浙江工业大学

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Undergraduate International Students' Graduation Project Report (Thesis)

开题报告
Opening Report

Design and Implementation of an AI-Assisted Travel Planning App

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1 Introduction

In the realm of travel planning, the journey from conception to execution involves a very complex process of decisions and considerations. Historically, this process was usually done by travel agencies or self-held guidebooks, both of them are either not very affordable for economic travelers or lack of comprehensive information. However, with the development of internet and smart phones, the digital revolution led us enter the era of online platforms and mobile applications, transforming travel planning into a more accessible and customizable experience for individuals. While the digital tools bring convenience to travelers, the data explosion makes it to harder to make decisions. We often struggle to find a suitable trip for our own personal preferences in an ocean of travel recommendations efficiently. This is where the potential of artificial intelligence comes in. The recent heat of ChatGPT and other large language models (LLM) both in academia and industry demonstrated many novel solutions in many fields, including travel and tourism industry. The LLMs performs outstanding abilities in natural language process, sentiment analysis and recommendation. By utilizing LLMs, it is a great possibility to optimize the travel planning process by offering dynamic and personalized travel experiences efficiently.

This thesis proposes the development of an AI-Assisted Travel Planning App - iJourney, designed specifically for iOS platforms. By integrating OpenAI's cutting-edge AI technologies ChatGPT, with Apple's development frameworks including SwiftUI and MapKit as well as the state-of-the-art programming language Swift, the project aims to explore a deep understanding of MVVM (Model-View-ViewModel) architecture pattern, and pioneer a semi-automated approach to individual travel planning. This application will provide individual travelers a convenient way to plan their travels with great personalization and efficiency previously unattainable with conventional digital tools. Through this project, we explore the collaboration between AI capabilities and mobile technology in creating a travel planning experience that is both intuitive and innovative.

1.1 Background

The advent of digital technology has revolutionized the way we travel for the past two decades, making it possible to explore the world with just a few clicks. However, despite the plenty of resources available, the complexity of planning an international trip remains an intimidating task for many.

Ever since the appearance of ChatGPT and all the other large language models (LLM), solving complex language-related problems has seen a new way. Many fields including education, software engineering and medical care have already started to implement LLMs into the real-world applications.

This project is motivated by both the recognition of the need for a more intuitive and efficient way to plan travel and the promising potential of LLMs' problem-solving capabilities, by using LLMs to simplify the process of organizing trip itineraries.

1.2 Related Works

Plenty of research works have been done by the academia ever since ChatGPT came out [1]. Many of them have reviewed the potential power of LLM and also the limitations and many of them also explored the applications of LLM and may have a huge impact on the industry [2].

When it comes to travel industry, the exploration of AI within the travel industry has historically revolved around traditional algorithms designed for specific tasks such as flight price optimization, hotel recommendation, and customer service automation, which shows the need of problem-solving methods in the industry. There are also a few research has been done regarding ChatGPT and travel but those are more experimental.

Thus, there's an obvious gap in the academia when it comes to LLM applications in the travel industry. Although many of them talked about the impact of LLM, little of them have real benefit for the industry.

1.2.1 ChatGPT and Its Application

Ever since the introduction of ChatGPT [1] and other recent LLMs, researchers have been looking for their potential applications in main domains. The potential applications of ChatGPT and Large Language Models (LLMs) are vast and varied, reflecting their evolving capabilities across different fields.

According to Naveed et al. [3], LLMs like ChatGPT serve as foundational technologies in natural language processing, offering unprecedented opportunities in language translation, content creation, and automated customer service. Kaddour et al. [4] highlight the role of LLMs in enhancing machine learning tasks, including predictive

text generation and sentiment analysis, which is required by this project's aim. Chen et al. [5] delve into the niche of prompt engineering, demonstrating how fine-tuning LLMs can unlock specialized applications in domains requiring nuanced understanding, such as legal advice or medical diagnosis. Fine-tuned LLMs can be a consideration in this project, but both the deployment of self-trained and fine-tuned open-source LLMs and fine-tuned GPT models provided by OpenAI would be overbudget, so we will mainly focus on stock GPT products which still has phenomenal performance. Wu et al. [6] underscore ChatGPT's significance in educational settings, suggesting its use as a tutoring aid, a tool for personalized learning, and a facilitator for research and writing. Nazir and Wang [7] and Gallardo Paredes et al. [8] extend the application scope to specialized fields like dentistry and software development, respectively, showcasing how ChatGPT can offer tailored information retrieval and integration solutions. These capabilities of LLMs could help with travelers to build their own trip plans based on their own personalities. Furthermore, Bahrini et al. [9] and Chowdhury and Haque [10] discuss the broader societal and economic benefits, including enhancing accessibility to information. Lastly, Fui-Hoon Nah et al. [11] envision a future where AI-human collaboration, facilitated by tools like ChatGPT, revolutionizes creative industries, research, and even daily personal interactions.

In terms of how we can use the LLMs from an end-user and application perspective, there are many works done regarding prompt engineering, which is a field of study that becomes popular after the explosion usage of ChatGPT. Even though some research showed that the training process of a language model would have more impact on result generating than well-designed prompts [12][13][14], using structured prompts can also create fine results. Arora et al. [15] developed a prompting method called AMA to improve the output result of LLMs and emphasize the importance of structured prompts for better results. Lu et al. [16] also introduced a new way that managed to improve the results of few-shot prompts. They have shown that well-designed prompts can substantially improve the result accuracy, so in this project, we would design structured prompts to achieve better results.

1.2.2 ChatGPT and Travel Industry

In the travel industry, the implementation of ChatGPT is poised to redefine customer service and travel planning. Gursoy et al. [17] provide an overview of current trends and future research directions, indicating how ChatGPT can transform hospitality and tourism through improved decision-making and customized service

delivery. The potential of ChatGPT in enhancing information search and decision-making processes for travelers further underscores its significance in the travel industry [18]. Additionally, Demir & Sen Demir [19] suggest that ChatGPT can significantly impact service individualization and value co-creation in travel, highlighting its role in transforming industry practices for better consumer engagement and satisfaction.

1.2.3   Modern iOS Development

In the mobile application development area, there are a lot of new technology frameworks developed by people all around the world. People tried to build more advanced mobile applications with modern frameworks that usually required less effort for developers while achieving better performance with the current demand of the market. And with the advent of different operating systems and platforms, including iOS, Android, Web etc., developers tend to build their systems on all the platforms to serve the market in diversity, but this also comes with the cost of addtiontial development effort. Then it comes many different cross-platform frameworks that aims to lower the cost of multi-platform development of the same product. Some noteworthy frameworks like React-Native by Meta (formerly Facebook), Flutter by Google and Electron by OpenJS. This usually brings up the question of whether we should choose to develop a product using cross-platform solutions or native platform solutions. The work by Kovács and Johanyák [20] shown that the performance of native iOS application is a big advantage against cross-platform solution which in this case Xamarin. Also, the cross-platform solution often require more setup work to do before development. Even though there're not many research papers regarding this topic, many developer communities have a lot of discussion on this.

1.2.4   MVVM Architecture Pattern

In recent years, the MVVM (Model-View-ViewModel) architecture pattern has gotten more and more attention by the industry for UI application developments. Many web front-end framework and mobile application framework have adopted the MVVM architecture like Vue.js, React and SwiftUI. Ever since, there are several research being done to explore the difference between MVVM and MVC (Model-View-Controller), which is an older architecture pattern but still being used by many industries. The difference between the two is basically how would data interact with the view in the user interface. Different than MVC that using a controller to directly control the view, MVVM separates the business logic (Model) with the view (View) to reduce the

coupling between the two, and it uses a binder to pass the values. Paramadani et al. [21] did a rendering performance comparison between MVVM and MVC architecture mobile applications and found out the MVVM exhibits superior UI rendering performance over MVC. A study done by Wilson et al. [22] also shows that the decoupling of MVVM improves the maintainability and testability of an application as well. Another study done by Magics-Verkman et al. [23] also points out that MVVM has better performance and better testability compared to MVC, while its easier to understand as well.

1.2.5   Current Market

Right now, there's actually not much application when it comes to travel itinerary generation using language models. With the advent of ChatGPT plugins and GPTs [24], many conventional travel all-in-one platforms have created their own GPTs that utilize both their APIs and ChatGPT's conversational interface. While these chatbots are useful if the traveler wants to talk about the itinerary with a bit of reference information, they are not meant to create a structural trip itinerary for the user. Other applications such as iplan.ai [25] has a more similar idea with this project. Their technology stack is unknown since it is a commercial close-source application. They have done a great job on creating itinerary for single city, but this project aims to expand to inter-city itinerary.

2   Project Overview

2.1 Content

This project is to research on ChatGPT and its application in travel industry and develop an AI-assist travel planning app on iOS platform. The project process is shown in Figure 1.
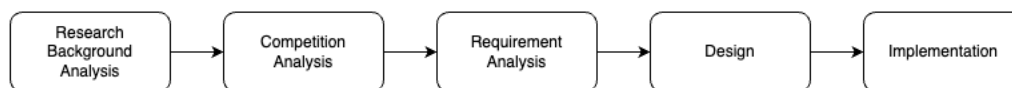
Figure 1 Project Process

The content of the project can be summarized as: (1) Make a comprehensive literature review on existing research regarding ChatGPT and its application; (2) Conduct a competition analysis regarding the existing products on the market; (3) Conduct the requirement analysis to create the requirements for this application; (4)

Design the architecture for the application using MVVM pattern, as well as the user interface, and engineer the prompts for ChatGPT API; (5) Implement the application using Xcode to iOS platform.

2.2 Key Technical Problems

To successfully complete the development of the AI-assist travel planning application, this project mainly faces the following three key technical issues:

1) Designing a clean MVVM architecture using SwiftUI. This is essential to this project since everything else will be built on top of it. We need to make sure to have clear business logic, and design user interface just enough to satisfy the data, so that there will be no additional components.

2) Design a prompt that is robust enough so that the current version ChatGPT (preferably GPT-3.5 Turbo) will return the desire results in JSON format with less error or irrelevant information while also keep a relative short response time. This will be the main source of data of the application.

3) Integrating third-part APIs to incorporate additional point-of-interest data which is separate from the information provided by ChatGPT to ensure the correctness. Third-part APIs usually have limitations and query, which is also what we need to consider of.

2.3 Objectives

The research objectives of this project mainly include the following three points:

1) Design and implement an iOS application that has intuitive interface with robust MVVM architecture using SwiftUI, MapKit and other frameworks.

1) Design a prompt for ChatGPT that can generate personalized trip itinerary according to the requirements in JSON format.

2) Incorporate APIs, both ChatGPT and other information retrieval third-party API into the system to create comprehensive trip itinerary.

3 Technology Stack

The iJourney app will be deployed on the latest iOS platform (as the time of writing is iOS 17). The development environment will be set up on macOS Sonoma 14.4.1 with Xcode 15.3. This is the latest macOS and Xcode version as the time of writing. Using the newest Apple platform makes sure that the latest technologies can be utilized. Backwards compatibility will be a less concern since the iOS upgrade adoption rate is

incredibly high.

The architecture of the application will be a best practice of MVVM pattern using SwiftUI (or clean architecture). The view (user interface) and model (business logic and data) will be separated by View Models which is a binder of the two. This ensures the decoupling of data and view and can improve the maintainability and testability of the application. SwiftUI and Combine are the two fundamental frameworks in this project. MapKit and SwiftData will be used to provide map features and persistent data.

The application will use HTTP requests directly to call ChatGPT's API and get response for the relevant data. This can eliminate the need of a server in this project so that we can focus on the iOS application itself. However, it would be recommended to have a dedicated server as a relay to have more control over the dataflow.

4 Timeline

The timeline of this project is given in Table 1.

Table 1 Project Timeline

	Time Periods	Tasks
1	2023.12.1-2023.12.30	Pre-research on the topic, learning the related technologies
2	2024.1.1-2024.3.1	Complete literature review, opening report, and foreign language paper translation
3	2024.3.2-2024.3.20	Complete requirement analysis
4	2024.3.21-2024.4.20	Design key components
5	2024.4.21-2024.5.20	Develop the application
6	2024.5.21-2024.5.30	Complete thesis writing
7	2024.6.1-2024.6.10	Prepare presentation

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