International Journal on Advanced Science Engineering Information Technology

Vol.14 (2024) No. 6
ISSN: 2088-5334

Enhancing Travel Planning Efficiency with a Comprehensive TripEase GenAI Mechanism

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***Abstract*—This paper highlights the trip-easiness generative AI mechanism to simplify domestic and international travel planning through a comprehensive services range based on the users' locations, including itinerary management and car rental. This research focuses on building TripEase GenAI Mechanism with generative artificial intelligence (AI) for a fully-fledged AI-based trip planner web application. This mechanism would function independently in addition to the alternative of seamless integration with another platform, a car rental and travel planning system. This would enhance the overall user experience. Within our TripEase GenAI mechanism, users can effortlessly create personalized recommended itineraries after providing their essential trip details. This mechanism will generate a complete itinerary. The suggested itinerary would accompany a tailored packing list specific to the destination. We are leveraging cutting-edge tools such as LangChain, Semantic Kernel, and ChatGPT to achieve this objective. Our main aim is to revolutionize the travel planning experience by harnessing the power of AI technology. This research is envisioned to provide travelers with a seamless and personalized journey that caters to their individual preferences and needs. This paper outlines the design, evolution, and planning of the TripEase GenAI mechanism. We have laid a strong foundation for a user-friendly travel planning platform through meticulous documentation, thoughtful design, and iterative development. The ultimate goal is to enhance the overall travel planning experience by efficiently enriching imported services such as itinerary management and car rental modules.**

***Keywords*—Generative artificial intelligence; travel planning; personalized journey; efficiency enhancement.**

Manuscript received 15 Jan. 2024; revised 23 Jul. 2024; accepted 30 Sep. 2024. Date of publication 31 Dec. 2024.

I. INTRODUCTION

In the aftermath of the COVID-19 pandemic, wherein people experienced months of quarantine, the resurgence of the desire to travel has become palpable. However, orchestrating an unforgettable trip remains a formidable challenge. While several tools exist to assist in travel planning, specific applications necessitate extensive user input, rendering the process laborious. Conversely, some AI-based tools simplify itinerary planning but often yield imprecise or insufficiently constructive results.

In response to these challenges, the proposed research, TripEase GenAI, seeks to augment the efficacy of TripEase, a travel planning application, by incorporating a robust generative AI backend system. Users can create manual itineraries with AI suggestions and complete AI-generated plans, offering a flexible and versatile experience. The innovation lies in leveraging the capabilities of ChatGPT, wherein users can effortlessly create itineraries by inputting information and preferences, with the AI system subsequently generating a comprehensive itinerary.

This research utilizes development tools such as Visual Code Studio and AI tools, including ChatGPT, Semantic Kernel, and Langchain. The resultant system represents a significant advancement in travel planning, addressing the limitations of existing applications. The accompanying report encompasses a comparative analysis of select applications and provides detailed insights into TripEase GenAI. Future enhancements will improve user interaction and expand the system's capabilities.

The research mainly explores different obstacles and problems in trip planning that exist in the present day. First, we will probe into generative AI's workflow used in an online system to organize travel details and cater to individual requirements. The aim is to learn and appreciate the technologies employed in the present cognitive functioning. In addition, the manual generation of travel itineraries

sometimes takes time and may lack efficiency. The problem that we are going to solve is the deficiency of the current engagement in the planning trip online, which in general, does not work properly and produces either unclear or incomplete recommendations. However, the absence of this feature can significantly slow and dispel the ease with which trip planning can be done.

The primary objective of this research is to construct an automated itinerary creation feature that seamlessly integrates with TripEase, the trip planner. Our idea is to build an AI-assisted console based on the model we have described to improve user experience while planning a trip with AI power. These goals are, in turn, associated with the system's objective of organizing a user-friendly, clean-looking, and straightforward interface that makes the trip planning process less complicated, resulting in users' lives with more ease and efficiency.

II. Materials and Method

A. Generative AI

Artificial Intelligence (AI) has seen remarkable advancements in recent years, particularly in generative models. ML models typically stay with the discovered connections and forecasts for the existing data. Generative AI technologies, on the flip side, allow the machine to produce original content, such as text, which is based on patterns learned from existing data [1]. The generative AI family is enriched by the powerful large language models (LLMs) which have attracted the attention of the AI community for their ability to produce relevant and coherent texts.

Natural Language Processing is undeniably one of the most famous models of Natural Language Processing, GPT (Generative Pre-trained Transformer), created by OpenAI. Through various editions of the GPT series, the performance of GPT has evolved and progressed to higher capabilities with each iteration. At the core of its operation, this system aspires to understand different languages and discern the nuances of human languages to provide users with the appropriate responses practically and accurately. GPT-3, among other offspring propelled by advancement in their algorithms, has been revealed to have unparalleled potential in generating natural language and comprehension. [2], [3] This study proposes a system based on the ChatGPT 3.5 model with the ChatGPT as the core of our system. Besides that, GPT-3.5 is an update of the GPT-3 model; it was created to enhance conversation quality and lower possible dangerous outcomes [4].

Generative AI is not just potent in text conversations; it extends across various domains. Take visual art, for instance, where Generative Adversarial Networks (GANs) have empowered the creation of lifelike images from scratch, revolutionizing realism in art [5], [6], [7]. Similarly, in music composition, Recurrent Neural Networks (RNNs) and other generative algorithms facilitate the generation of novel melodies and harmonies by extrapolating from existing musical compositions [8], [9], [10].

B. Large Language Models (LLMs)

Large Language Models (LLMs) are artificial neural network models that excel at natural language processing tasks. In recent years, numerous studies [11], [12], [13], [14] have been conducted to investigate and evaluate their capabilities. These models, trained on vast amounts of text data, learn to generate human-like text by predicting the next word or sequence of words in a sentence. One of the most prominent examples of LLMs is OpenAI's GPT (Generative Pre-trained Transformer) series, including GPT-3. These models have demonstrated impressive capabilities in various applications, including language translation, text completion, and creative writing [15].

Consequently, during the trip-planning phase, it can provide human-like textual responses to queries or prompts from users to support tasks such as preparing an itinerary and destination recommendations with travel tips [16]. According to research by Wong et al [17], the integration of ChatGPT greatly improved tourists' decision-making at every step of their trip, which included phases such as exploring for information. Table 1 lists the factorials of different LLMs, like the model size, the training data, and performance metrics (parameters) column-wise for comparison (parameters) in each row (factors) [18].

TABLE I
COMPARISON OF LARGE LANGUAGE MODELS

Model	Features and Parameters		
	Size	**Training Data**	**Performance Metrics**
GPT-3	175 billion	Diverse text sources	BLEU score: 45.76
BERT	340 million	Books, Wikipedia	F1 score: 91.0
XLNet	157 million	Books, Wikipedia	Perplexity: 17.7

C. Semantic Kernel and LangChain

In addition to LLMs, AI research has explored techniques for enhancing semantic understanding and contextual coherence in generative models. Two such approaches are the Semantic Kernel and LangChain. The method of Semantic Kernel is that semantic analysis techniques can enrich the generated text with contextual consistency and coherence. The semantic information of travel destinations, activities, and user preferences forms the basis for Semantic Kernel's capacity to create more helpful and well-detailed trip plans.

Meanwhile, LangChain is a framework that aims to enhance the linguistic coherence and structure of the generated text by modeling language as a chain of interconnected concepts and ideas. To ensure optimal responsiveness from the AI model, alignment between the personality and instruction style of the model and the prompt template is essential. Crafting a precise, prompt template with pertinent input and appropriate boilerplate language can effectively address this requirement within the Langchain framework [19]. LangChain's utility extends across various domains, mirroring the broad applications of language models in general. These encompass tasks such as automating customer service [20], Chat to Data Visualization applications [21], and leveraging LangChain for PDF summarization, which allows for efficient extraction and condensation of key information from extensive documents. [22] In the context of trip planning, LangChain can help ensure that generated itineraries and recommendations are logically organized and coherent, enhancing the user experience.

III. Results and Discussion

A. System Overview

Fig. 1 illustrates the intricate interaction model of the TripEase GenAI web application, elucidating the seamless synergy between users, devices, internal databases, and external APIs, such as the TripEase Service API and ChatGPT API, which collectively facilitate efficient trip planning experiences. Users engage with the system via diverse devices, ranging from computers to smartphones, to access the comprehensive suite of services offered by TripEase GenAI. Vital data is meticulously stored within the TripEase GenAI Main Database, meticulously powered by PostgreSQL, ensuring robust data management and retrieval capabilities. Leveraging the ChatGPT API, the system seamlessly integrates ChatGPT's natural language processing capabilities to facilitate the generation of comprehensive itineraries. Users can luxuriate in the collaborative trip planning features and explore ancillary services such as car rental that are seamlessly accessible via the TripEase platform.

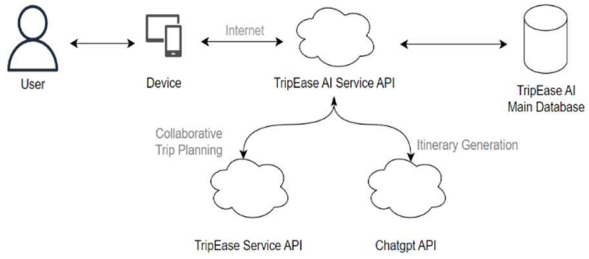

Fig. 1 System Overview Diagram

This system was created with the help of the Nuxt.js framework for the frontend which has been enriched with powerful tools for client-side rendering. On the backend, we use the NestJS framework, which has received acclaim for its scalability and modularity to build the API and manage back-end operations. MySQL is still used for executing database operations that allow for effective data storage and management to support all the application's functionalities. Moreover, user studies will be conducted in the future to assess user perceptions of the TripEase GenAI platform's ease of use, intuitiveness, and overall satisfaction.

B. Generation of Trip Easiness Recommendations

Fig. 2 shows the use case diagram of the TripEase GenAI system, where the sole actor is the user. The system encompasses 12 use cases, broadly categorized into three groups: profile management, itinerary management, and packing list management. Under the profile management category, users are given alternative tasks, such as logging in, seeing and viewing their profiles, reviewing saved itineraries and intervals, and deleting them if they wish.

Itinerary Management comprises several functions to arrange and fashion our travel programs to our tastes. They can also be the engines of new itinerary creation by providing justified and specified travel details. They carefully view the details of the whole itinerary and its qualities. They can also be exported to the TripEase application for further usability. For example, destination details can be easily accessed by clicking on destination names while they travel. Itinerary adjustments according to the traveler's preferences and changing wishes will also be made.

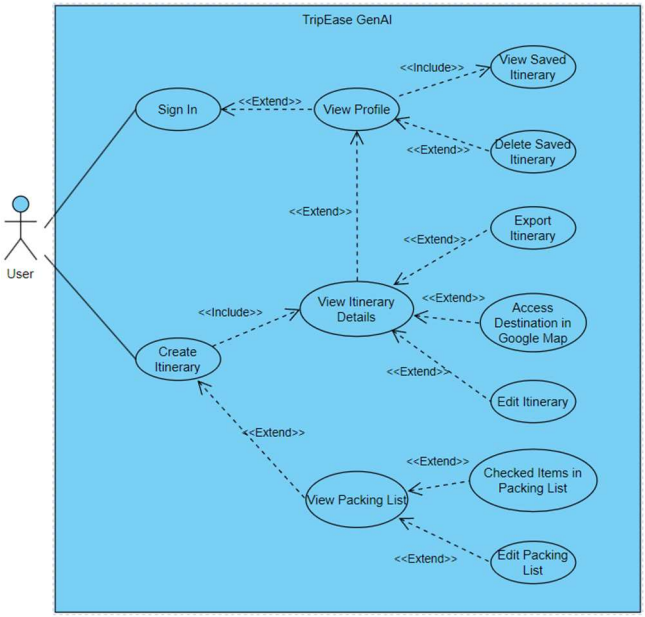

Fig. 2 Use Case Diagram of TripEase GenAI

Fig. 3 represents the view saved itinerary activity diagram. To view a saved itinerary of the user account, the user must sign in with their Google account and check their profile by clicking the user avatar. The system will then display the itineraries saved in the database, the user can then select the desired itinerary, prompting the system to retrieve and display the itinerary details.

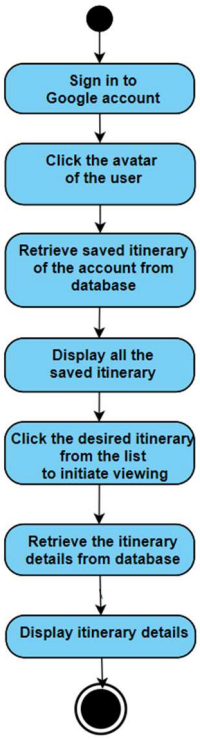

Fig. 3 View Saved Itinerary Activity Diagram

In Fig. 4, the process begins when the user views the itinerary details. Subsequently, the user can click on the destination name, which is hyperlinked. The Google Maps

link is extracted upon clicking, and a new tab is opened. The Google Map is then loaded with the destination information. Eventually, the planning phase will also be made easier with a packing list management feature, enabling users to arrange prospective travel essentials properly and neatly. This feature allows the user to quickly scan packing lists, check items, mark them out individually, and edit them so that travel plan changes or preferences occur.

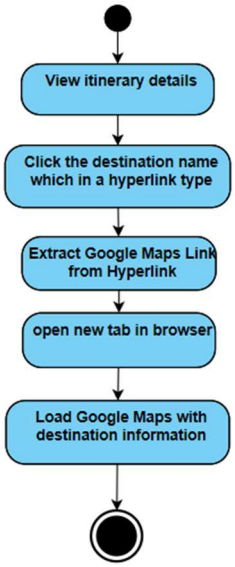

Fig. 4 Access Destination in Google Map Activity Diagram

Fig. 5 illustrates the create itinerary activity diagram. The process begins when the user clicks the "Start Planning" button, prompting the system to redirect the user to the Create Itinerary page.

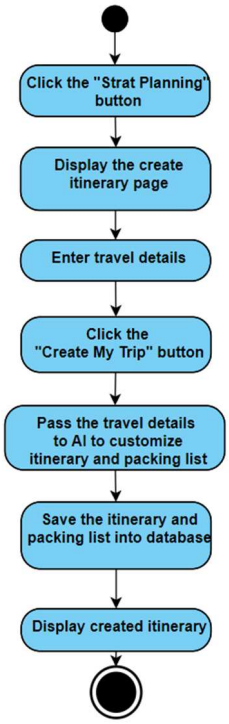

Fig. 5 Create Itinerary Activity Diagram

After the user enters the travel details and clicks the "Create My Trip" button, the details are passed to the AI to initiate the itinerary generation process. Subsequently, the system saves the itinerary and packing list into the database and displays them to the users. Fig. 6 depicts the export itinerary activity diagram. Users have two methods to export the itinerary to the TripEase application. Firstly, they can navigate to the saved itinerary on the profile page and click the three dots next to the target itinerary to reveal the export option. Alternatively, when viewing the itinerary details, an "Export" button is available at the top left corner of the table. Upon selecting the export option, the system generates the itinerary's JSON file and downloads it to the user's device. A confirmation message is displayed upon successful completion of the download.

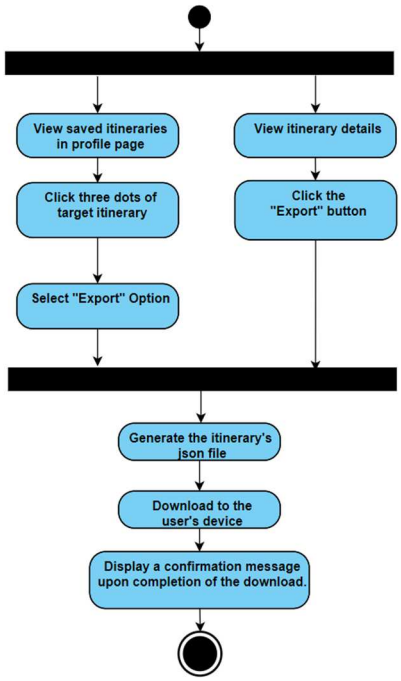

Fig. 6 Export Itinerary Activity Diagram

Fig. 7 illustrates the activity diagram for checking items in the packing list. Within the itinerary packing list view page, users have the option to click the checkbox next to each item. Upon selection, the system will mark the item with a tick and strike through it, updating the packing list in the database accordingly.

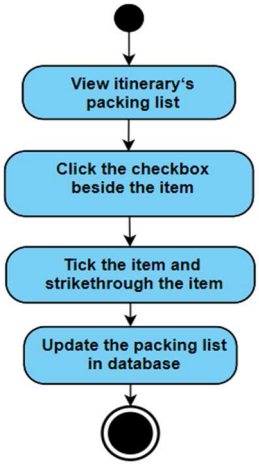

Fig. 7 Checked Items in Packing List Activity Diagram

In Fig. 8, the process commences when the user views the itinerary details and clicks the edit button. Subsequently, the system transitions to edit mode and displays the edit buttons. Within this mode, users can perform three types of edit functions. Firstly, they can click and hold the table rows to reorder itinerary destinations. Secondly, by clicking the delete icon, the system prompts for confirmation before deleting the destination upon user confirmation. Lastly, users can double-click the destination's time to modify it according to their plans.

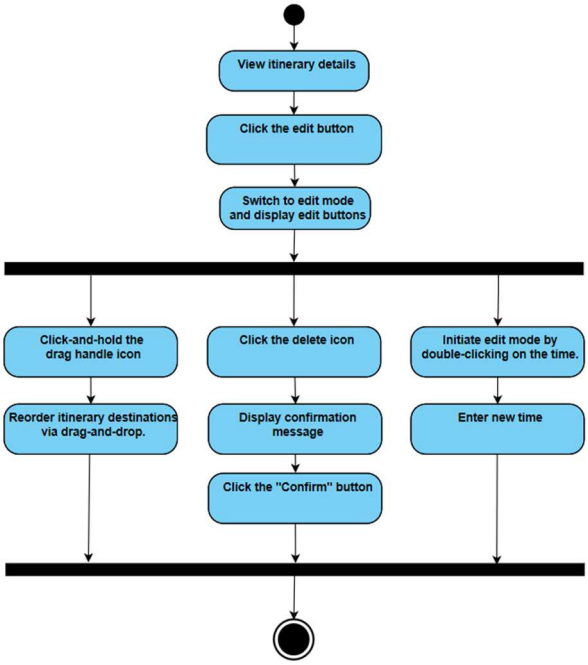

Fig. 8 Edit Itinerary Activity Diagram

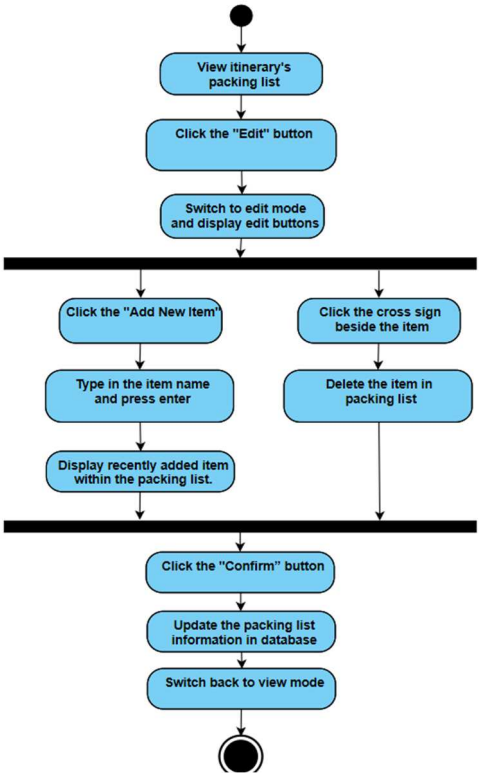

Fig. 9 Edit specific packing list for an itinerary Activity Diagram

As shown in Fig. 9, upon accessing the packing list page, the users can click the edit button, transitioning the view to edit mode. Within this mode, users can perform two edit functions. Firstly, they can click the "Add New Item" button to add a new item to the packing list by entering its name. Conversely, users can click the cross sign next to an item to delete it from the packing list. Once the user has finished editing the packing list, they can click the "Confirm" button. Subsequently, the system will update the packing list information in the database and switch the packing list back to view mode.

C. Results

Fig. 10 depicts the logo of TripEase GenAI, which incorporates the TripEase application logo with the term "AI" appended to it. This design conveys the association between the two applications and ensures a seamless user experience when transitioning between them. The logo combines dark cyan and vibrant yellow colors, creating a visually appealing and aesthetically clean design.

Fig. 10 TripEase GenAI Logo

Fig. 11 presents the homepage of the TripEase GenAI system. Viewed from a broader perspective, the background features a warm-themed street scene with a robot carrying luggage, evoking a sense of readiness for travel while also conveying a futuristic ambiance. Upon closer inspection, the "TripEase AI" logo is positioned in the upper left corner, while a sign-in button is located in the upper right corner. Positioned centrally on the page is a "Start Planning" button placed directly below the welcome text. Clicking this button initiates the journey of planning an adventurous trip.

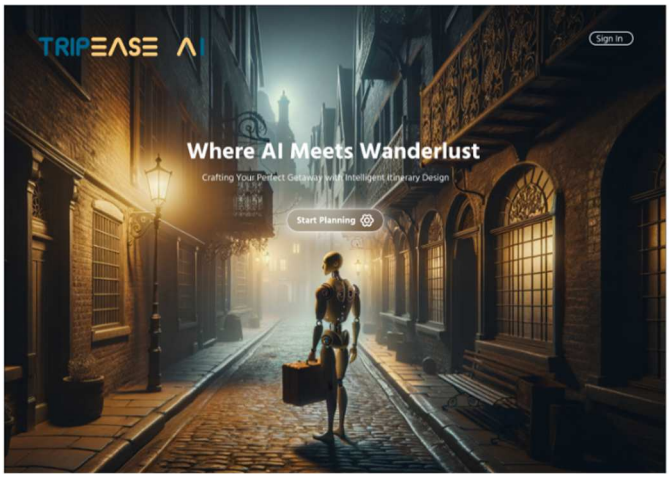

Fig. 11 Home Page of TripEase GenAI System

As depicted in Fig. 12, our sign-in page features a sleek design with a semi-transparent card overlaying the screen, presenting the sign-in option "Continue with Google." This design, characterized by the semi-transparent card, aligns with current trends in technology-focused design aesthetics

while maintaining coherence with the overarching futuristic design theme.

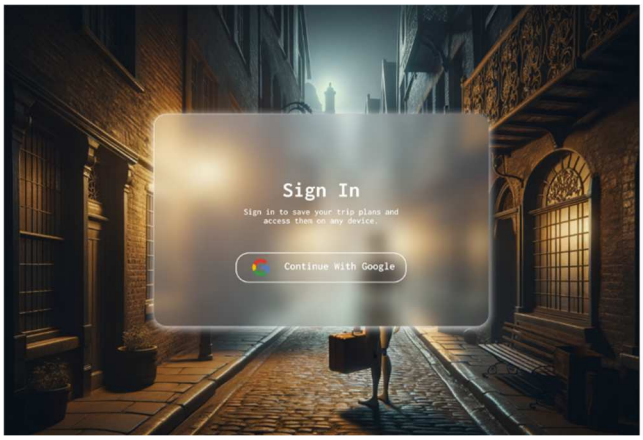

Fig. 12 Sign-in Page of TripEase GenAI System

Fig. 13 displays our system's profile page. Upon signing in with their Google account, users can access their profile by clicking the avatar in the upper left corner. Users can review the itineraries they have created within the profile, and they are automatically saved. This can be done by clicking on each rounded corner frame, which displays the destination name at the center and provides additional travel details such as travel date and the number of people for the trip at the bottom center. Users can add a new itinerary directly from this page by clicking on the frame with the plus sign.

Fig. 13 Profile Page of TripEase GenAI System

As depicted in Fig. 14, users can input their travel details, including destination, trip date, duration of travel, and trip intensity, to customize their itinerary according to their preferences. Upon entering all the necessary details, users can generate a travel itinerary by simply clicking the "Create My Trip" button.

Upon completion of itinerary generation, the itinerary details will be presented in a table format as shown in Fig. 15, as per the preference indicated in the survey form, where most respondents found it to be the most intuitive layout. At the top of the page, the destination name and travel date are prominently displayed. Within the table, there are three columns: "Day," "Time," and "Activities." Each destination title serves as a hyperlink, allowing users to access detailed information on the destination via Google Maps. At the top edge of the table are three buttons: an export button for exporting the itinerary to the TripEase Application, a smart packing list button for displaying the packing list related to the itinerary, and an edit button for making modifications to the itinerary.

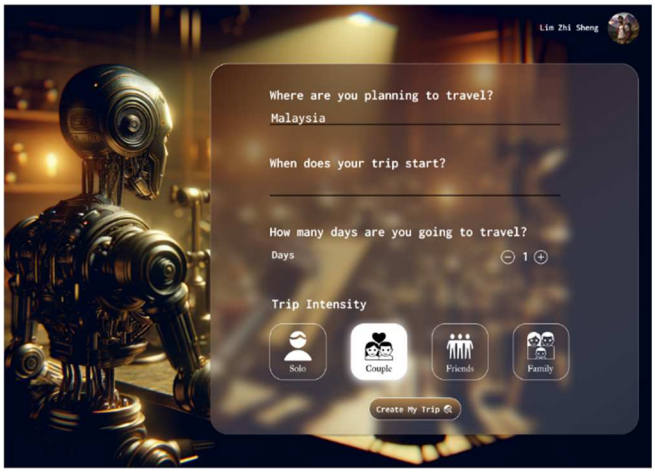

Fig. 14 Travel Details Page of TripEase GenAI System

Fig. 15 Itinerary Details Page of TripEase GenAI System

As illustrated in Fig. 16, adjacent to each destination title resides a light bulb icon. Upon clicking this icon, users can access destination-specific suggested packing items. If they wish to add the suggested item, users can modify their smart packing list by clicking the plus symbol.

Fig. 16 Destination-Specific Suggested Packing Items Frame

Upon clicking the edit button as depicted in Fig. 16, the system will redirect users to the itinerary details edit mode, as displayed in Fig. 17. In edit mode, users can modify the itinerary by dragging table rows to change the sequence of destinations, adjusting times, or deleting destinations directly by clicking the dustbin icon located at the right of each table row. Users can click the confirm button once the editing process is complete, and the edited itinerary will be saved.

Fig. 17 Itinerary Details Page (Edit)

Fig. 18 showcases another pivotal feature of the TripEase GenAI: the smart packing list. As the AI generates the itinerary, it concurrently generates a packing list containing essential items for travel. Users can access this page by clicking the "Smart Packing List" button on the Itinerary Details Page (Fig. 16) and return to the itinerary by clicking the "Itinerary" button. Within the packing list, users can check off items to denote that they have been packed and edit the list by clicking the edit button at the upper right corner.

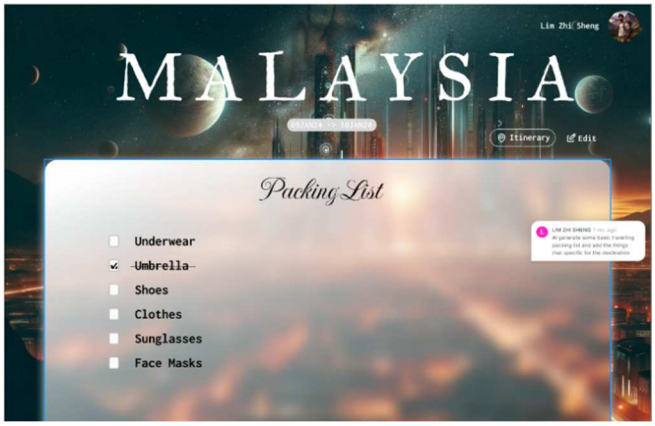

Fig. 18 Smart Packing List Page (View)

Fig. 19 displays the smart packing list's edit mode. Users can remove items by clicking the cross icon or add a new item by clicking the "Add New Item" button. After modifying the packing list, users can click the "Confirm" button to save the updated list.

Fig. 19 Smart Packing List Page (Edit)

Incorporation of TripEase GenAI with different travel booking system platforms is a process that needs to solve multifaceted compatibility problems. This includes the combination of the different formats, the ways of exchanging information, and the means of identity confirmation among different systems. At the same time, it is crucial to carry out strict performance measurements to maintain high outcomes of service provision. The focus on response time, throughput, and error rate would ensure that scalability issues are solved before they affect the user's experience during high-traffic conditions. Also, strong firewall measures are crucial to protect the new concept of TripEase GenAI from cyber threats. Overarching security measures, recurring checks, and quick response measures enhance security and safeguard valuable user data, as well as the functionality of the system.

In the future, our vision is to expand our system's capabilities to include accommodation and various transportation booking services. We aim to streamline all aspects of trip planning so that users can seamlessly book hotels and flight tickets directly within our platform. Additionally, we plan to integrate a map feature, leveraging AI with map APIs to optimize the order of destinations and minimize unnecessary backtracking between places. By visualizing the itinerary on a map, users can intuitively understand the path and gain clarity about their travel plans. With the rapid advancement of technology, the trend toward one-stop system services is becoming increasingly prevalent. Our ultimate goal is to leverage the convenience of technology to save people time, energy, and money in trip planning, offering a comprehensive solution that enhances the overall travel experience.

IV. Conclusion

In conclusion, TripEase GenAI development reflects great advances in the trip planning process, making it easy and more successful. By adopting cutting-edge generative AI technology, including ChatGPT and others such as Semantic Kernel and LangChain on the platform, users are able to have a smooth tour planning and packing list generation experience. The primary purpose of this service is to make the process easier by providing a professional interface and high-end features to simplify this process.

In the future, the system will have a wider scope, going beyond the routine of accomplishing booking services for accommodation and transportation booking to integrating mapping features for visualizing the routes. This involves the initiatives to measure the goodness of results generated from artificial intelligence [23], [24], Weather Application Programming Interface (API) [25], [26], [27], [28], and location detection [29], [30], [31], [32]. This total approach to trip planning provides a clear picture of TripEase GenAI's desire to produce a unified solution that saves time and energy and has the power to make the traveling experience good. We aspire for TripEase GenAI to be the platform that will be the instant choice for a traveler looking for amenity, expediency, and individual-tailored travel planning.

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