



浙江工业大学

本科毕业设计说明书（论文）

Undergraduate International Students' Graduation Project Report (Thesis)

文献综述

Literature Review

Design and Implementation of an AI-Assisted Travel

Planning App

学 院： 计算机科学与技术学院、软件学院

专 业： 软件工程（中外合作办学）

班 级： 2020 软件工程（中外合作办学）01

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提交日期： 2024 年 3 月

Design and Implementation of an AI-Assisted Travel Planning App

Abstract: This thesis explores the development of an AI-assisted travel planning application, aimed at revolutionizing the way individuals plan their travels by leveraging the capabilities of large language models (LLMs) like ChatGPT. Against the backdrop of growing demand for personalized travel experiences, the project seeks to bridge the gap between generic travel advice and personal preferences using advanced AI technology. By integrating OpenAI's ChatGPT with Apple's iOS development frameworks, the application offers a semi-automated, highly personalized travel planning service. This thesis navigates through the evolution of travel planning, the technological underpinnings of AI and iOS development, and the potential of AI in enhancing travel planning. This literature review critically analyzes existing literature, identifies gaps in current technologies, and proposes a novel approach to personalized travel planning. The anticipated outcome is an iOS application that significantly improves the efficiency and personalization of travel planning through AI.

Keywords: ChatGPT, Large Language Model, Travel Planning, iOS Development

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.

The main work of this article is as follows: (1) This article outlines the evolution of travel planning, from traditional methods to modern digital solutions, and introduces the potential for further innovation through AI.; (2) This article provides comprehensive definitions of the state-of-the-art large language models, modern application design patterns and Apple's mobile development frameworks as well as related concepts; (3) The article critically examines existing literature, research, and applications that involves LLMs and mobile applications with travel planning. This includes analyzing both successes and limitations in the field, thereby identifying gaps that the project aims to fill; (4) This article discusses the current problems and challenges in the field as well as the future research development directions.

The organizational framework of this article is as follows: Chapter 1 is the introduction, which mainly introduces an overview of travel planning evolution, the possibility of LLM in travel planning, the main work of the article, and the organizational framework; Chapter 2 is the research background and concepts, mainly analyzing theoretical foundations of the field and providing definitions of related concepts including LLM, MVVM architecture pattern and iOS development; Chapter 3 introduces the current research status, mainly focusing LLM and its potential application, as well as relevant applications that are already available on the market; Chapter 4 is a discussion, mainly focusing on limitations and challenges, as well as future research directions; Chapter 5 is a summary, summarizing the work of this article.

2 Research Background and Basic Concepts

2.1 Natural Language Processing

Natural language processing (NLP) Natural Language Processing (NLP) is an interdisciplinary field at the intersection of computer science, artificial intelligence, and linguistics, dedicated to creating algorithms that allow computers to process and understand human (natural) language. NLP encompasses a wide range of techniques and applications aimed at bridging the gap between human communication and machine understanding, facilitating tasks such as speech recognition, text analysis, and language generation. It integrates computational models of language with the development of practical systems, enabling computers to perform tasks like translating languages, responding to voice commands, and summarizing large volumes of text. The evolution and capabilities of NLP are underscored by significant research, such as the interdisciplinary approach to modeling language computationally ^[1] and the advancement of technologies for real-world applications ^[2], reflecting its foundational role in enhancing human-computer interaction and processing linguistic data at scale. In the realm of travel planning, NLP can be used to interpret user queries, process natural language inputs, and generate human-like responses to travel-related questions.

Transformers are a type of deep learning model that fundamentally rely on self-attention mechanisms to process sequential data, enabling them to understand and model the contextual relationships within the data without the sequential processing limitations of prior architectures like RNNs and LSTMs. Introduced by Vaswani et al. ^[3] in "Attention Is All You Need," transformers have revolutionized the field of natural language processing (NLP) and have since been adapted for a wide range of applications beyond text, including computer vision, audio processing, and even healthcare. The key innovation of transformers is their ability to handle long-range dependencies within data, allowing for parallel processing of sequences and significantly improving efficiency and performance on tasks such as language translation, text generation, and semantic analysis ^[4].

Large Language Models (LLMs) is defined as pre-trained Transformer models over large-scale corpora, which demonstrate significant capabilities in solving various NLP tasks. The term "Large Language Models" was coined to distinguish these models by their size, as scaling the model size beyond a certain level resulted in not only a significant performance improvement but also the emergence of abilities not present in smaller-scale models. This definition and the evolution of LLMs, from statistical to

neural language models and then to the pre-trained models we are familiar with today, are detailed in the survey paper by Zhao et al. ^[5], which provides an extensive review of recent advances in LLMs, covering aspects such as pre-training, adaptation tuning, utilization, and capacity evaluation. In the context of travel planning, LLMs can analyze user input to understand preferences and requirements and then generate personalized travel suggestions, itineraries, or advice.

OpenAI is an AI research and deployment company that has been at the forefront of developing cutting-edge AI technologies, including LLMs. OpenAI's mission is to ensure that artificial general intelligence (AGI)—highly autonomous systems that outperform humans at most economically valuable work—benefits all of humanity. OpenAI has developed several iterations of its language models, culminating in the highly advanced ChatGPT. OpenAI's API provides access to these models, allowing developers to integrate sophisticated language understanding and generation capabilities into their applications.

ChatGPT is a variant of the **GPT (Generative Pretrained Transformer)** language models developed by OpenAI, designed specifically for generating human-like text in a conversational context. It was first introduced by Brown et al. ^[6] in “Language Models are Few-Shot Learners”. It leverages deep learning techniques to produce responses that mimic human conversation, making it particularly well-suited for applications requiring interaction with users in natural language. In your AI-assisted travel planning app, ChatGPT could serve as the interface through which users communicate their travel preferences and receive personalized travel information. ChatGPT's ability to understand context and generate relevant, detailed responses can significantly enhance the user experience by providing tailored travel recommendations, answering queries, and facilitating a more interactive planning process.

2.2 iOS Development

Apple Inc. is a global technology company that designs, manufactures, and markets consumer electronics, software, and services. Renowned for its innovation in the tech industry, Apple has introduced a range of products that have become integral to many people's lives, including the iPhone, iPad, and Mac computers. The company also develops its own operating systems to power these devices, such as iOS for iPhones, providing a seamless ecosystem that integrates hardware, software, and services.

iOS is the mobile operating system created and developed by Apple Inc. exclusively for its hardware. It is the software platform that runs on all iPhone models, providing

the foundational interface and functionality users interact with. iOS is known for its intuitive design, security features, and robust performance. It offers developers access to a wide range of APIs and tools to create dynamic and engaging applications, ensuring a consistent and seamless user experience across all devices.

MVVM (Model-View-ViewModel) architecture is a software design pattern that facilitates a clear separation of concerns in applications, particularly useful in graphical user interfaces. This pattern divides the application into three interconnected components: the Model, which represents the data and the business logic; the View, which is the user interface; and the ViewModel, which acts as a mediator by binding the Model data to the View. This separation not only simplifies the management of complex interfaces but also enhances the development process, allowing for more manageable code and improving the ability to test components independently of each other. MVVM is especially popular in applications built using platforms like WPF, Xamarin, or frameworks such as Angular, due to its strong support for data bindings and event-driven programming.

Swift ^[7] is a powerful and intuitive programming language for iOS, macOS, watchOS, and tvOS app development. Introduced by Apple in 2014, Swift is designed to work with Apple's Cocoa and Cocoa Touch frameworks and the large body of existing Objective-C code written for Apple products. It's known for its safety, speed, and modern syntax that makes programming more straightforward, thus enabling developers to create more reliable and faster apps. Swift is continuously evolving, supported by a vibrant community of developers.

SwiftUI ^[8] is a user interface toolkit introduced by Apple in 2019 that allows developers to design and build graphical user interfaces across all of Apple's platforms, including iOS, macOS, watchOS, and tvOS. It uses a declarative syntax that makes it straightforward to design interfaces with less code than was traditionally required with Apple's older framework, UIKit. SwiftUI code automatically updates the view when the underlying data changes, thanks to its tight integration with the data-driven Combine framework. SwiftUI is naturally conducive to the MVVM architectural pattern.

MapKit ^[9] is a framework provided by Apple that allows developers to integrate map-based services into their apps. It offers a rich set of features to display maps, annotate them with custom information, and implement location-based services directly within iOS apps. Developers can use MapKit to add interactive maps that can zoom in and out, show user location, and even provide turn-by-turn navigation. This makes it

an invaluable tool for travel-related applications, where mapping and precise navigational instructions are crucial for enhancing user experiences.

3 Current Research Status

3.1 ChatGPT and Its Application

Ever since the introduction of ChatGPT 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. ^[10], 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. ^[11] 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. ^[12] 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. ^[13] 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 ^[14] and Gallardo Paredes et al. ^[15] 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. ^[16] and Chowdhury and Haque ^[17] discuss the broader societal and economic benefits, including enhancing accessibility to information. Lastly, Fui-Hoon Nah et al. ^[18] 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 ^[19-21], using structured prompts can also create fine results. Arora et al. ^[22] 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. ^[23] 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.

3.2 ChatGPT and Travel Industry

In the travel industry, the implementation of ChatGPT is poised to redefine customer service and travel planning. Gursoy et al. ^[24] 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 ^[25]. Additionally, Demir & Sen Demir ^[26] 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.

3.3 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 additional 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 ^[27] 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.

3.4 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. ^[28] 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. ^[29] 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. ^[30] also points out that MVVM has better performance and better testability compared to MVC, while its easier to understand as well.

3.5 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 ^[31], 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 ^[32] 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.

4 Discussion

4.1 Challenges and Limitations

The current research state and iOS development technologies in the context of the development of an AI-assisted travel planning app presents several challenges and limitations. Firstly, even many research have pointed out the bright side of the future of ChatGPT and LLMs, there're still many problems to solve, including sentiment analysis barriers, privacy issues, prompt security issues and ethical concerns. Liu et al. ^[33] discussed about using fine-tuning to improve the performance of GPT, which means if the tasks required to be performed in this project exceed the stock ChatGPT's abilities, further fine-tuning will be required. Webson and Pavlick ^[21] did an experiment that showed GPT may not be able to "understand" instructions, indicating strict prompt engineering is needed for desired output. Greshake et al. ^[34] pointed out a few security issues related to ChatGPT and relevant applications that utilizes ChatGPT's service. Prompt injection will cause unwanted results and may further damage by jailbreaking the models.

With that being said, when it comes to the implementation of ChatGPT in the target application, we need to make sure both the accuracy and security of the prompt, which means there will be no dialogue interface for the user. This might be a limitation but will surely improve the accuracy of the results from ChatGPT as well as eliminating the potential security hazard of prompt injection. One other thing that we need to have in mind is that by using the API from OpenAI, we will have to update our product whenever OpenAI updates theirs. The language models are not very consistent in every way as it was pointed out in a research by Chen et al. ^[35]. We will need a way to resolve the consistency problem to insure the robustness.

In terms of architecture patterns, MVVM would be the first choice. Especially that Apple is pushing the development of their newest UI framework SwiftUI, which is their interpretation of MVVM architecture pattern. But compared to UIKit, SwiftUI is still very new and is still evolving. The stability of SwiftUI is not as good as UIKit. There might also be some drawbacks if we want to implement very custom UI elements.

4.2 Future Research Directions

As said that there are still many challenges and limitations remain to be solved. Future research and projects should focus on limitations of ChatGPT or other language models. In terms of language models, the future work can explore if using fine-tuned

smaller localized language models can achieve more efficient results. In terms of application integration, exploring the integration of real-time data, such as weather and local events could further tailor travel recommendations, but this also requires wider data access. Research into user interaction with AI-assisted apps will provide valuable insights into improving usability and engagement in the study of human-computer interaction. Lastly, expanding the app to include community-driven content might also be a consideration, such as user reviews and recommendations, which could enrich the travel planning process, offering a comprehensive platform for all travel needs.

5 Summary

This thesis embarked on the project of designing and implementing an AI-assisted travel planning application, focusing on individualized travel experiences powered by ChatGPT. It commenced by delineating the historical progression of travel planning, highlighting the transition from traditional methods to digital solutions, and the advent of AI technologies. The literature review thoroughly covered the fundamentals of natural language processing, iOS development, MVVM architecture pattern, and the integration of LLMs like ChatGPT into practical applications. It critically reviewed existing applications, underscoring the novelty and potential of the proposed app in the context of current market offerings. Despite encountering challenges such as sentiment analysis barriers, privacy, and ethical concerns, we proposed viable solutions to mitigate these issues. Future research directions were outlined, suggesting a focus on fine-tuned LLMs, integration of real-time data, and community-driven content to further enhance the app's functionality and user experience.

6 References

- [1] JOSHI A K. Natural Language Processing[J/OL]. Science, 1991, 253(5025): 1242-1249. DOI:10.1126/science.253.5025.1242.
- [2] HIRSCHBERG J, MANNING C D. Advances in natural language processing[J/OL]. Science, 2015, 349(6245): 261-266. DOI:10.1126/science.aaa8685.
- [3] VASWANI A, SHAZEER N, PARMAR N, et al. Attention is All you Need[C/OL]//GUYON I, LUXBURG U V, BENGIO S, et al. Advances in Neural Information Processing Systems: Vol. 30. Curran Associates, Inc., 2017. https://proceedings.neurips.cc/paper_files/paper/2017/file/3f5ee243547dee91fbd053c1c4a845aa-Paper.pdf.

- [4] ISLAM S, ELMEKKI H, ELSEBAI A, et al. A Comprehensive Survey on Applications of Transformers for Deep Learning Tasks[J/OL]. 2023[2024-04-10]. <https://arxiv.org/abs/2306.07303>. DOI:10.48550/ARXIV.2306.07303.
- [5] ZHAO W X, ZHOU K, LI J, et al. A Survey of Large Language Models[J/OL]. 2023[2024-04-10]. <https://arxiv.org/abs/2303.18223>. DOI:10.48550/ARXIV.2303.18223.
- [6] BROWN T, MANN B, RYDER N, et al. Language Models are Few-Shot Learners[C/OL]//LAROCHELLE H, RANZATO M, HADSELL R, et al. Advances in Neural Information Processing Systems: Vol. 33. Curran Associates, Inc., 2020: 1877-1901. https://proceedings.neurips.cc/paper_files/paper/2020/file/1457c0d6bfc4967418bfb8ac142f64a-Paper.pdf.
- [7] INC A. Swift.org[EB/OL]//Swift.org. [2024-04-10]. <https://swift.org>.
- [8] INC A. SwiftUI Overview - Xcode - Apple Developer[EB/OL]. [2024-04-17]. <https://developer.apple.com/xcode/swiftui/>.
- [9] MapKit[EB/OL]//Apple Developer Documentation. [2024-04-10]. <https://developer.apple.com/documentation/mapkit/>.
- [10] NAVEED H, KHAN A U, QIU S, et al. A Comprehensive Overview of Large Language Models[J/OL]. 2023[2024-04-10]. <https://arxiv.org/abs/2307.06435>. DOI:10.48550/ARXIV.2307.06435.
- [11] KADDOUR J, HARRIS J, MOZES M, et al. Challenges and Applications of Large Language Models[J/OL]. 2023[2024-04-10]. <https://arxiv.org/abs/2307.10169>. DOI:10.48550/ARXIV.2307.10169.
- [12] CHEN B, ZHANG Z, LANGRENÉ N, et al. Unleashing the potential of prompt engineering in Large Language Models: a comprehensive review[M/OL]. arXiv, 2023[2024-03-29]. <http://arxiv.org/abs/2310.14735>.
- [13] WU T, HE S, LIU J, et al. A Brief Overview of ChatGPT: The History, Status Quo and Potential Future Development[J/OL]. IEEE/CAA Journal of Automatica Sinica, 2023, 10(5): 1122-1136. DOI:10.1109/JAS.2023.123618.
- [14] NAZIR A, WANG Z. A comprehensive survey of ChatGPT: Advancements, applications, prospects, and challenges[J/OL]. Meta-Radiology, 2023, 1(2): 100022. DOI:10.1016/j.metrad.2023.100022.
- [15] GALLARDO PAREDES C M, MACHUCA C, SEMBLANTES CLAUDIO Y M. ChatGPT API: Brief overview and integration in Software Development[J/OL]. International Journal of Engineering Insights, 2023, 1(1): 25-29. DOI:10.61961/injei.v1i1.7.
- [16] BAHRINI A, KHAMOSHIFAR M, ABBASIMEHR H, et al. ChatGPT: Applications, Opportunities, and Threats[C/OL]//2023 Systems and Information Engineering Design Symposium (SIEDS). Charlottesville, VA, USA: IEEE, 2023: 274-279[2024-04-11]. <https://ieeexplore.ieee.org/document/10137850/>. DOI:10.1109/SIEDS58326.2023.10137850.
- [17] CHOWDHURY M N U R, HAQUE A. ChatGPT: Its Applications and Limitations[C/OL]//2023 3rd International Conference on Intelligent Technologies (CONIT). Hubli, India: IEEE, 2023: 1-7[2024-04-11].

- <https://ieeexplore.ieee.org/document/10205621/>.
DOI:10.1109/CONIT59222.2023.10205621.
- [18] FUI-HOON NAH F, ZHENG R, CAI J, et al. Generative AI and ChatGPT: Applications, challenges, and AI-human collaboration[J/OL]. *Journal of Information Technology Case and Application Research*, 2023, 25(3): 277-304. DOI:10.1080/15228053.2023.2233814.
 - [19] LOGAN IV R L, BALAŽEVIĆ I, WALLACE E, et al. Cutting Down on Prompts and Parameters: Simple Few-Shot Learning with Language Models[M/OL]. *arXiv*, 2021[2024-04-08]. <http://arxiv.org/abs/2106.13353>.
 - [20] SANH V, WEBSON A, RAFFEL C, et al. Multitask Prompted Training Enables Zero-Shot Task Generalization[M/OL]. *arXiv*, 2022[2024-04-08]. <http://arxiv.org/abs/2110.08207>.
 - [21] WEBSON A, PAVLICK E. Do Prompt-Based Models Really Understand the Meaning of their Prompts?[M/OL]. *arXiv*, 2022[2024-04-08]. <http://arxiv.org/abs/2109.01247>.
 - [22] ARORA S, NARAYAN A, CHEN M F, et al. Ask Me Anything: A simple strategy for prompting language models[C/OL]//The Eleventh International Conference on Learning Representations. 2023. <https://openreview.net/forum?id=bhUPJnS2g0X>.
 - [23] LU Y, BARTOLO M, MOORE A, et al. Fantastically Ordered Prompts and Where to Find Them: Overcoming Few-Shot Prompt Order Sensitivity[M/OL]. *arXiv*, 2022[2024-04-08]. <http://arxiv.org/abs/2104.08786>.
 - [24] GURSOY D, LI Y, SONG H. ChatGPT and the hospitality and tourism industry: an overview of current trends and future research directions[J/OL]. *Journal of Hospitality Marketing & Management*, 2023, 32(5): 579-592. DOI:10.1080/19368623.2023.2211993.
 - [25] SUDIRJO F, DIAWATI P, RIADY Y, et al. The Role of ChatGPT in Enhancing the Information Search and Decision-Making Process of Travellers[J/OL]. *Jurnal Minfo Polgan*, 2023, 12(1): 500-507. DOI:10.33395/jmp.v12i1.12443.
 - [26] DEMIR M, DEMİR Ş Ş. Is ChatGPT the right technology for service individualization and value co-creation? evidence from the travel industry[J/OL]. *Journal of Travel & Tourism Marketing*, 2023, 40(5): 383-398. DOI:10.1080/10548408.2023.2255884.
 - [27] KOVÁCS M, JOHANYÁK Z C. Comparative Analysis of Native and Cross-Platform iOS Application Development[J/OL]. *Műszaki Tudományos Közlemények*, 2021, 15(1): 61-64. DOI:10.33894/mtk-2021.15.12.
 - [28] PARAMADANI R B, AKBAR M A, PINANDITO A. User Interface Rendering Time in Android Applications: Revealing the Effects of Design Patterns[C/OL]//Proceedings of the 8th International Conference on Sustainable Information Engineering and Technology. Badung, Bali Indonesia: ACM, 2023: 631-636[2024-04-17]. <https://dl.acm.org/doi/10.1145/3626641.3626948>. DOI:10.1145/3626641.3626948.
 - [29] WILSON A, WEDYAN F, OMARI S. An Empirical Evaluation and Comparison of the Impact of MVVM and MVC GUI Driven Application Architectures on Maintainability and Testability[C/OL]//2022 International Conference on

- Intelligent Data Science Technologies and Applications (IDSTA). San Antonio, TX, USA: IEEE, 2022: 101-108[2024-04-17].
<https://ieeexplore.ieee.org/document/9923083/>.
 DOI:10.1109/IDSTA55301.2022.9923083.
- [30] MAGICS-VERKMAN H, ZMARANDA D R, GYÖRÖDI C A, et al. A Comparison of Architectural Patterns for Testability and Performance Quality for iOS Mobile Applications Development[C/OL]//2023 17th International Conference on Engineering of Modern Electric Systems (EMES). Oradea, Romania: IEEE, 2023: 1-4[2024-04-17].
<https://ieeexplore.ieee.org/document/10171619/>.
 DOI:10.1109/EMES58375.2023.10171619.
- [31] Introducing GPTs[EB/OL]. [2024-04-11]. <https://openai.com/blog/introducing-gpts>.
- [32] iplan.ai - Your smart travel planner[EB/OL]. (2021-12-01)[2024-04-11].
<https://iplan.ai/>.
- [33] LIU X, ZHENG Y, DU Z, et al. GPT understands, too[J/OL]. AI Open, 2023: S2666651023000141. DOI:10.1016/j.aiopen.2023.08.012.
- [34] GRESHAKE K, ABDELNABI S, MISHRA S, et al. Not What You've Signed Up For: Compromising Real-World LLM-Integrated Applications with Indirect Prompt Injection[C/OL]//Proceedings of the 16th ACM Workshop on Artificial Intelligence and Security. Copenhagen Denmark: ACM, 2023: 79-90[2024-04-08].
<https://dl.acm.org/doi/10.1145/3605764.3623985>.
 DOI:10.1145/3605764.3623985.
- [35] CHEN L, ZAHARIA M, ZOU J. How is ChatGPT's behavior changing over time?[M/OL]. arXiv, 2023[2024-04-11]. <http://arxiv.org/abs/2307.09009>.