



PLANADAY : SUGGEST ONE DAY TRIP APPLICATION

MR. SITIPORN WIMOLPUNYAKUL

MS. KANYARANT PREMPRAPAPONG

MS. THANAKORN CHOTTHANIGARN

A PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF BACHELOR OF SCIENCE (COMPUTER SCIENCE)

SCHOOL OF INFORMATION TECHNOLOGY

KING MONGKUT'S UNIVERSITY OF TECHNOLOGY THONBURI

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Mr. Sitiporn Wimolpunyakul
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A Project Submitted in Partial Fulfillment of the Requirements for
The Degree of Bachelor of Science (Computer Science)
School of Information Technology
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Project Committee

.....
(Asst.Prof. Worarat Krathu)

Advisor

.....
(Dr. Watanyoo Suksa-ngiam)

Committee

.....
(Dr. Vithida Chongsuphajsiddhi)

Committee

Project Title	PLANADAY : SUGGEST ONE DAY TRIP APPLICATION
Project Credits	6
Candidate	Mr. Sitiporn Wimolpunyakul MS. Kanyarant Premprapaong MS. Thanakorn Chotthanigarn
Project Advisor	Asst.Prof. Worarat Krathu
Program	Bachelor of Science
Field of Study	Computer Science
Faculty	School of Information Technology
Academic Year	2024

Abstract

PlanADay is a mobile application designed to generate personalized one-day trip plans with minimal effort based on user preferences and input data. The application utilizes two recommendation strategies: Most-Related Places From Location Area and Based-on-Preferences Interests. Users can specify details such as their categories of interest (e.g., gyms, parks, cafes, restaurants, museums, theaters, or art galleries), the starting date and time, preferred location area, and the number of places to visit. Additionally, PlanADay allows users to view detailed attraction information, bookmark plans, and access their plan history.

This project demonstrates the practicality of implementing a plan suggestion system by leveraging user inputs to tailor recommendations. The app provides an intuitive and engaging experience, enabling users to efficiently discover and plan their ideal day while enhancing satisfaction and utility.

Keywords : Plan/ Interests / Mobile Application / Suggestion

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Chapter 1

Introduction

1.1 Background

In today's fast-paced world, people rely more on technology to plan their daily activities and their free time. However, many planning tools provide general suggestions that may not be suitable for individual preferences or specific situational requirements such as time, location, or interest activities. The growing demand for personalized planning in mobile applications gives an opportunity to create a smart solution that personalizes recommendations to each user's specific preferences. Users today expect convenience, accuracy, and relevance, especially when it comes to planning their day or deciding where to go for activities. Personalized services are no longer an option but rather a requirement for improving user satisfaction and engagement in an increasingly digital era.

1.2 Objectives

1. To provide the plan which is suitable to the user's preference.
2. To provide up-to-date information on opening hours and availability.

1.3 Scope

This project aims to develop a mobile application that suggests one-day trip plans based on user interests, such as cafes, restaurants, shopping, parks, and more. Users can also provide input, such as starting location, date and time, and the number of places to visit, to refine the suggestions and include more relevant locations in their plans. Users of the PlanADay application

- **can create** personalized one-day trip itineraries based on their interests and preferences.
- **can discover** nearby attractions that align with their preferences and current location.
- **can adjust** their generated plans by rearranging locations, deleting stops, or regenerating.
- **can view** detailed information for each suggested location.
- **can share** their trip plans with others on the platform.
- **can bookmark** plans created by other users for easy access and reference in the future.
- **can explore** their plan history to revisit past itineraries or gain inspiration for new trips.

1.4 Expected Benefits

1. **Seamless Trip Planning:** The main features of the application will help users to create their personal preferences, ensuring a tailored and enjoyable experience.
2. **User Satisfaction and Flexibility:** Users will appreciate both the thoughtfully generated plans and the ease of customizing them to suit their needs, ensuring a more satisfying experience.
3. **Business Partnerships:** By featuring related points of interest, such as shops and cafes, PlanADay opens opportunities for businesses to partner and connect with a highly engaged audience.

Chapter 2

Feasibility

2.1 Introduction

PlanADay Application: Suggest One Day Trip is a mobile application that helps people who want to go on a one-day trip without wasting time to create the plan that has many steps to do such as searching for places, available hours on each place, finding the route path and so on. The application will help reduce the time spent on organizing a one-day trip by suggesting the place due to the user's preferences and providing the place detail

2.2 Problem Statement

Planning a one-day trip can be challenging and time-consuming. It involves multiple steps, including searching for places of interest, checking operating hours, determining suitable routes, and aligning schedules. Many people lack the time or abilities to plan an efficient trip, which often results in frustration, inefficiency, or missed opportunities to explore exciting places. Current solutions may offer individual recommendations or maps, but they do not take a comprehensive approach to creating a personalized, structured plan. This gap highlights the need for an application like PlanADay, which streamlines the process by providing personalized recommendations to help users maximize their travel experience with minimal effort.

2.3 Related research and projects

Location based services: ongoing evolution and research agenda

Explores the evolution and research trends of Location-Based Services (LBS) in the context of the mobile information era, highlighting their significance in delivering location-dependent information to users. It identifies key research challenges, including advancements in positioning, modeling, communication, and the evaluation of LBS-generated data. Additionally, the article addresses social, ethical, and behavioral considerations associated with LBS integration into daily life, offering a comprehensive research agenda to shape the future of LBS in a positive and impactful way.

Personalized Day-Trip Planning: A TSP-TW-Based Multimodal Multicriteria Optimisation Approach

Innovative approach to creating personalized one-day travel itineraries by enhancing the Traveling Salesman Problem with Time Windows (TSP-TW). It incorporates multi-criteria optimization, flexible activities, park-and-ride options, and multiple transport modes to address diverse mobility preferences. Using choice experiments, the authors derive utility functions to optimize itineraries, achieving a 16.19% reduction on travel time. The method was validated through simulations in a medium-sized German city, showcasing its effectiveness in real-world scenarios.

2.4 Requirement specifications for the new system

2.4.1 Function requirements

1. Preference setting: Users should be able to select their own preference of categories for the application to provide the suggestion for the user.
2. User Input: The application should allow users to input trip details with plan name, categories of interested place, location area, start time, start date, and the number of places to visit.
3. Location suggestion: The application should suggest places based on user preferences and user input to find the appropriate place.
4. Itinerary Generation: The system must provide a sequential trip plan with details like order of visit, travel time between locations, and routing path to each place.
5. Plan Customization: Users should be able to customize the plan including edit plan name. Delete or add more places, reorder the place, and regenerate the plan.
6. Attraction Details: The application should display detailed information for each attraction, including photos, descriptions, rating, and opening hours.

2.4.2 Data requirements

1. Location data from Google Map API

2.4.3 System requirements

1. Smartphone with Android OS or iOS
2. Has geo-positioning sensor (GPS)

2.5 Implementation techniques

2.5.1 Frontend

- Language
 - Dart
- Framework
 - Flutter

2.5.2 Backend

- Language
 - Typescript
- Framework
 - Bun
 - Elysia
- External Service
 - GoogleMap API
- Testing
 - Jest
 - Postman

2.5.3 Infrastructure

- Operating System
 - Debian Linux
- Hosting
 - SSD Node (Virtual Private Server)
- Container Management
 - Docker
- Image Storage
 - Docker Registry

- External Service
 - Google Cloud Platform
- Web-server
 - Nginx
- Database
 - mongoDB
 - Redis
 - PostgreSQL

2.5.4 Other

- Editor Development: Visual Studio Code
- DevOps: Github Action
- Project Management: Trello
- Online meetings: Microsoft Teams and Discord
- Design: Figma and Canva
- Clipart and Icon: Freepik, Scale by Flexiple, Flaticon and Feather
- Diagram Design: Lucid Chart

2.6 Implementation Plan

No.	Task Name	Duration	Start Date	End Date
Phase 1: Project Initiation				
1.	Define topic	1 week	25 January 2024	1 February 2024
2.	Define scope	1 week	25 January 2024	1 February 2024
3.	Conduct feasibility study	1 week	25 January 2024	1 February 2024
4.	Develop business model	1 week	25 January 2024	1 February 2024
Phase 2: Project Acquisition				
1.	Project Profile	2 weeks	11 March 2024	25 March 2024
2.	Project proposal preparation	2 weeks	11 March 2024	25 March 2024
3.	Submit project approval	1 day	25 March 2024	25 March 2024
Phase 3: Project Planning				
1.	Manage scope and requirements changes	2 weeks	4 April 2024	19 April 2024
2.	Develop project management plan	3 weeks	10 August 2024	3 September 2024
Phase 4: Project Execution				
1.	Presentation Project Exam 1	1 day	2 April 2024	2 April 2024
2.	User Interface Design	1 month	24 April 2024	6 June 2024
3.	Presentation Project Exam 2	1 day	4 June 2024	4 June 2024
4.	Proof of Concept (POC)	3 weeks	23 July 2024	15 August 2024
5.	Database design	2 weeks	30 July 2024	16 August 2024
6.	Development	3 months	10 August 2024	9 November 2024
	- Frontend	3 months	10 August 2024	9 November 2024
	- Backend	3 months	10 August 2024	9 November 2024
7.	Alpha Exam: Midterm Examination	1 day	11 October 2024	11 October 2024
8.	Testing	20 days	20 October 2024	9 November 2024
9.	Deployment	3 days	6 November 2024	9 November 2024
10.	Beta Exam: SIT's Undergraduate Student Demonstration Project Day	1 day	11 November 2024	11 November 2024
Phase 5: Project Closeout				
11.	Planning to do Project Report	1 day	13 November 2024	13 November 2024
12.	Project Report preparation	1 week	18 November 2024	25 November 2024

Table 2.1: Table of the project task

Chapter 3

Analysis and Design

3.1 Introduction

This chapter provides an explanation of our project design in the following sections: analysis of the existing system, user requirement analysis, and system design. First is analysis of the existing system, this section evaluates the current systems and applications available in the market, identifying their features, limitations, and areas for improvement along with the PlanA-Day application. Second, the user requirement analysis section that explains the features of the project. Third, the system design user diagrams consist of a context diagram, data flow diagram, activity diagram, use case diagram, system sequence diagram, flow chart, and key-valued database diagram.

3.2 Analysis of the existing system

Currently, several applications are available in the market that assist users in planning trips, such as Google Maps, Stripl, Gethergo, and ChatGPT. These platforms offer various features, including route navigation, attraction suggestions, and itinerary planning. However, they differ in their ability to cater to specific user needs.

For instance, most existing applications, like Google Maps and Stripl, are well-suited for users who already know where they want to go, as they provide efficient routing paths and location-based directions. Similarly, Gethergo offers recommendations based on user-defined interests but requires users to input detailed preferences or destinations. On the other hand, PlanADay offers catering to users who may not have a clear idea of where they want to go. The application generates personalized, one-day trip plans based on broad user interests, preferences, and current location, offering a complete itinerary without requiring extensive input or prior knowledge of specific destinations. The comparison table below summarizes the key features of each application.

Feature	Stripl	gethergo	Google Map	ChatGPT	PlanADay
Require less input	✓	-	✓	-	✓
Suggest plan base on user interests and preferences	-	✓	-	✓	✓
Suggest route based on location	✓	✓	✓	-	✓
Real-time place Details	-	✓	✓	-	✓
Provide routing path	✓	✓	✓	-	✓
Generate/ Regenerate plan	-	-	-	✓	✓
Save related plan from others	✓	✓	✓		✓
Overview Detail	-	✓	✓	-	✓

Table 3.1: Table of the feature comparisons

The PlanADay application aims to address these limitations by offering a more personalized and flexible experience. It not only generates customized one-day trip plans based on user interests but also allows users to adjust itineraries, share plans with others in the community, and bookmark suggestions for future use. By bridging these gaps, PlanADay seeks to provide a more user-focused and collaborative solution compared to existing systems.

3.3 User requirement analysis

The user requirement analysis aims to identify the expectations, preferences, and functional needs of users who seek efficient and personalized one-day trip planning. Below is a breakdown of the key user requirements that they might found:

1. Users do not get the satisfied plan from the user's input.
 - Customization plan: Users can edit the plan which is delete the place, add more places, and reorder the place on their own again to make the most appropriate plan for the user.
2. Users want to change their preferences.
 - Preference setting: Users can reselect their preferences all the time in application.
3. Users do not have any specific input.
 - Suggestion plan: The application provides the plan that are generated from other users, so the user can use other's plan to travel.

3.4 System Design

3.4.1 Use case diagram

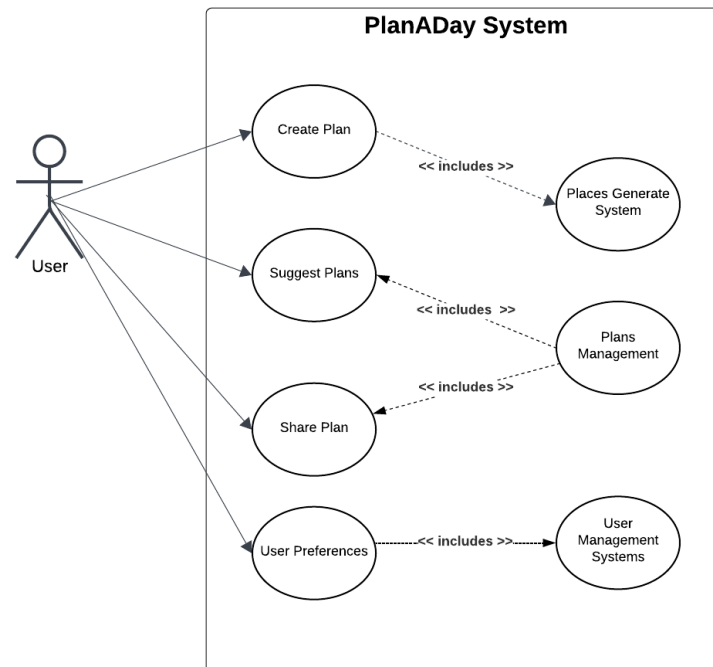


Figure 3.1: Use case diagram

The Actors who are in the PlanADay System. The user must create the account to authenticate in the system. After the user input all field forms to create a plan, including the plan name, place type, location, date and time and amount of places, The system will generate the plan and display it to the user. if the user is not satisfied they can customize the plan by rearrange, regenerate. The suggestion plans will show the public plans that mean each plan is shared by other users. and filter the plan by user preferences.

3.4.2 Context diagram

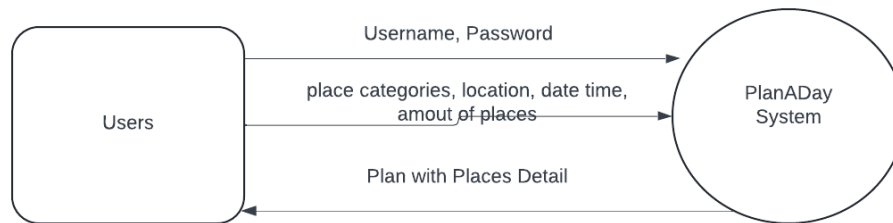


Figure 3.2: Context diagram

The context diagram shows the overall of PlanADay System that requires the username, password that need to be used in authentication service, place categories, location, date and time, amount of places that need to be used in generating the plan. Then the system will provide a plan that matches with input that includes details.

3.4.3 Activity Diagram

Authentication process

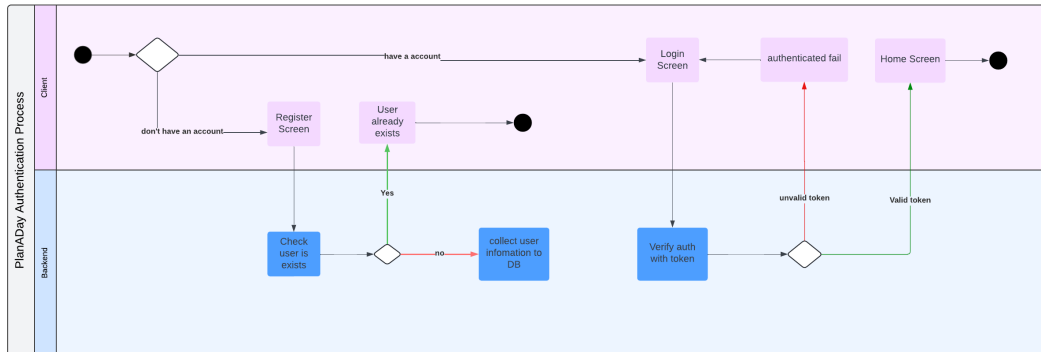


Figure 3.3: Activity Diagram of Authentication Process

The PlanADay Authentication Process illustrates the workflow for user registration and login, divided into client-side and backend interactions. The process begins with a decision: if the user does not have an account, they are directed to the registration screen. On registering, the backend checks if the user already exists. If the user exists, they are informed and redirected to the login screen; otherwise, their information is collected and stored in the database. For users with an account, the login screen allows them to authenticate. The backend verifies the authentication using a token. If the token is valid, the user is granted access to the home screen. In the event of an invalid token, authentication fails. This flow ensures a secure and user-friendly mechanism for handling account creation and login.

Generate Plan Process

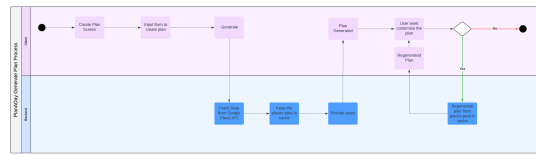


Figure 3.4: Activity Diagram of Generate Plan Process

The PlanADay Generate Plan Process outlines the workflow for creating and customizing plans. The process begins on the client side, where the user accesses the "Create Plan" screen, fills out an input form, and initiates the plan generation. The backend fetches relevant data from the Google Places API, caches the data for future use, and provides the generated plan to the client. After the plan is displayed, the user has the option to customize it. If they choose to do so, the backend regenerates the plan using the cached data without making additional API calls. If no customization is needed, the process ends. This workflow ensures efficiency through caching and provides a seamless user experience for generating personalized plans.

3.4.4 User Interface Design



Welcome back

Log in to your account

Username

Password



Login

New user here? [Sign up](#)

Figure 3.5: Login Page

Figure 3-5. display the Login page of PlanADay application. The system requires the user to login using username and password for authentication.



Register

Please register to log in

Username

Password

Confirm password









Register

Already have account? [Sign in](#)

Figure 3.6: Register Page

Figure 3-6. display the Register page of PlanADay application. When users get in the application for the first time, they are required to create the account to use in the system.

Choose your interests

 Popular	 Cafe
 Food and Drink	 Shopping
 Sport	 Entertainment and Recreation
 Museum	 Services

Done

Figure 3.7: Persona Page

Figure 3-7. display the Persona page of PlanADay application. Users can set their preferences in this page and it will be used to suggest the plan in the system.

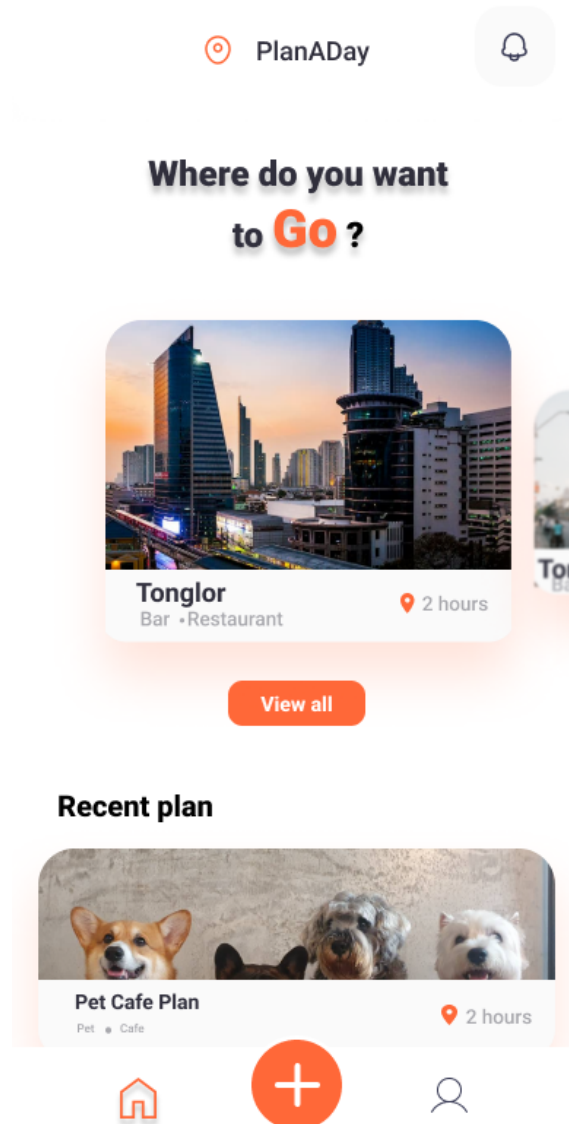


Figure 3.8: Home Page

Figure 3-8. display the Homepage of PlanADay application. The application will show the plan suggestion and the plan that the user created in this page.

×

Create new plan

Plan name

Select activity/plan

✓ Popular

✓ Cafe

Food and Drink

Shopping


Sport

Entertainment

Museum

Services

Location area



Start time


Number of place (Optional)


−

1

+

Generate plan








Figure 3.9: Home Page

Figure 3-9. display the Create Plan page of PlanADay application. Users can create their own plan on this page. The input are plan name, categories, location area, start date, start time, and number of places.

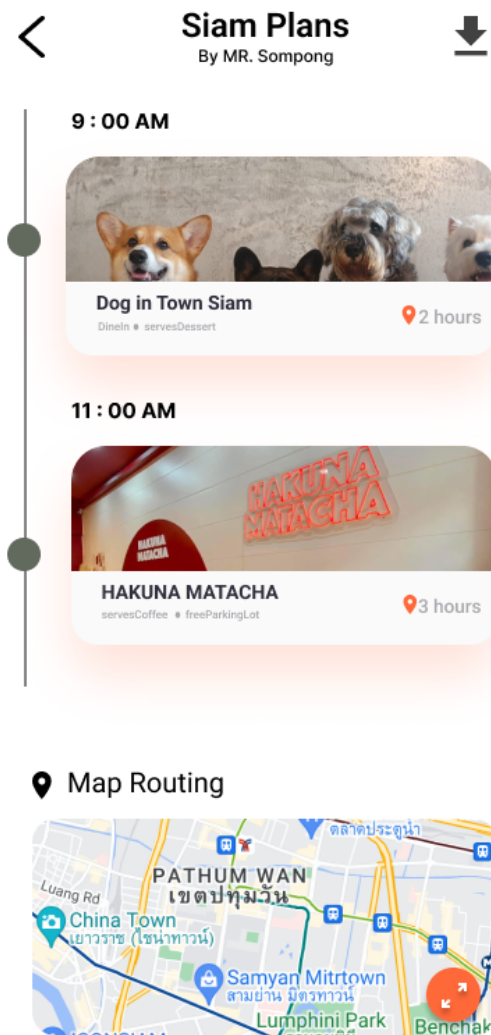


Figure 3.10: Generated Page

Figure 3-10. display the Generated Plan page of PlanADay application. After the user selects their input and clicks on the generate plan button, the system will suggest the plan according to the input, and all the plan details will show in this page.

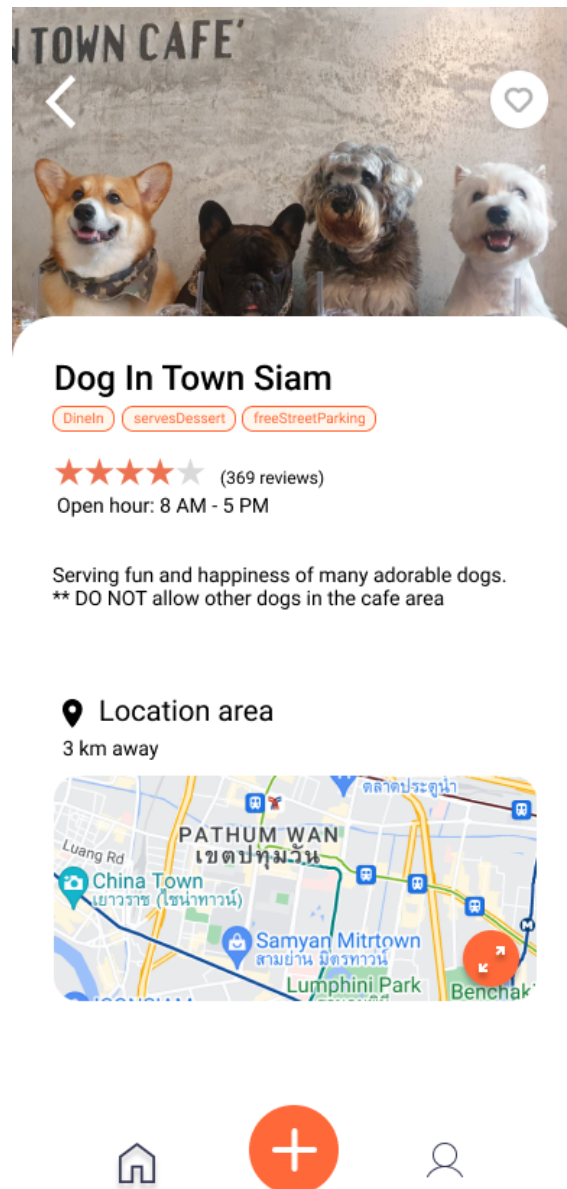


Figure 3.11: Place Detail Page

Figure 3-11. display the Place Detail page of PlanADay application. This page will show after the user clicks the place card in the Generated Plan page. The details that this page shows are place name, service types, rating, available open hours, and location on google map.

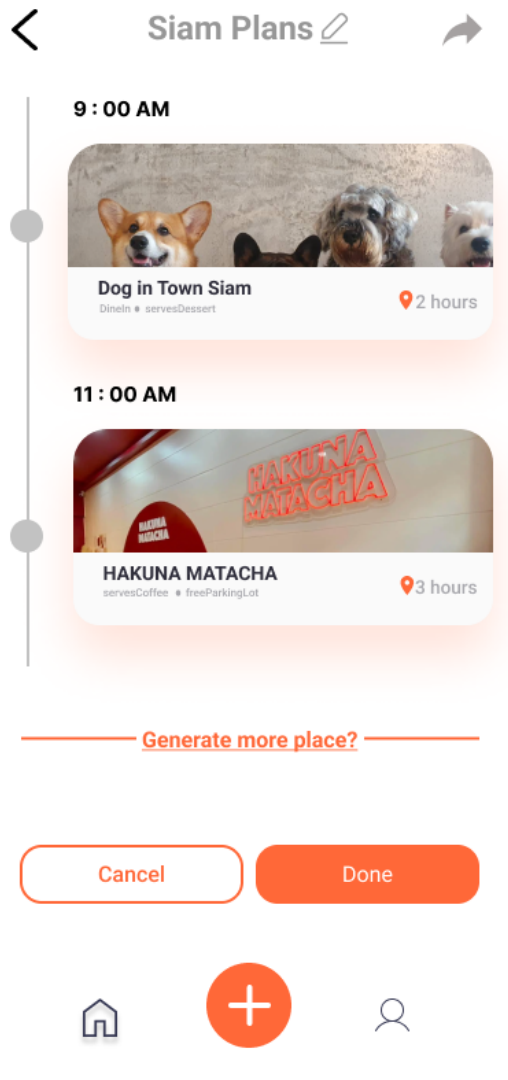


Figure 3.12: Edit Plan Page

Figure 3-12. display the Edit plan page of PlanADay application. If the user is not satisfied with the generated plan, they can click on the edit plan button and it will navigate to this page. Users can edit the plan name, delete each place, regenerate the place, and add more places.

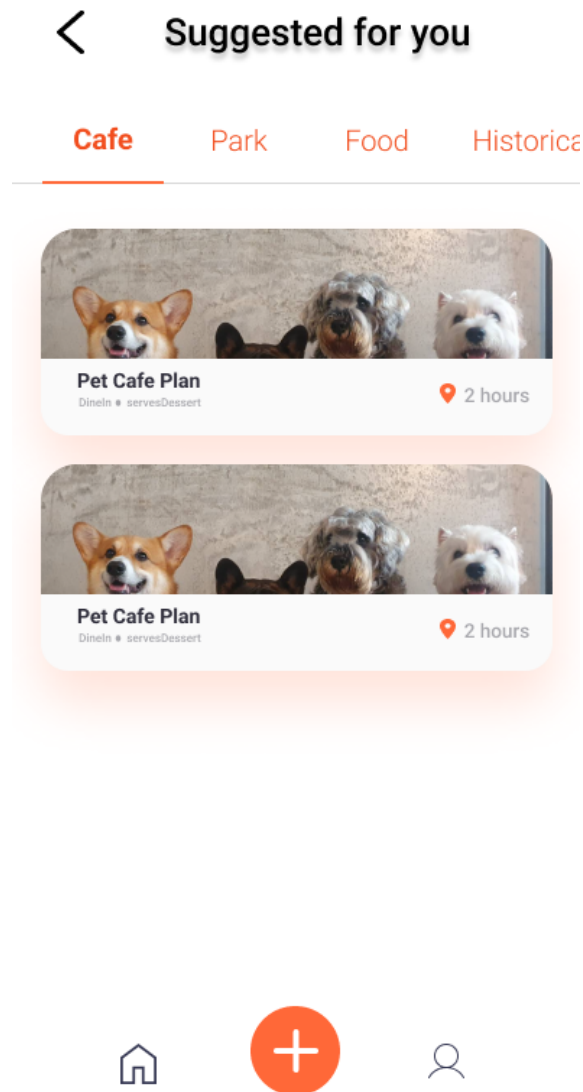


Figure 3.13: Suggest Plan Page

Figure 3-13. display the Suggest Plan page of PlanADay application. This page can get on from the Homepage of the application. This page will show the plan that was generated from others user in the application and the user can click on each plan to see the details.

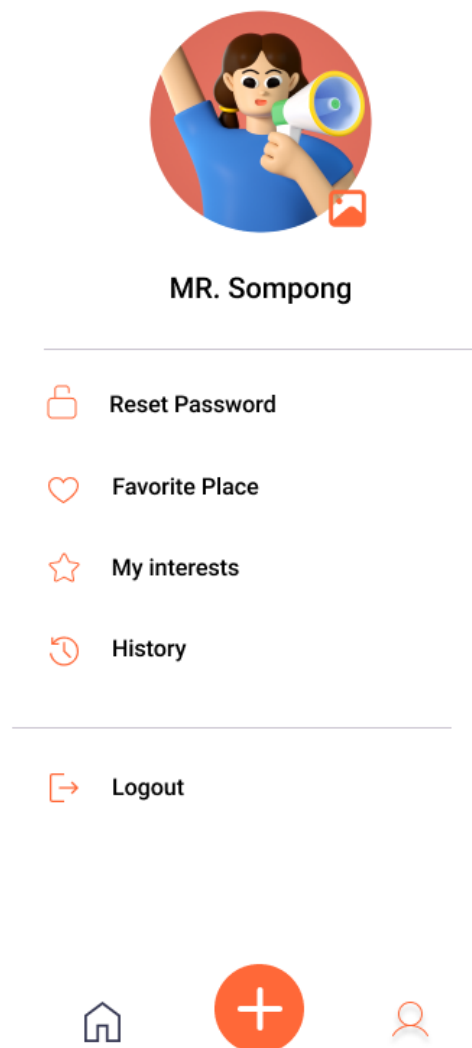


Figure 3.14: Profile Plan Page

Figure 3-14. display the Profile page of PlanADay application. Users can access the history page, persona page, and logout from their account on this profile page.

History

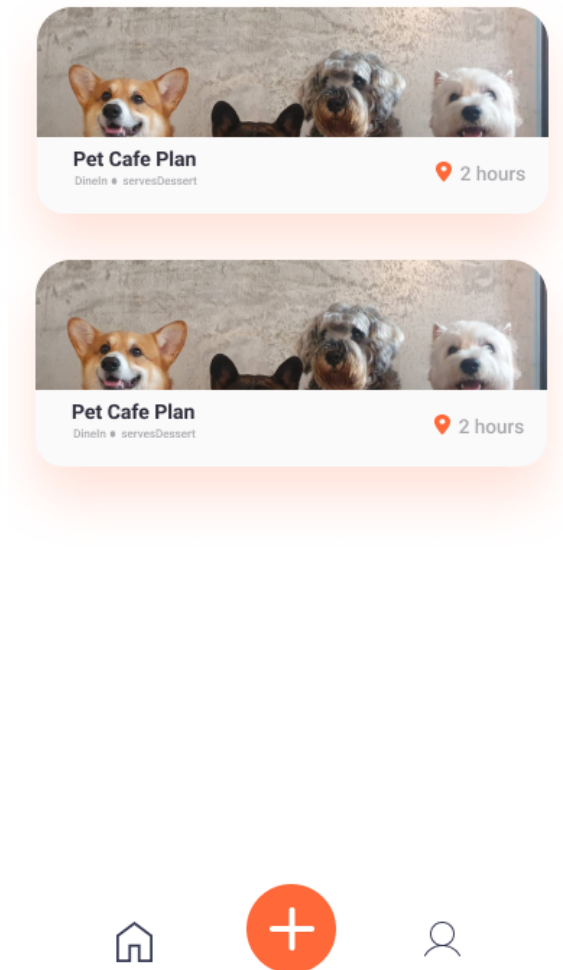


Figure 3.15: History Page

Figure 3-15. display the History page of PlanADay application. This page shows all the plans that the user generated.

3.5 Database design

3.5.1 Relational Database

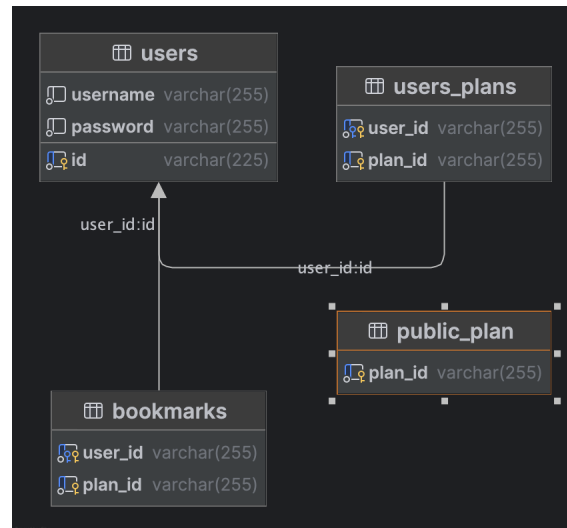


Figure 3.16: Relational Database Schema

Our database relies on PostgreSQL. The ER diagram illustrates a system for managing public plans and user interactions with them. Public plans are stored in the public-plan entity, identified by their unique plan-id. Users are represented in the users entity with their username, password, and id. The users-plans entity establishes a many-to-many relationship between users and public plans, allowing users to be associated with multiple plans and vice versa. The bookmarks entity also represents a many-to-many relationship, enabling users to bookmark multiple public plans and plans to be bookmarked by multiple users.

3.5.2 non-relational database

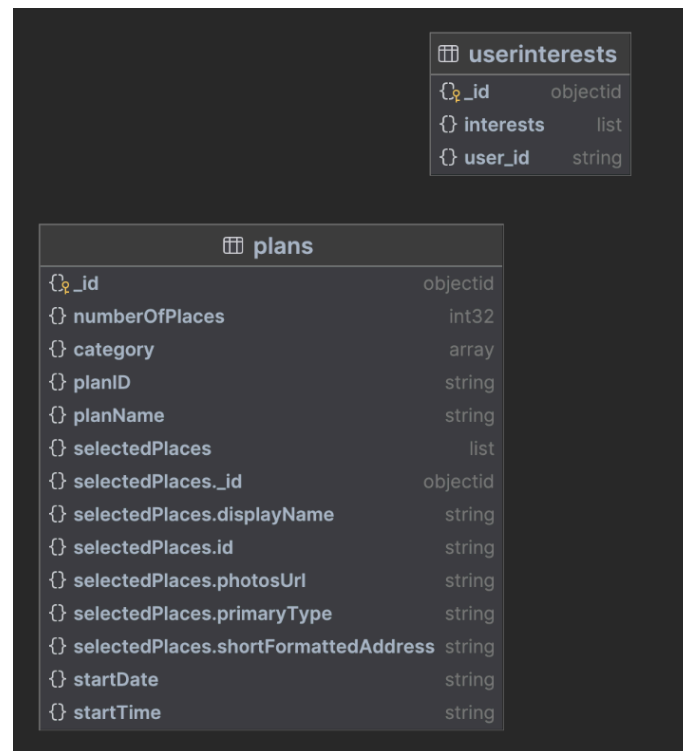


Figure 3.17: Non-Relational Database Schema

The ER diagram depicts a database schema for managing travel plans and user interests. The user interests table stores user IDs and their associated interests. The plans table contains detailed information about travel plans, including the number of places, category, plan ID, name, selected places with their attributes, and start date/time.

Chapter 4

System functionality

4.1 Introduction

This chapter describes the system architecture, the plan, and the test result. First, the chapter begins with the system architecture which consists of the system functionality and main functions. The system functionality describes the components of the system and the overall structure of the system. The main function section describes all the functions in the system. Lastly, the test plan and the results explain the processes and procedures used for testing the system.

4.2 4.2 System architecture

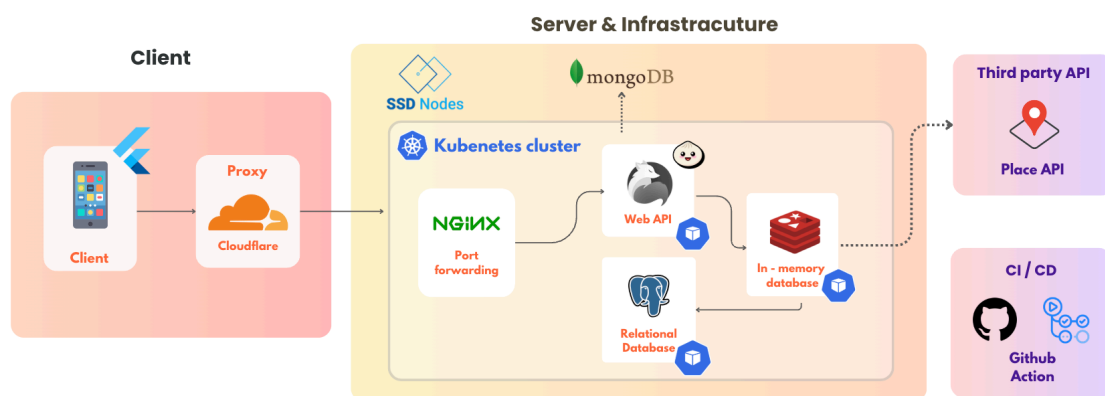


Figure 4.1: System architecture

The PlanADay software architecture employs a client-server model, with the frontend handling user interaction through screens and forms, and the backend managing core logic, API integrations, and database operations. The frontend allows users to create plans, customize them, or authenticate via registration and login, sending input to the backend for processing. The backend retrieves data from external APIs like Google Places, caches it for efficient reuse, verifies user credentials using token-based authentication, and stores user data securely. This architecture prioritizes separation of concerns, efficiency through caching, and security, ensuring a scalable and user-friendly system for generating and customizing plans.

4.3 Test Plan

Module	Test Case	Step	Description	Expected Result
Authentication	Sign in	1	Provide correct credentials in the sign-in form.	User is directed to Home Screen.
		2	Provide invalid credentials in the sign-in form.	An error message, "Failed to log in", is displayed.
	Sign up	3	Register a new account with valid credentials	Registration is successful, and the user id directed to Home screen.
		4	Attempt to create an account with a username that already exists.	An error message, "User already existed", is displayed.
Home Screen	Create new plan	1	Tap on the "Create new plan" button to initiate a new trip plan.	CreatedPlanScreen is displayed.
	Suggested plan cards	2	Tap on the suggested plan card displayed on the Home Screen.	Display Plan Screen with plan's details.
	View all suggested plan	3	Access the full list of suggested plans from the Home Screen by tap on the "View all" button.	Suggest Screen is displayed.
	Plan History	4	Ensure that completed plans are visible on the Home Screen.	Finished plan card are displayed on Home Screen.
Generate Plan Feature	Plan Generat Model	1	Plan Generate Model that save user's plan in mongoDB.	The plan is returned in the specified format.

Table 4.1 continued from previous page

	Return Places from Cache	2	After fill the input in CreatePlanScreen properly and tap on the “Generate” button. Then generate a trip plan using cached places.	Random places are returned along with a success status, if data existed in the cache.
		3	Attempt to generate a trip plan when the requested number of places exceeds the cache availability.	Return random places and success status if data is in cache. Or if there are insufficient realted places in the cache, appropriate error handling is triggered.
	Nearby search	4	Fetch a list of places within a specified distance scale (e.g., 3 km) based on the user’s latitude , longitude, and selected categories.	A list of places within the specified distance is returned.
	Time traveling	5	Retrieve the estimated travel times between two locations identified by their “place_id” for multiple travel modes (e.g., driving and walking).	Return an object containing the travel times for the specified modes. And mode fails are handled.
Customize Plan Feature	Generate more place	1	Press on ”Generate More” to expand the list of places in the current plan.	Additional places are added to the plan based on the user’s preferences and location.

Table 4.1 continued from previous page

	Regenerate plan	2	Tap on the "Regenerate Plan" button to refresh the trip itinerary while maintaining the user's initial input.	A new plan is generated, replacing the previous one.
Suggested Plan Feature	User interest and plan suggestion	1	Plans from other users are suggested on CarouselSlider in Home Screen based on user interests	Plans from other users are suggested in the CarouselSlider on the Home Screen.
	Update user Interests	2	Modify the user's preferences to update plan suggestions.	The user's interests are updated, and relevant plans are displayed on the Home Screen.
Publish and Bookmark Feature	Publish the plan to other users.	1	Share a user's plan with others who have similar interests.	The plan is published to other users' suggested plans.
	Create Bookmark	2	Click the "Bookmark" icon on a others' plan to save to the user's bookmarks.	The selected plan or location is saved to the user's bookmarks.
	Delete Bookmark	3	Access the bookmarks list and select "Delete" for the desired item.	The item is successfully removed from the bookmarks list.

Table 4.1: Test Plan

4.4 Test Results

Module	Test Case	Expected Result	Actual Result	Status
Authentication	Sign in	User is directed to Home Screen.	Login Successfully and direct to Home Screen	Passed
		An error message, "Failed to log in", is displayed.	An error message, "Failed to log in," is displayed.	Passed
	Sign up	Registration is successful, and the user id directed to Home screen.	Register Successfully and direct to Home Screen.	Passed
		An error message, "User already existed", is displayed.	An error message is displayed.	Passed
Home Screen	Create new plan	CreatedPlanScreen is displayed.	The CreatePlanScreen is displayed.	Passed
	Suggested plan cards	Display Plan Screen with plan's details.	Display Plan Screen with plan' details related to the user's interests.	Passed
	View all suggested plan	Suggest Screen is displayed.	The Suggest Screen is displayed.	Passed
	Plan History	Finished plan card are displayed on Home -Screen.	First login user has no plan history [] and after have created plan, it displayed on Home Screen.	Passed
Generate Plan Feature	Plan Generat Model	The plan is returned in the specified format.	The received plan data is returned as an object in the correct format.	Passed
	Return Places from Cache	Random places are returned along with a success status, if data existed in the cache.	Random places fetched successfully.	Passed
		Return random places and success status if data is in cache. Or if there are insufficient realted places in the cache, appropriate error handling is triggered.	Plan data sent successfully with status "success".	Passed

Table 4.2 continued from previous page

	Nearby search	A list of places within the specified distance is returned.	A list of places within the specified distance is returned when the plan is created.	Passed
	Time traveling	Return an object containing the travel times for the specified modes. And mode fails are handled.	Travel time data received successfully.	Passed
Customize Plan Feature	Generate more place	Additional places are added to the plan based on the user's preferences and location.	New places are generated. Failed to receive new plan data is handled.	Passed
	Regenerate plan	A new plan is generated, replacing the previous one.	New plan is generated. Failed to receive new plan data is handled.	Passed
Suggested Plan Feature	User interest and plan suggestion	Plans from other users are suggested in the CarouselSlider on the Home Screen.	Plans from other users are displayed.	Passed
	Update user Interests	The user's interests are updated, and relevant plans are displayed on the Home Screen and Suggest Screen.	Plans from other users are displayed. On the Home Screen and Suggest Screen.	Passed
Publish and Bookmark Feature	Publish the plan to other users.	The plan is published to other users' suggested plans.	Other user's can see the plan that are published.	Passed
	Create Bookmark	The selected plan or location is saved to the user's bookmarks.	Bookmark with unique plan_id created successfully.	Passed
	Delete Bookmark	The item is successfully removed from the bookmarks list.	Bookmark with unique plan_id deleted successfully	Passed

Table 4.2: Test Result

Chapter 5

Summary and suggestions

5.1 Project Summary

PlanADay Application: Personalized One-Day Trip Planning System is a mobile application that assists users in creating custom itineraries through three key types of suggestions: based on user interests, you might be interested, and location-based recommendations. The definitions of each suggestion are explained below.

Plan Customization:

The system recommends locations that match the user's stated preferences, such as cafes, parks, restaurants, museums, gyms, shopping, etc. Using the user's input, including starting location, preferred starting date and time, and desired number of stops. PlanADay generates a complete itinerary. This feature ensures that the trip plan aligns closely with the user's interests while exploring nearby attractions that they have not visited before.

Completed Plans Shared by Others:

This suggestion feature analyzes the user's interests and bookmarked plans from other users to recommend similar places they might enjoy. For instance, if a user sets their interests as cafes and shopping, the system suggests completed plans shared by other users in the application that align with these interests. This helps users discover new places and plans while ensuring the recommendations remain relevant to their preferences.

With these features, PlanADay enables users to explore new destinations, enjoy tailored itineraries, and make the most out of their one-day trips. It provides a seamless blend of personalization, discovery, and flexibility.

5.2 Problems encountered and solutions

We encountered some problems during the mobile application development phase, and some issues took time and effort to solve. The problems encountered and solutions will discuss as follow:

5.2.1 Location fetching issue

In our system design, we rely on the Google Maps API to fetch location data, as it provides a comprehensive and reliable source of geolocation information worldwide. However, during implementation, we encountered a significant challenge: the cost associated with using the Google Cloud Platform (GCP). GCP requires users to subscribe and potentially incur charges to access their resources, including the Google Maps API. Since cost-efficiency is a priority for us, we explored ways to minimize expenses while maintaining functionality. After thorough research, we discovered that Google Cloud Platform offers a \$300 free credit to new users. This credit can be utilized without being charged unless the account is upgraded to a fully paid subscription. By strategically registering and using this free credit, we temporarily mitigated the cost barrier. This approach allows us to proceed with development and testing without incurring immediate expenses. However, this solution is only temporary, and we recognize the need to plan for long-term sustainability by either optimizing API usage or exploring alternative solutions. Furthermore, to minimize API call costs, we are considering strategies caching frequently accessed location data and reducing redundant API calls. These measures aim to reduce dependency on external APIs and limit the associated expenses.

5.2.2 Data storage

The main challenge with storing location data is managing the large volume of information fetched during the planning process. Continuously saving every fetched or edited location to the database would consume excessive storage and increase costs unnecessarily. To address this, we use a temporary cache to store fetched location data. Users can edit, add, or delete locations in the cache during the planning phase. Only the finalized plan, once submitted by the user, is stored in the database. This approach minimizes storage usage, reduces database overhead, and ensures only relevant data is saved. The cache is also periodically cleared to free up memory.

5.3 Suggestions for further development

Suggestion	Details
Authentication	Enhance the sign-in and sign-up processes by integrating Gmail validation, moving beyond the basic username and password approach. This feature ensures a more secure and reliable authentication process for users. Additionally, incorporate third-party authentication options, such as Google, Facebook, and other social media platforms, to simplify the login process and improve user convenience and make account management more accessible and efficient.
Place Pool Expansion	Efficient Filtering Algorithms: Use advanced filtering techniques to optimize the matching process and make the most of the existing pool before resorting to real-time fetching. Along with dynamic data fetching, implement a fallback mechanism to fetch additional data in real-time when the pool does not meet user requirements. This ensures that users always receive relevant suggestions.
Details and more options	Enhance the detailed view of each place by providing cost estimates and more specific filters. For example, food-related locations can include details such as whether they are halal, vegan, or vegetarian-friendly. These additions offer users more clarity and enable them to customize their preferences more effectively.
Recommendation Plan from others	Introduce an interactive interface for users to engage with trip plans recommended by others. Before publishing their plans, users can add comments, share experiences, and provide feedback on the plans they followed, fostering collaboration and building a more engaging community within the application.
Frontend & Backend Code quality	Apply other higher-efficiency techniques to build the large-scale recommendation system both frontend and backend.

Table 5.1: List of Suggestions for further development