Intelligent Travel Companion: AI-Optimized Route and Trip Advisory Tool

Harvard APCOM215

**Jiho Kil (jihokil@g.harvard.edu), Brian Sutioso (brian_sutioso@g.harvard.edu),
Yuan Tang (yuantang@g.harvard.edu), Wenyu Yang (wenyu_yang@brown.edu)**

Background and Motivation:

Large Language Models (LLMs) are transforming user experiences across various industries, including tourism. Established platforms like Expedia and TripAdvisor have integrated LLMs for trip planning and product recommendations. Additionally, applications that suggest tourist sites and create itineraries based on time and location exist, such as utilizing Google Maps for guidance.

Despite these advancements, there is still room for improvement. Many applications often require users to manually drag each site into their plan, which can be time-consuming and inefficient. There is also a desire for a more comprehensive service available to users with different objectives. For example, when Yuan traveled to Europe last summer, he needed to apply for a visa, which required a detailed trip plan. Wenyu, on the other hand, has abstract preferences—she wants to visit places with oceans of flowers—but doesn't have the time to browse the internet for details. Jiho found a picture online but has no idea where it was taken, yet wants to embark on an immediate trip. Brian wanted to plan a romantic trip for his girlfriend on their anniversary, having a date and location in mind. Our project aims to fulfill all these wishes in one platform.

Pre-trained LLMs can comprehend user requirements, such as travel dates, duration, and preferences, and possess extensive knowledge of popular sites. However, they often lack spatial awareness, which can result in inefficient itineraries with unnecessary backtracking, and they do not have the capability to interpret visual inputs. Our project seeks to integrate LLMs with various input sources and the Google Maps API to enhance the reliability of LLMs in generating efficient trip plans with professional travel advice that truly understand and cater to user needs. This aligns with our interest in making travel planning both efficient and enjoyable.

Scope and Objectives:

Our project aims to develop a pipeline that integrates users' visual, textual, and audio inputs, structures them into appropriate prompts, and processes them through a LLM. We will extract information from the LLM in a format compatible with the Google Maps API to generate optimized routes. This information will then be used to re-prompt the LLM to produce the final output. The end result is a travel plan with professional advice presented in consistently structured natural language, supplemented with a map-aided visual guide. We expect our project deployment could handle multiple users querying the chatbot simultaneously.

To achieve this goal, we will employ techniques such as vision transformers for processing visual inputs, prompt engineering for effective communication with the LLM, fine-tuning the LLM for our specific use case, and Retrieval-Augmented Generation (RAG) to enhance the model's responses with relevant data.

The challenges we anticipate include integrating multimodal inputs, ensuring effective communication between the LLM and external APIs like Google Maps, and the complexities involved in deploying such a system in GCP.

Learning Emphasis:

The project aims to deploy a LLM capable of processing multimodal inputs, including both image and text. The image input will be handled by a Vision Transformer, which will then communicate the results to the LLM. The LLM's responses will be enhanced by tourism-specific knowledge obtained through fine-tuning and user reviews, using RAG techniques, aligning with the course learning objectives.

Source of Data & Description of Dataset

Travel Conversations: https://huggingface.co/datasets/soniawmeyer/travel-conversations-finetuning

- The dataset contains **1.5 million question-answer dialogs** related to travel topics. Each dialog contains multiple question-answer pairs structured in a list. The data is stored in CSV format.

Location Reviews API: https://serpapi.com/google-maps-reviews-api

- The API provides data from Google Map reviews. Given a place ID, the API returns a JSON structure that includes place information, address, ratings, original reviews, translated reviews, review URLs, and more.

Google Map API: https://mapsplatform.google.com/

- The API is used to visualize geospatial data. It presents data in map form, illustrating locations and routes.

Key Attributes:

GeoPy:

- By giving the location name, the api could return its latitude and longitude.

Google Map API:

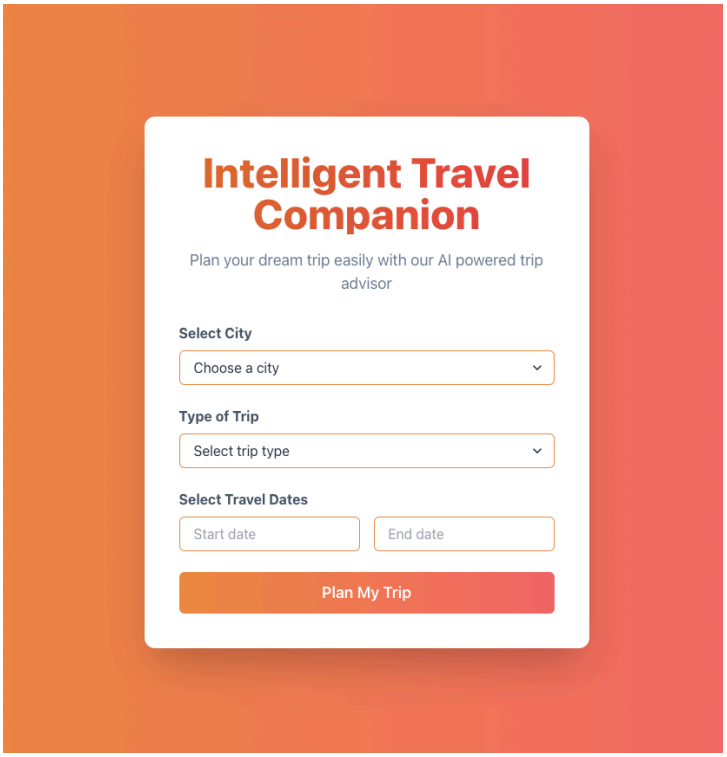
- For the result display, we will visualize the trip route using this API.

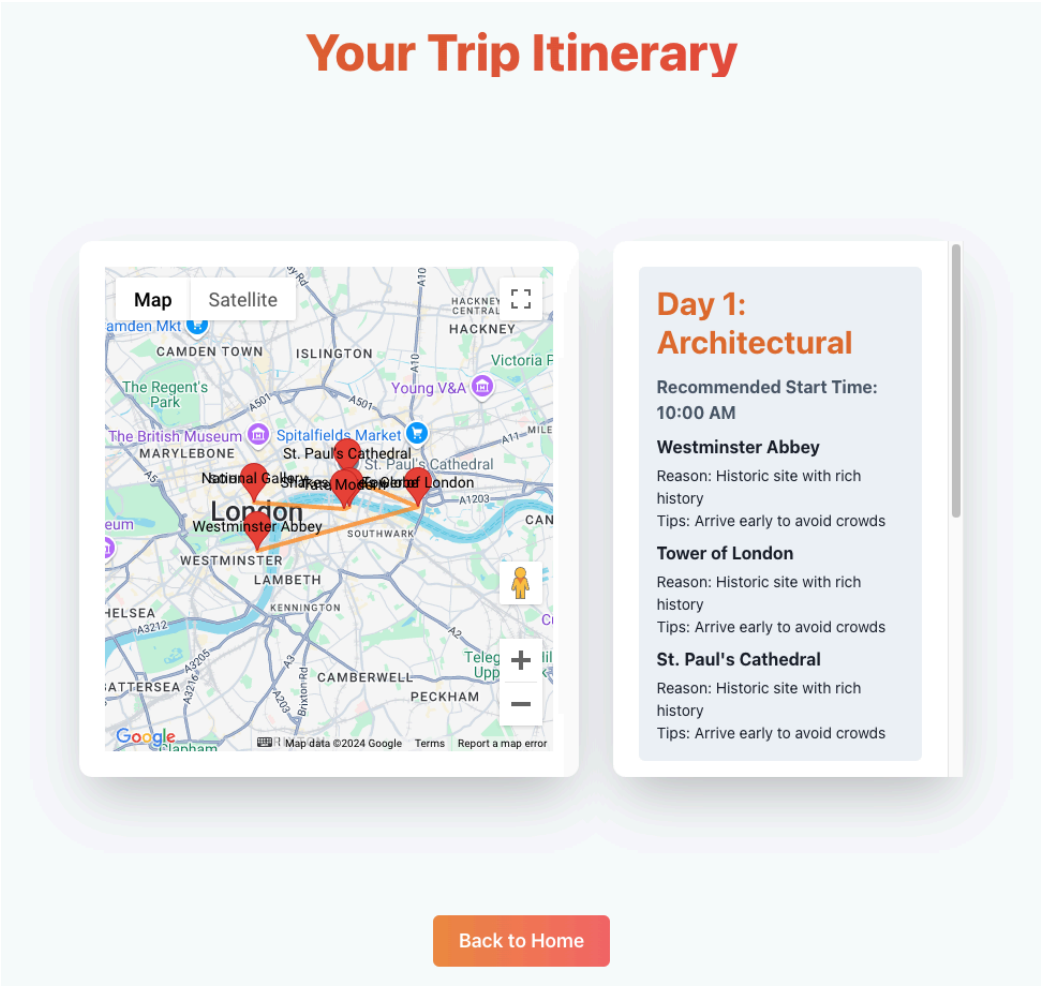
Limitations and Risks:

Scalability is a concern as increasing user requests can lead to processing overload and slower model predictions. In our project, Google Maps is tightly integrated with the Google Cloud Platform due to Google's native support structure. Therefore, we expect to utilize its ecosystem together with Kubernetes-based horizontal scaling solutions to handle peak request volumes effectively.

We will adopt a microservices architecture that will handle distinct functions such as interacting with external APIs, processing text queries, and managing user data. This would allow the application to scale specific services based on demand. For example, the microservice responsible for route optimization could experience higher usage and would need to scale without impacting other services like trip history storage.

Application Mock Design:





Milestones & Tentative Deadlines:

- Data collection and preprocessing: [Sept. 27]
- Backend implementation: [Oct. 18]
- Frontend development: [Oct. 25]
- LLM integration: [Nov. 8]
- Final testing and deployment: [Nov. 22]

References:

- Caleb. "Build an Automated Travel Planner with Next.js and OpenAI API: Unleash the Power of AI." *Medium*, Aug 4, 2023, https://medium.com/javascript-in-plain-english/build-an-automated-travel-planner-with-next-js-and-openai-api-unleash-the-power-of-ai-84ca1982f432. Accessed Sept. 20, 2024.
- "Google AI Summer Travel Planning." *Google Blog*, Google, Jun 12, 2024, https://blog.google/products/maps/google-ai-summer-travel-planning/. Accessed Sept. 20, 2024.
- "Routes Overview." Google Maps Platform Documentation, Google, https://developers.google.com/maps/documentation/routes. Accessed Sept. 20, 2024.
- "AI Route Optimization." *NextBillion.ai Blog*, NextBillion.ai, https://nextbillion.ai/blog/ai-route-optimization. Accessed Sept. 20, 2024.

- Sudarma, Suyadnya, and Prayuda, 2016, Geographic Information System Route Travel Planning using Google Maps API. Journal of Industrial Engineering and Applications, IISTE. https://www.iiste.org/Journals/index.php/JIEA/article/view/31267. Accessed Sept. 20, 2024.