. Since each of us has unique skill sets, working with my team allowed me to develop new ones and gain exposure to machine learning algorithms that I was previously unaware of. Despite the many ups and downs, I am happy with what my team has produced since we all gave it our all. In summary, I believe that I have gained a lot of knowledge from working on this project and have also experienced what it is like to collaborate with a team to suggest and build a website from scratch.

### Jingling

Through this project, I was able to experience the Agile techniques taught in class in a real group setting. Our sprint planning and sprint review sessions allowed us to stay on track with our tasks, and our daily stand-up meetings helped us stay updated on our teammates' progress. I found the sprint reviews to be particularly useful, as those sessions allowed me to gather regular feedback from my teammates. In addition to practising Agile techniques, this project also enabled me to hone my Node.js and EJS skills, which I had recently learnt in my current semester. This was also my first time implementing an API in an application, as well as using a collaborative tool like Github. These skills I have learnt will definitely benefit me in the future, for both my school and work projects.

### **Qixuan**

Throughout this project, I had the privilege of developing the flights page, a crucial component of our travel planner website. This experience not only allowed me to deepen my technical skills but also provided valuable insights into the collaborative nature of software development and the application of agile methodologies. Developing the flight page was both challenging and rewarding. It requires a comprehensive understanding of the Skyscanner's API and the ability to integrate its functionality seamlessly into our website. This project enabled me to gain practical experience in back-end development with Node.js and front-end templating with EJS. I encountered various challenges, such as handling API integration and maintaining code quality in a dynamic development environment. There was also an issue whereby the Skyscanner API was taken down by RapidAPI a few weeks before the submission of this project. This led me to email the user of the API and was notified it would be down for some time till it was moved to another platform. I also gained a deeper appreciation for the importance of clear and continuous communication within a development team. Agile methodologies facilitated this by fostering an open and collaborative environment where everyone's input was valued and considered in decision-making.

### **Khee Hing**

When I started this project, I had a mix of anticipation and uncertainty; I was more used to the traditional and linear approaches when building software, and the dynamic and iterative nature of agile was quite refreshing and different. Embracing change and continual collaboration allowed for a more versatile development environment. Through frequent feedback loops and testing, engaging with end-users early on significantly enhanced their overall experience. The meetings provided the opportunity for continuous self-improvement. Despite its challenges, embracing agile methodologies has instilled invaluable traits such as resilience, adaptability, and problem-solving. Hosting the website was also interesting.

(Word count: 8789)

## 10. Bibliography

1. Altexsoft. "Merging User and Travel Experience: Best UX Practices for Booking and Reservation Websites." *AltexSoft*, 25 July 2017, <https://www.altexsoft.com/blog/travel/merging-user-and-travel-experience-best-ux-practices-for-booking-and-reservation-websites/>. Accessed 14 September 2023.
2. Charlton, Graham. "Digital Trends in the Travel Industry: 12 Fascinating Stats." *SaleCycle*, 22 August 2023, <https://www.salecycle.com/blog/featured/digital-trends-travel-industry-12-fascinating-stats/>. Accessed 14 September 2023.
3. Codetheorem. "12 must have key features for your Travel Website." *Code Theorem*, 6 September 2022, <https://codetheorem.co/blogs/must-have-features-for-travel-website>. Accessed 14 September 2023.
4. Eernisse, Matthew. "EJS." *EJS -- Embedded JavaScript templates*, <https://ejs.co/#features>. Accessed 11 September 2023.
5. Elixirr. "Travel UX: the good, the bad and the ugly." *Elixirr*, 8 December 2022, <https://www.elixirr.com/2022/12/08/travel-ux-the-good-the-bad-and-the-ugly/>. Accessed 14 September 2023.
6. "Firebase Pricing." *Firebase*, 13 July 2023, <https://firebase.google.com/pricing>. Accessed 10 September 2023.
7. "Heroku Pricing." *Heroku*, <https://www.heroku.com/pricing>. Accessed 10 September 2023.
8. "JaydipPrajapati1910." *Uiverse.io*, <https://uiverse.io/profile/JaydipPrajapati1910>. Accessed 17 September 2023.
9. "NodeJS." *Node.js*, <https://nodejs.org/en/about>. Accessed 10 September 2023.

10. Paliychuk, Ulyana. "Best Practices of Sustainable Software Development." *Beetroot*, 15 March 2023,  
<https://beetroot.co/greentech/best-practices-of-sustainable-software-development/>. Accessed 14 September 2023.
11. RamSys, jordisan. "User Experience (UX) in travel sites | by jordisan -aka RamSys." *Medium*, 14 October 2018,  
<https://medium.com/@jordisan/user-experience-ux-in-travel-sites-cc838d6f56c3>. Accessed 14 September 2023.
12. "Tahmid Ahmed." *YouTube*, <https://www.youtube.com/@tahmidahmed-yt>. Accessed 17 September 2023.
13. Vagabond Journey, Other Voices. "Why Efficient Travel Planning Is Key to Enjoying Your Journey." *Vagabond Journey*, 6 September 2023,  
<https://www.vagabondjourney.com/why-efficient-travel-planning-is-key-to-enjoying-your-journey/>. Accessed 14 September 2023.