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AI Powered UK Travel Guide Chatbot

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Declaration

No part of this project has been submitted in support of an application for any other degree or qualification at this or any other institute of learning. Apart from those parts of the project containing citations to the work of others, this project is my own unaided work. This work has been carried out in accordance with the Manchester Metropolitan University research ethics procedures and has received ethical approval number **64143.**

Signed

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Abstract

The tourism sector is growing quickly, with AI introducing innovative approaches to enhance vacation planning. Traditional techniques dependent on travel agents and local specialists encounter scalability challenges, personal biases, and a reliance on the availability of professionals. This initiative presents a UK Travel Guide Chatbot powered by AI, offering tailored and dependable details about UK destinations. The chatbot employs NLP models for superior language comprehension and response generation, and it merges data streams including geographical data and user preferences. Tailored for users without technical expertise, the chatbot is designed with an intuitive interface and a scalable backend architecture. The creation phase involved the implementation of SpaCy's NER model, application construction using Flask, and the integration of external APIs for updated travel data. Rigorous testing ensured the chatbot's dependability and efficiency. Findings indicate that the AI-powered chatbot improves the travel planning experience by providing dynamic, customized suggestions. Feedback from users highlights its potential to change travel planning. The task illustrates that AI can successfully address the shortcomings of traditional approaches, offering a scalable, efficient, and user-centric solution. Future activities will focus on expanding the chatbot’s functionalities and broadening its utility.

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Abbreviations

Table 1 - Abbreviations

Abbreviation	Description
AI	Artificial Intelligence
AIML	Artificial Intelligence Markup Language
API	Application Programming Interface
ASR	Automatic Speech Recognition
BIO	Begin, Inside, Outside
CA	Conversational Agent
CB	Contextual Bandit
CORS	Cross-Origin Resource Sharing
CRF	Conditional Random Fields
DNN	Deep Neural Network
EU	European Union
GDPR	General Data Protection Regulation
GPT	Generative Pretrained Transformers
GPE	Geo-Political Entities
LBS	Location-Based Service
LLM	Large Language Model
MAB	Multi-Armed Bandit
ML	Machine Learning
NER	Named Entity Recognition
NLP	Natural Language Processing
NLU	Natural Language Understanding
RDBMS	Relational Database Management System
RNN	Recurrent Neural Network
RS	Recommender Systems
TAM	Technology Acceptance Models
U&G	Uses and Gratifications
UTAUT	Unified Theory of Acceptance and Use of Technology

1. Introduction

1.1. Project Background

The tourism sector is experiencing significant transformations with the rise of technological advancements, particularly in AI. In the past, organizing a journey typically required the involvement of travel agents or experts with in-depth knowledge of the destinations. This method offered customized guidance but also came with limitations such as scalability challenges, potential biases in the suggestions, and reliance on expert availability. As demand for travel services increases, these problems can lead to delays and varied experiences for tourists. Furthermore, the subjective views of travel specialists may not align with the diverse tastes of different travellers, stressing the importance of more inclusive and efficient solutions.

AI, powered by NLP technologies, provides an effective option. The travel industry would be able to offer instant, personalized recommendations that cater to individual preferences, thanks to AI. This shift is evident with the introduction of AI-powered chatbots by leading companies, which improve service interactions through timely and relevant information. These AI tools not only make the planning process smoother but also enhance the capacity to serve more users and minimize the biases that are often present in human-led methods. With ongoing advancements in AI, its incorporation into travel services is set to change the sector by making the planning of trips more streamlined, bespoke, and user-centric, thereby improving the overall travel experience.

1.2. Aim and Objectives

1.2.1. Aim

This project aims to develop an innovative UK Travel Guide Chatbot, leveraging AI to provide personalized and updated information about selected locations within the UK. The chatbot's functionality is designed to hand out customized recommendations covering regional attractions, dining options, accommodation recommendations, and transportation alternatives through interactive, human-like dialogues. The primary aim is to improve the user experience by integrating advanced AI models for enhanced language comprehension, drawing from different data sources. The goal is to deliver an AI-driven travel companion that is user-friendly, efficient, and ethically sound.

1.2.2. Objectives

The objectives of this project are as follows:

- Assess various Natural Language Processing models and architectures in the context of chatbot development.
- Implement advanced AI models to enhance the chatbot's language comprehension and response generation capabilities.
- Develop a strategy for gathering and integrating diverse data sources, including location-specific data, user preferences, real-time event feeds, and user-generated content.
- Design and implement a robust database system using appropriate technologies to store and manage the collected data.
- Prioritize usability for non-technical users to ensure a seamless and engaging user experience.
- Create a scalable and efficient back-end platform to host the chatbot and handle user queries.
- Integrate external APIs for travel and regional data to enhance the chatbot's capabilities in providing real-time and accurate information.
- Utilize programming languages suitable for the development of the chatbot.
- Translate user queries to internal representations and evaluate the system's ability to generate relevant responses.

1.3. Dissertation Structure

The rest of the dissertation is organized as follows:

Chapter 2 examines existing research relevant to the project. It begins with an overview of how AI technologies are currently used in the travel and hospitality industry to improve user experiences. The chapter then explores the data sources and integration strategies that are crucial for developing AI applications, emphasizing the importance of using diverse and real-time data. It also covers strategies for engaging users and how AI chatbots can be effectively designed for user interaction. Additionally, the chapter discusses techniques for personalizing AI systems and the role of NLP in enhancing how these systems interact with users.

Chapter 3 details the design methodologies used in this project, including a discussion of the Waterfall and Kanban approaches to software development. It then outlines the system requirements, both functional and non-functional, that are necessary for the chatbot's implementation. This chapter incorporates insights from research and user needs analysis that influenced the design process. It also discusses the design of the user interface, explaining how the chatbot's interface was crafted to be user-friendly and intuitive. Lastly, the chapter reviews the tools and technologies employed in the project, offering a detailed look at the technical components involved.

Chapter 4 details the implementation phase of the project, covering the project setup and the development of key components such as the NER model, Flask application, and chatbot functionalities. It discusses the integration of external APIs and the deployment of the online service using Heroku. The chapter also examines various testing methodologies used, including functional, usability, regression, and performance testing, to ensure the reliability and effectiveness of the chatbot.

Chapter 5 evaluates the project against its initial objectives, assessing how well it met user needs and drawing on insights from user testing and feedback analysis. It examines the effectiveness of the chatbot, identifies areas for improvement, and discusses any limitations encountered during the project.

Chapter 6 summarizes the completed work, reflecting on the achievements and challenges of the project. It reviews the limitations of the current implementation and suggests directions for future work, providing a comprehensive overview of the project's outcomes and its potential for further development.

2. Literature Review

2.1. Overview of AI in Travel and Hospitality

The inclusion of AI within the travel and hospitality sectors marks a large change, fundamentally transforming the management of operations and customer interactions. Initially aimed at automating straightforward tasks, AI's role has broadened significantly, boosting both operational efficiency and customer service (Gursoy and Cai, 2024). This shift is driven by both technological progress and a strategic focus on creating more engaging and responsive customer experiences (Pillai and Sivathanu, 2020). AI use has evolved from simple automation to more advanced uses, such as AI-powered chatbots. These chatbots have transformed customer service by offering continuous assistance, streamlining the booking process, and providing rapid responses to customer queries.

This development highlights a broader trend where AI applications in hospitality have evolved from basic mechanical functions, such as scheduling and bookings, to encompass more complex operations aimed at enhancing personalized guest experiences and operational decision-making. This transition emphasizes a significant shift away from traditional service methods towards highly personalized interactions, reflecting a dual evolution in the industry (Limna, 2022). This progression leverages AI not just for cost reduction but also for strategic enhancements in customer engagement and service innovation. The integration of service robots and voice assistants into customer service processes represents this shift, offering improved efficiency and a more engaging customer experience (Gursoy and Cai, 2024).

This perspective encourages for viewing AI and human intelligence as connected components within a structured hierarchy of information processing systems. Emphasizing a multidisciplinary approach to intelligence, this view combines insights from the humanities, natural sciences, and technical sciences (Suleimenov et al., 2020). Such a standpoint is crucial for understanding the complex role of AI in the travel and hospitality sectors, showing AI technologies not just as additional tools but as essential elements in a complex system that changes both operational and customer interaction models.

The framework of dialectical positivism, which combines elements of positivism and dialectical reasoning to analyse complex social interactions (Jamil, 2021), suggests a unified method for analysing AI and human intelligence interactions. This approach reveals AI's potential to break traditional boundaries and improve communication and efficiency. Research shows that AI's adeptness in data handling and creation significantly contributes to innovation, especially in the travel and hospitality

sectors (Kim et al., 2024). By developing new algorithms and information processing systems, AI climbs to a top position in the information hierarchy, broadening our understanding of intelligence outside of human comparisons and highlighting AI's transformative role across multiple sectors.

By using a more varied approach, people involved in the travel and hospitality sector are encouraged to think about AI's role beyond the usual uses. They see its potential to create new strategies that boost customer satisfaction and engagement. This view has deep influence, prompting a rethink of how AI technologies are developed, implemented, and integrated in the industry. It suggests that by gaining a better understanding of AI's role within a wider information and operational ecosystem, the industry can fully use AI to innovate and improve how services are delivered, how customers are interacted with, and how operations are run (Limna, 2022).

AI chatbots within the hospitality and tourism sectors of India highlights several key factors that promote the adoption and acceptance of this technology. Analysis based on discussions with senior management and a survey of 1,480 consumers shows that the simplicity of interaction, the utility perceived by users, reliability, intelligence, and lifelike characteristics of chatbots play significant roles in their popularity (Pillai and Sivathanu, 2020). This study supports the principles of the TAM and UTAUT models, which are widely used to examine the uptake of new technologies like mobile apps and social media marketing in this industry. The work emphasizes the value of these frameworks for understanding user behaviour and the incorporation of technology, stressing the importance of ongoing research to deepen our understanding of how technology is adopted in varying cultural and organizational settings (El Archi and BENBBA, 2023).

This underlines the need to develop chatbots that are user-friendly and can communicate in multiple languages, making them suitable for a wide range of users. This is particularly important in a country like India, known for its rich linguistic diversity (Pillai and Sivathanu, 2020). Chatbots designed to interact in local languages are more likely to be accepted and effective. Additionally, giving these chatbots human-like qualities is crucial as it helps in building trust and makes conversations seem more natural, which can significantly improve user satisfaction and acceptance.

AI advancements like automated kiosks and robotic service agents enhance efficiency and allow for continuous operation without tiring, but they also raise significant concerns about job security and the ethical implications of widespread automation (Gursoy and Cai, 2024). These technologies help cut labour costs and boost service quality by taking over routine tasks, freeing up human workers to handle more nuanced aspects of service that require a personal touch. Yet, the initial investment needed to set

up, maintain, and train staff on these technologies is considerable. Additionally, there is notable resistance from employees, who may see these technologies as a threat to their roles, and from customers, who often prefer interactions with humans (Limna, 2022). Cultural attitudes towards automation also differ, influencing how these technologies are adopted and function across various regions (Ivanov and Webster, 2017). This complex situation calls for a careful approach to integrating AI, weighing both the potential benefits and the challenges. It suggests a strategy where AI supports rather than replaces human staff, ensuring that technological progress positively impacts economic growth and job stability in the hospitality industry.

An organised review of AI methodologies and applications within these sectors further demonstrates the lack of conventional data analysis techniques and the advantage of AI in extracting predictive insights and improving customer service experiences, highlighting the adoption of technologies like robotics, virtual/augmented reality, and chatbots in changing customer interactions and operational effectiveness (Doborjeh et al., 2021). This analysis underlines the potential of AI to transform decision-making processes, enhance forecasting accuracy, and personalize customer experiences, thereby encouraging interdisciplinary research to explore innovative AI applications in the growing environment of hospitality and tourism.

2.2. Data Sources and Integration for AI Applications

Using a variety of current data sources is crucial for providing tailored, timely advice to travellers. This involves combining information from diverse sources such as local attractions, dining options, social media insights, and live transportation updates. This not only includes a wide range of information but also emphasizes the importance of keeping data secure, private, and accurate. AI, which spans fields like computer science, biology, psychology, and more, has broad applications from speech recognition to robotics (Zhang and Lu, 2021). Its varied foundation allows AI to improve personalization and efficiency in many sectors, including travel.

Additionally, a study explores the balance between AI-driven recommendations and those from human travel experts. This research highlights how the number of options offered, and the level of traveller involvement are key to shaping perceptions of AI advice. The findings suggest that providing a broader range of choices can reduce the natural scepticism toward AI, known as algorithm aversion, by giving users more control (Jang et al., 2023). This aligns with the main purpose of AI-powered travel guides, which is to offer personalized, detailed travel suggestions. The thorough examination of technology use

in the tourism sector emphasizes the strategic integration of information systems to gain competitive advantage and boost customer engagement (Cai et al., 2019). This underscores the importance of using technology in tourism strategies to meet changing consumer needs and enhance personalization. This is achieved by utilizing diverse data sources and advanced methods to integrate this information effectively.

The task of smoothly blending AI-based recommendation systems with a wide variety of existing data sources is a significant challenge, requiring the latest strategies in data management. A paper explains the crucial role of combining machine learning algorithms with RDBMSs (Kumar et al., 2017). This combination is key to making data processes more efficient. It greatly reduces the need to move data around unnecessarily, which in turn boosts the effectiveness of AI-driven applications. By bringing together ML and RDBMS, the process of managing data becomes more streamlined. This also makes the system more agile and able to offer reliable recommendations.

Moreover, the paper discusses how using optimization techniques from databases, like query optimization and updating models bit by bit, is crucial in making machine learning systems more efficient for travel guides (Kumar et al., 2017). These strategies allow for the constant updating of recommendation algorithms with new information, ensuring that the suggestions given are always up-to-date and relevant.

Privacy is a major concern when developing AI-driven travel guides, particularly for services that use LBS, which involve significant privacy challenges. Research stresses the importance of balancing personalized travel experiences with data protection (Wang et al., 2018). A report recommends techniques to keep user queries private without losing service accuracy. For example, it describes a method called "query content preservation" that ensures precise LBS responses while keeping the query details confidential. Furthermore, using generative data models with synthetic data can enhance privacy protection (Murdoch, 2021). This approach, inspired by healthcare AI, ensures user data remains secure and makes travel guides both accurate and helpful. These strategies demonstrate that it is feasible to provide detailed, personalized travel guides without compromising user privacy.

A paper emphasizes the importance of following the EU GDPR, which requires strict privacy measures and careful data management. GDPR focuses on transparency, consent, and protecting individual rights, presenting challenges for AI-driven travel guides. It highlights the need for advanced data management systems that ensure user privacy while providing personalized travel suggestions (Goddard, 2017). The "content sealed bottle" method encrypts the content of queries, allowing service providers to offer

accurate responses without directly accessing the details, aligning with GDPR's emphasis on minimal data use and privacy by design to ensure top-level confidentiality and security.

The use of big data analytics in the hospitality industry offers comparisons for AI-driven travel guides. The promise for improved customization, better operational efficiency, and increased customer interaction through big data is balanced by the challenges of managing data, protecting privacy, and the need for technological investments (Mnyakin, 2023). The strategies recommended to tackle these challenges, like effective data management systems, strong data security measures, and wise investments in technology, lay out a plan for incorporating complex data sources into AI-driven applications. This underlines the vital roles of innovation, privacy, and a focus on the user in developing AI-driven applications.

2.3. User Engagement and Interaction Strategies in AI Chatbots

Effectively engaging with users involves more than just captivating interactions; it also requires sustained, high-quality communication. This can be achieved by producing dynamic conversational paths that include interactive media and tailored content. This method is reflected in the designs of CAs like Siri, Google Assistant, and Alexa (Jain et al., 2018). The dialogue systems used in conversational AI have evolved to be more complex, enabling deeper and more meaningful exchanges with users (McTear, 2022). These systems utilize advanced machine learning techniques to improve understanding of and responses to user queries, making the communication more dynamic and user-friendly.

Generative AI technologies, especially GPT like ChatGPT, have made AI more accessible, not just for skilled software engineers but for everyone (Bilgram and Laarmann, 2023). These advancements allow non-technical users to partake in creative processes like ideation and prototyping. LLMs support a variety of tasks, from translating natural language into programming code to assisting in environmental studies and sparking creative ideas. These improvements in conversational agents aim to replicate human-like interactions to enhance the user experience. The objective is to make these interactions not only engaging but also intuitive and responsive to individual needs, thereby seamlessly narrowing the gap between human and machine communication.

Research categorizes CAs into three primary types based on their interaction modalities: speech-based, text messaging-based, and multimodal (Jain et al., 2018). The development of these agents has progressed from the early text-messaging chatbot ELIZA to their current, more sophisticated versions.

This evolution has been driven by various user needs, including efficient information retrieval, entertainment, and social interaction. The effectiveness of chatbots not only depends on their technological capabilities but also on their ability to meet user expectations (Brandtzaeg and Følstad, 2017). Successful chatbots engage users meaningfully, manage conversation contexts adeptly, and handle task failures smoothly, enhancing user satisfaction and engagement. Despite the increase of chatbots, with over 100,000 on platforms like Facebook Messenger, adoption rates remain low (Jain et al., 2018). It's crucial for chatbots to communicate their functionalities clearly, engage in meaningful small talk, manage conversation contexts effectively, and handle task failures with ease.

In addition to interaction qualities, AI-powered chatbots in specific contexts, like the tourism sector in Jeddah, demonstrate potential for transforming service delivery. Specifically, these chatbots, when employed correctly, are pivotal in transforming service delivery within the sector, particularly in accommodating the arrival of tourists driven by initiatives like Saudi Arabia's Vision 2030 (Alotaibi et al., 2020). The adoption of technologies such as NLP and ML enables these chatbots to deliver personalized and immediate assistance, which is crucial in enhancing the tourist experience. For example, the Rasa.ai framework, through its implementation of both Rasa NLU and Rasa Core modules, offers an advanced solution for managing dialogues and understanding user intents effectively.

The U&G theory is a key framework in communication studies that explains how AI-powered chatbots meet user needs in various sectors, including healthcare and retail (Xie et al., 2024). According to this theory, chatbots are truly effective when they fulfil several user needs: delivering information, providing emotional support, and facilitating social interactions. Research in Chinese e-commerce using the U&G model shows that user engagement with chatbots is influenced by cognitive, affective, and social needs (Marjerison et al., 2022). The study found that features like authenticity, enjoyment, and convenience boost acceptance of chatbots, while privacy issues and technological shortcomings are major hurdles. These elements significantly enhance user satisfaction by addressing practical, pleasurable, and social needs. Findings suggest that users are most content when chatbots efficiently meet their everyday requirements. It's important that the information provided is accurate, timely, and contextually relevant to the user’s situation, which helps users make better decisions and streamline their interactions.

As AI becomes more widespread across various sectors, the current understanding of how users benefit from interacting with chatbots grows stronger. However, privacy issues present a major hurdle, which could potentially lessen user satisfaction. It's essential to weigh these privacy concerns against the advantages that chatbots offer to build user trust and maintain their ongoing engagement with these technologies. A study that surveyed over a thousand U.S. customers using chatbots from well-known

brands pinpointed specific benefits that lead to user satisfaction (Cheng and Jiang, 2020). These benefits include receiving helpful information, enjoying entertainment, appreciating the chatbot's media capabilities, and experiencing a sense of social connection. The study also highlights the critical role of privacy in shaping user satisfaction and loyalty.

2.4. Personalization Techniques in AI Systems

Personalization in AI systems has evolved significantly, largely driven by advancements in ML and algorithm development tailored to understand and predict individual preferences and behaviours. Historically dominated by linear algorithms like matrix factorization used in collaborative filtering since the Netflix challenge in 2007, the field has witnessed a paradigm shift towards more sophisticated models (Goldenberg et al., 2021). The start of deep learning has introduced complex structures capable of adding non-linearity to recommendations, which has been exploited by major companies like Google, Alibaba, and Twitter. These organizations employ models such as wide and deep learning and deep interest networks for tasks like click-through rate predictions and personalized shopping experiences, processing vast amounts of data with increased accuracy and relevance (Goldenberg et al., 2021).

In the travel industry, AI significantly enhances the customization of experiences using RS (Badouch and Boutaounte, 2023). These systems deploy ML algorithms, including collaborative filtering, content-based filtering, and hybrid methods, to continuously analyse user interactions and feedback. Collaborative filtering capitalizes on the behaviours and preferences of similar users to predict the interests of a new user, leveraging shared tastes and experiences (*Collaborative Filtering | Machine Learning*, n.d.). In contrast, content-based filtering focuses on the characteristics of the items themselves, recommending new destinations or activities that align with previously expressed preferences (*Content-based Filtering | Machine Learning*, n.d.). Hybrid systems combine these approaches to draw on their strengths and mitigate their individual limitations, thereby providing a deeper understanding of user preferences. This integration not only continuously refines the accuracy and relevance of the recommendations based on new data but also significantly boosts user engagement and satisfaction.

Research shows that these technologies are widely used across different industries, highlighting their broad utility and impact. For instance, RNNs use a network structure where connections between nodes create a sequence over time (Villagra and Artuñedo, 2023). This setup lets recommendation systems add and use contextual information effectively. It's especially important for keeping up with changes in

user preferences over time, ensuring recommendations stay relevant and timely. RNNs are especially valuable in areas like e-commerce and media streaming, where what users want can change quickly. They help these systems keep track of changing patterns and trends in user behaviour, keeping recommendations accurate and relevant.

Additionally, recent developments in recommendation systems have seen the strategic use of MABs and CBs. These methods help balance the introduction of new items with the promotion of familiar user preferences (Marković et al., 2021). This balance is key for keeping users engaged, mixing novel experiences with well-liked options. These techniques constantly improve how decisions are made by integrating feedback in real time, which allows recommendation systems to adjust dynamically to changes in user behaviour and market trends (Pilani et al., 2021). In doing so, MABs and CBs not only provide more precise recommendations but also ensure that the system evolves with user interests and external shifts, thereby boosting the overall effectiveness and adaptiveness of personalized services.

In the healthcare industry, AI technologies are being used more often to make treatments more accurate. These technologies work by analysing a lot of detailed patient data, from genetic information to past medical history (Nazer et al., 2023). This helps doctors come up with treatment plans that are specifically tailored to each patient's needs, which is especially useful for serious diseases like cancer. However, using AI in healthcare has also brought up concerns about it possibly making existing inequalities in healthcare worse.

Research highlights the essential need for careful monitoring at every stage of AI development and use in healthcare. From gathering the initial data to rolling out AI's final predictions, examination must be done at each step for possible biases. These biases might come from the data itself, arise during the development of AI, or reflect ongoing inequalities in healthcare practices. For example, an AI system using data on healthcare spending unfairly targeted Black patients (Ledford, 2019). It inaccurately assessed their health needs because it assumed that higher spending meant greater healthcare needs, neglecting the actual health conditions of these individuals. Such problems are revealing of wider systemic issues in healthcare access. Without attentive oversight, AI systems could unintentionally deepen these inequalities.

To tackle the challenges of AI-driven personalization, strict validation and ethical guidelines are essential from development to deployment. In personalized medicine, especially in cancer treatment, AI algorithms that analyse extensive genomic data must be thoroughly tested across different demographic groups to ensure they are fair and effective (Rezayi et al., 2022). These systems use

advanced machine learning and deep learning models to predict disease progression and treatment responses, underlining the need for accurate and reasonable outcomes from AI.

Within recommendation systems, techniques like MABs and CBs must efficiently balance exploration of new items with management of known user preferences, constantly incorporating user feedback to improve these models (Goldenberg et al., 2021). Additionally, the application of causal inference helps devise more precise and impactful marketing strategies. Integrating explainability and fairness into these systems is crucial for maintaining transparency and building user trust, ensuring that AI recommendations are not only effective but also ethically sound.

2.5. NLP for Enhanced User Interactions

NLP is essential for enhancing chatbots, boosting their skills in understanding and responding to human language. With NLP, chatbots can comprehend user inputs, craft relevant replies, and participate in significant dialogue. This advancement has revolutionized user interactions with digital platforms, making them more natural and conversational.

For example, NLP has improved the user experience on college websites through a college inquiry chatbot (Lalwani et al., 2018). This chatbot uses AI and NLP to analyse user questions, identify key information, and provide accurate answers about admissions, exams, attendance, and placements. It efficiently handles both regular chats using AIML and specific queries through a query analysis system, saving time and enhancing information access.

Within the credit card insurance sector, AI-powered chatbots that utilize NLP and DNN technologies are improving client satisfaction and optimizing operational efficiencies (Nuruzzaman and Hussain, 2018). Conventional methods of customer service are often tedious and inefficient. AI chatbots, however, provide round-the-clock support, handle routine questions, assist in claim processing, and contribute to product sales. This not only alleviates the burden on call centres but also enhances their productivity. These chatbots incorporate sophisticated NLP algorithms and frameworks to deliver interactions that closely mimic human conversations and provide accurate responses.

NLP enables chatbots to understand complex questions, correct grammatical errors, and provide contextually appropriate responses (Lalwani et al., 2018). This flexibility is essential across various fields such as customer service, education, healthcare, and more. Ongoing improvements in NLP models

also mean that chatbots can support multiple languages and integrate with other systems, increasing their usefulness.

NER is crucial for identifying and categorizing specific entities within user inputs, such as place names, dates, and activities. For instance, the development of a smart tourism chatbot involved creating robust NER datasets in both Korean and English using diverse tourism information sources (Jwa and Jwa, 2022). This system used the Khaiii morpheme analyser for recognizing user intents and employed the KoBERT-CRF model, using a combination of the Korean pre-trained language model KoBERT and CRF to train these datasets. The datasets were built using BIO tagging, which helped the chatbot understand user queries better and provide accurate information. This method particularly improved the identification of the beginning of entities, addressing challenges posed by the uneven distribution of entity types in the training data.

Breakthroughs in deep learning have considerably propelled the domain of NLP. LLMs, such as GPT-3, have become benchmarks for producing text that closely mimics human speech, enhancing chatbot interactions. These models are adept at grasping conversations, constructing fitting replies, and managing complex inquiries with precision. For instance, employing GPT-3 in gathering health-related information has demonstrated that LLM-based chatbots can deliver diverse, context-sensitive responses, which enhance both user engagement and the overall effectiveness (Wei et al., 2024). Research on various prompt configurations indicates that while structured prompts with added personality traits are most effective for precise information retrieval, prompts that are more descriptive tend to promote empathy and user acknowledgment.

In smart tourism, the combination of AI, NLP, and big data into complex models such as KoBERT-CRF demonstrates the application of enhanced ML techniques in developing more complex and responsive chatbots (Jwa and Jwa, 2022). These models' capabilities to comprehend and produce natural language are essential for improving interactions with users. This makes chatbots an invaluable resource in sectors such as tourism and healthcare. Ongoing enhancements in these technologies and models enable developers to create chatbots that provide accurate, efficient, and tailored experiences for users.

Despite significant advancements in NLP, achieving human-like dialogues in chatbots remains challenging. One major issue is the accurate understanding of user inputs, which involves both ASR and NLU. Models that simultaneously handle intent detection and slot filling have proven more effective by reducing errors and improving efficiency. However, challenges such as incorrect annotations, out-of-vocabulary words, and the need for more natural conversational data continue to pose problems.

Techniques like data augmentation, few-shot learning, and transfer learning are being used to mitigate these issues but ensuring that models work well across different domains and languages is still a challenge (Weld et al., 2022).

Managing conversations and maintaining context over multiple interactions also presents significant difficulties. Effective dialogue management requires sophisticated NLP tools to track conversation state, manage user intents, and generate contextually appropriate responses. This complexity increases with the need to understand varied syntactic structures in user queries. While tools like Deep Text and SyntaxNet are being further developed to tackle these issues, they have not yet reached full reliability (Rahman et al., 2017). Additionally, voice-based chatbots face the task of accurately converting sound waves into text and producing natural-sounding speech, which includes handling diverse accents and background noises, as well as interpreting and responding to the user's emotional state (Allouch et al., 2021).

3. Design

3.1. Design Methodologies

3.1.1. Waterfall

The Waterfall methodology follows a step-by-step project management style, where each stage must be finished before the next one can start. It begins with detailed planning, then moves to design, building, testing, and ends with deployment and upkeep. A major advantage of Waterfall is that it allows for clear budgeting and scheduling because everything is planned out from the start. However, its fixed steps can make it difficult to adapt if things need to change during the project, often leading to delays and extra costs. Also, since the client isn't involved much after the project starts, new requirements that come up later can be hard and expensive to include (Adobe Communications Team, 2022). Nevertheless, for projects with clear and unchanging goals, Waterfall works well because of its orderly approach.

3.1.2. Kanban

Kanban is an Agile method that emphasizes clear communication and transparency about ongoing work. It uses a Kanban board with tasks represented on cards and organized into columns like 'To Do,' 'In Progress,' and 'Done.' This setup makes it easy to see task statuses and identify any bottlenecks. One advantage of Kanban is that it limits the number of tasks in progress, preventing team overload and promoting a steady workflow. Additionally, its continuous flow allows teams to start new tasks as soon as they are ready, offering flexibility to adapt to changes. However, one disadvantage is that without a set schedule, it can be harder to predict long-term deadlines. Another downside is that it may require constant monitoring to ensure tasks are progressing efficiently (Radigan, n.d.).

Using Trello, as shown in Figure 1, has proven helpful in organizing work. Trello's visual board layout aids in tracking task progress and prioritizing effectively. It simplifies collaboration and ensures that tasks are managed in a structured way, enhancing overall productivity and output quality.

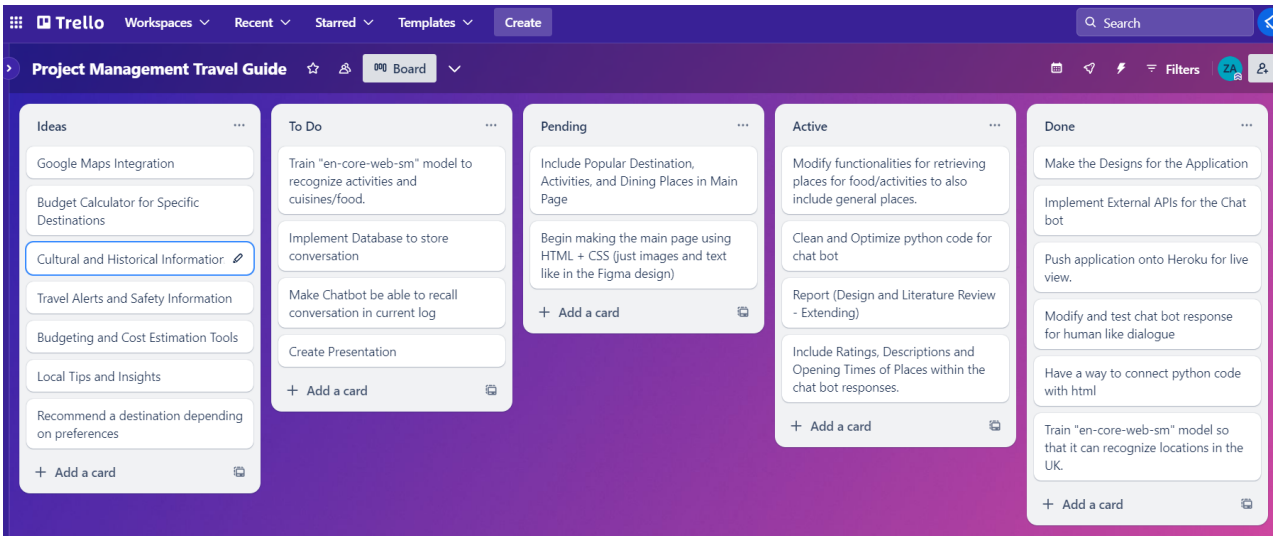


Figure 1 - Trello Board

3.2. System Requirements

3.2.1. Functional Requirements

The chatbot will use Google Maps API and the Yelp API to get up-to-date information about attractions and places to eat in the UK. It will also use OpenAI's GPT-4 API to process data better and improve interactions with users. This setup helps the chatbot provide quick and relevant information, enhancing the overall experience by offering personalized content. Evaluation will be done on the chatbot's performance by how quickly it can fetch data, aiming for within ten seconds, and its ability to correctly understand user queries, targeting a success rate of at least 90% during tests.

The chatbot will use the pre-trained NER model 'en-core-web-sm' to accurately identify and understand entities related to locations, food, and activities in user queries. This model will be further trained to recognize terms particularly relevant to UK travel queries. This approach ensures the chatbot can intelligently process and respond to user inputs, offering precise information and recommendations based on identified entities. The effectiveness of the chatbot in handling queries will be assessed by its ability to correctly recognize and respond to entities in over 90% of interactions.

The chatbot will customize interactions by recognizing user preferences and inquiries during the session. Algorithms will process this information to adjust recommendations and responses based on individual interests and requirements. For example, if a user looks up outdoor activities, the chatbot will later highlight similar options. This customized strategy is designed to enhance user

engagement and satisfaction by making interactions more applicable and instinctive. The success of the personalization will be measured through user retention metrics and feedback, aiming to increase positive interactions progressively.

3.2.2. Non-functional Requirements

The chatbot should be made to quickly answer questions, making conversations more efficient. It should reply to general questions in less than 10 seconds and to itinerary-related questions in less than 20 seconds. Keeping these response times fast is important to hold users' interest and keep the conversation flowing smoothly. The chatbot's performance will be tested during normal use to make sure it can meet these times in at least 95% of interactions. This standard is crucial for the system to work well and remain responsive, even when lots of users are asking questions at the same time.

The chatbot should be easy to use and designed to help many people, including those with disabilities. It will follow the Web Content Accessibility Guidelines (WCAG) to ensure that everyone can use it comfortably. Testing its ease of use will involve trials with users, aiming for at least 90% of them to manage the chatbot well without needing to learn how beforehand. It's important to reach this level of user-friendliness so the chatbot is approachable and usable by people with different backgrounds and various levels of tech experience.

The chatbot must maintain at least 99% operational uptime, apart from planned maintenance periods. This high reliability ensures the chatbot is always available, particularly for users who rely on it for real-time travel information. The system’s reliability will be continuously monitored to confirm it meets this standard. Maintaining such high uptime is crucial for keeping user trust and satisfaction, as it ensures the chatbot is consistently accessible whenever needed.

3.3. Research Insights & User Needs

This section analyses survey results concerning the use of AI-powered travel guides. Ethical considerations were strictly obeyed to in the survey: no personal data was collected, and all results are securely stored on the student OneDrive to maintain confidentiality and integrity.

The survey, demonstrated within Figure 2, revealed that most individuals use travel guides primarily for entertainment. Notably, 88.9% of respondents indicated they use them for leisure activities, while only 11.1% utilize them for business trips. There was no mention of using travel guides for educational purposes, suggesting that their main use is for enjoyment rather than for work or learning.

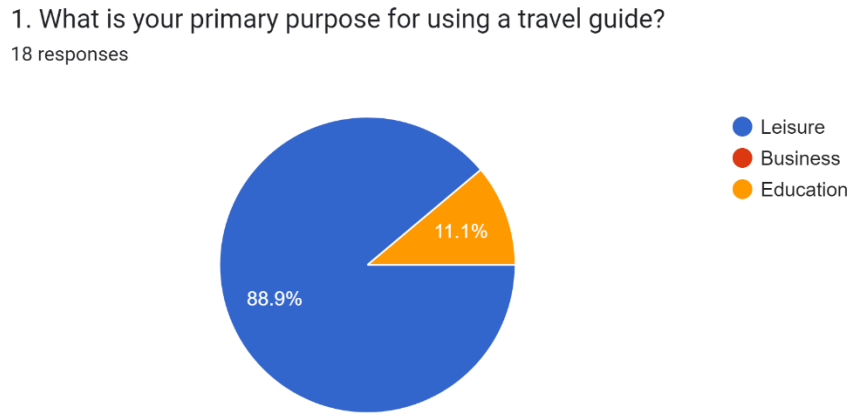


Figure 2 - Survey Result for Primary Purpose for Travelling

Considering the predominant interest in leisure information, it would be practical for the AI travel guide chatbot to cater to this audience. This means the chatbot should be proficient in providing recommendations on places to visit, dining options, and enjoyable activities. Although only a few use guides for business, the chatbot will still support basic needs related to business travel without emphasizing this aspect.

In question 2 of the survey, as shown in Figure 3, respondents indicated their excitement about exploring different parts of the UK with the AI travel guide. Half of them (50%) favoured England, making it the most popular choice. Scotland drew interest from just 11.1% of participants, while Wales received no votes, and Northern Ireland was chosen by only one respondent. However, one-third (33.3%) expressed a desire to explore the entire UK.

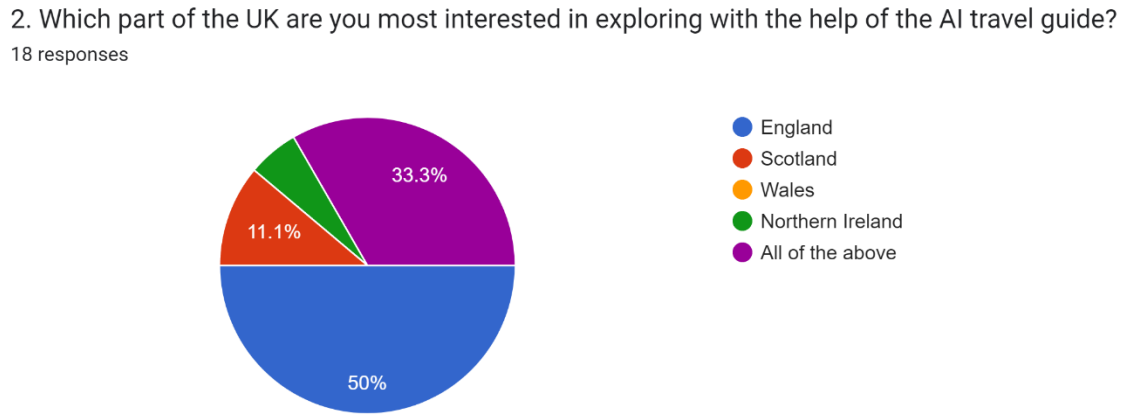


Figure 3 - Survey Result for Exploring Different Parts of the UK

This strong preference for England suggests that the AI travel guide should include detailed information about well-known cities like London and Manchester, as well as lesser-known locations. Considering the interest in nationwide travel, the guide should also cover Scotland, Wales, and Northern Ireland to accommodate users' diverse preferences. The lack of interest in Wales and the minimal data on Northern Ireland indicate a need for further investigation into these areas. Understanding why they are less popular and enhancing their appeal in the chatbot could involve highlighting unique attractions and activities that are not widely known.

In question 3 of the survey, as shown in Figure 4, participants were asked about the travel information they value most. The majority, 88.5%, indicated that information on accommodations is crucial. Dining options were also significant, with 66.7% of respondents highlighting their importance. Additionally, 61.1% valued details on cultural attractions such as museums and historical sites.

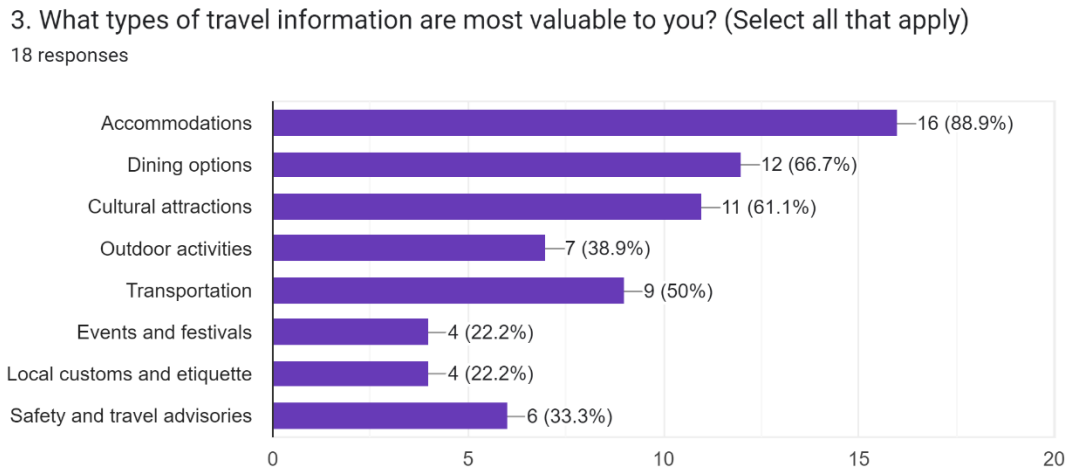


Figure 4 - Survey Result for Valuable Travel Information

From these findings, it is evident that the AI travel guide chatbot should prioritize providing detailed information on lodging and dining. It should also include extensive information on cultural sites like museums and historical attractions. While transportation details are essential for half of the participants, aspects such as events, local customs, and safety tips, though less critical, should still be accessible but not as prominently featured. This approach will ensure that the chatbot meets the main interests and needs of its users, facilitating an easier travel planning experience.

In question 4, as shown in Figure 5, when asked how they organize their travels, participants mentioned a range of methods. The most frequently cited were online travel websites, used by half of the respondents (50%). A smaller portion (16.7%) uses mobile apps, and even fewer (11.1%) depend on

personal recommendations. Notably, 11.1% reported that they do not plan their travels at all. Very few mentioned the use of travel agencies.

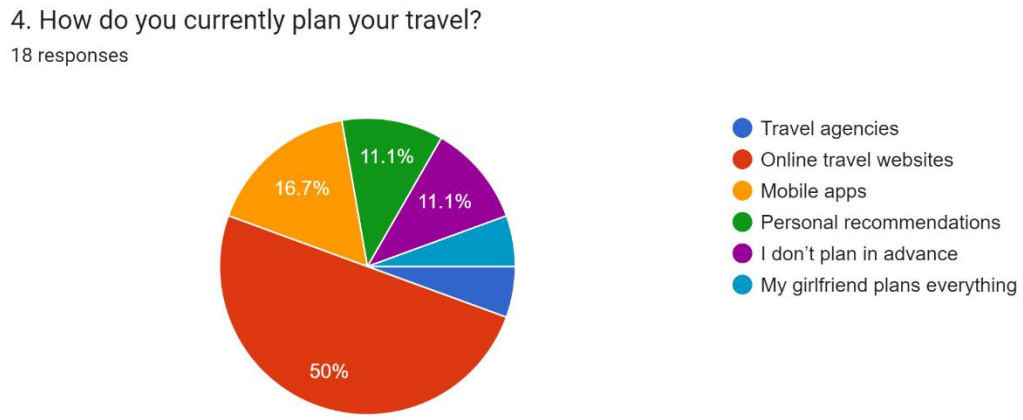


Figure 5 - Survey Result for How Travel Plans are done

The preference for online travel websites indicates a trend towards self-managed trip planning, utilizing tools that allow for comparisons of prices and services. This trend suggests a significant potential for an AI-powered travel guide that could provide similar or enhanced features. The limited use of mobile apps might indicate either a lack of awareness or dissatisfaction with the apps available. The fact that a considerable number of individuals do not plan their travels at all presents a distinct opportunity for the AI travel guide. This chatbot could serve spontaneous travellers by providing immediate recommendations and simplified planning tools, making travel planning less time-consuming and more straightforward.

In question 5, as shown in Figure 6, participants were asked about their use of AI-powered apps for trip planning. A significant 72.2% indicated they are not familiar with any AI travel apps, while about 16.7% mentioned using Google Trips. Very few, if any, mentioned other apps such as Hopper or TripIt.

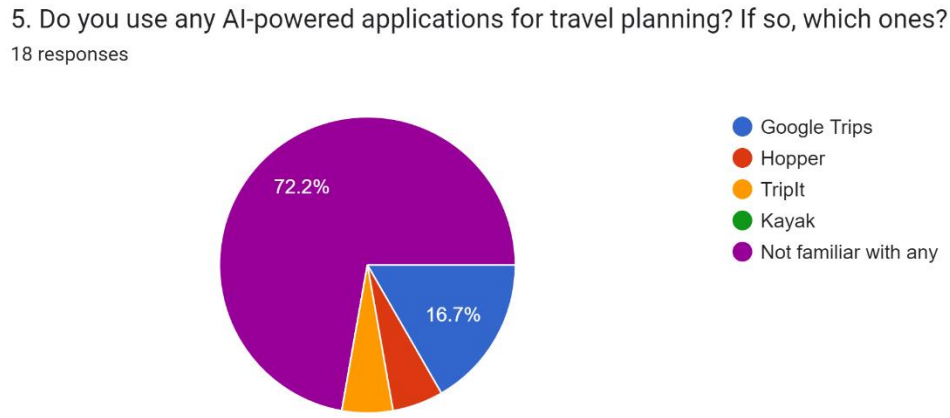


Figure 6 - Survey Result for current AI-Powered Applications

This lack of use suggests a substantial opportunity in the AI travel app market. It may be that people are not aware of these apps or that the existing apps do not meet travellers' needs effectively. This situation highlights a potential for the proposed AI travel guide chatbot. The minimal mention of other popular apps like Hopper and TripIt suggests that these apps might be lacking in features that connect travellers with local events or provide instant navigation advice in new cities. To attract users to the new chatbot, it is crucial to emphasize its ease of use and how it simplifies travel planning. Demonstrating how AI can streamline getting updated information and offering personalized travel recommendations could make the chatbot particularly appealing.

In question 6, as shown in Figure 7, participants were asked whether they would trust AI to provide personalized travel recommendations, resulting in mixed responses. Approximately 44.4% expressed trust in AI for this purpose, indicating openness to the technology. However, an equal percentage (44.4%) were uncertain, showing they are still undecided. Only a minor group, 11.1%, rejected trusting AI for travel advice.

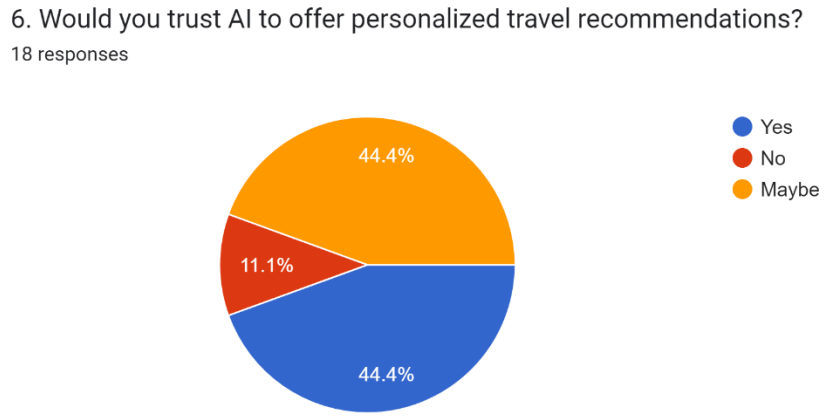


Figure 7 - Survey Result for Trust in AI

These varied responses reveal a cautious interest in using AI for travel guidance, paired with some reservations. The uncertain responses may point to concerns about data security with AI, the quality of its recommendations, or a general lack of understanding about AI capabilities. To address these concerns and enhance comfort with the AI travel guide chatbot, it is crucial to communicate clearly about its functionality. Explaining how user data is protected, how the AI determines suitable recommendations, and demonstrating its effectiveness are key steps in building trust and user acceptance.

In question 7 of the survey, as shown in Figure 8, participants were asked about the features they would value in an AI travel guide. The majority, 83.3%, prioritized real-time travel updates, highlighting a desire to remain informed about factors like weather and traffic during travel. Additionally, 66.7% expressed interest in itinerary planning, and approximately 61.1% were keen on receiving local insider tips to uncover hidden spots.

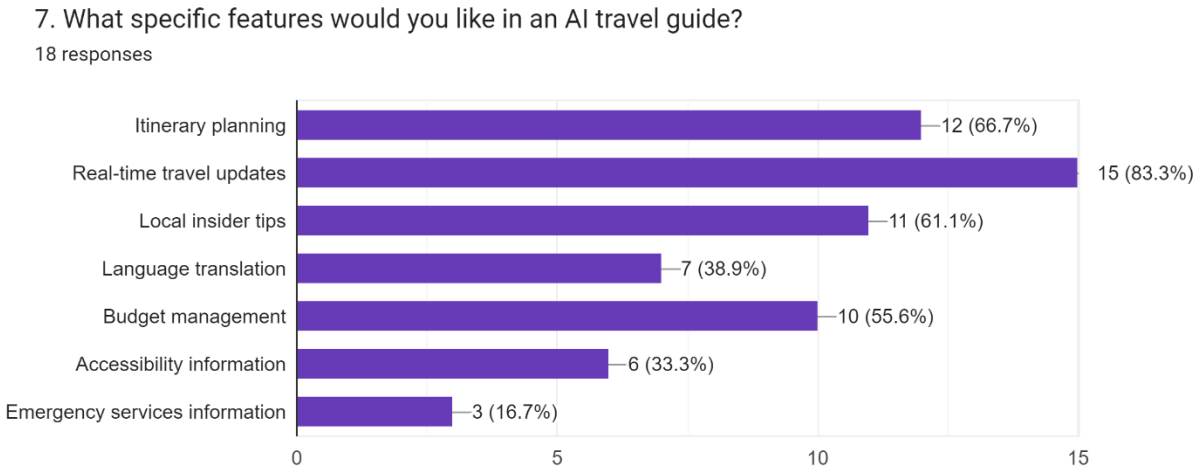


Figure 8 - Survey Result for Specific Features

The strong preference for real-time updates indicates that travellers highly value being well-informed throughout their journeys. Thus, the AI chatbot should excel at providing the latest information about local conditions. The interest in itinerary planning and local insider tips suggests that users are not solely focused on well-known tourist destinations. They seek a more local experience, which implies that the chatbot should also recommend lesser-known locations and local favourites to enrich their travel experience.

In question 10 of the survey, as shown in Figure 9, participants were asked about the major challenges they encounter while traveling in the UK. Approximately one-third highlighted that finding reliable information is the primary difficulty they face. Budget concerns were also significant, noted by nearly 28% of respondents. Around 17% indicated that navigating transportation was a challenge. Less common issues such as language barriers and safety concerns were mentioned.

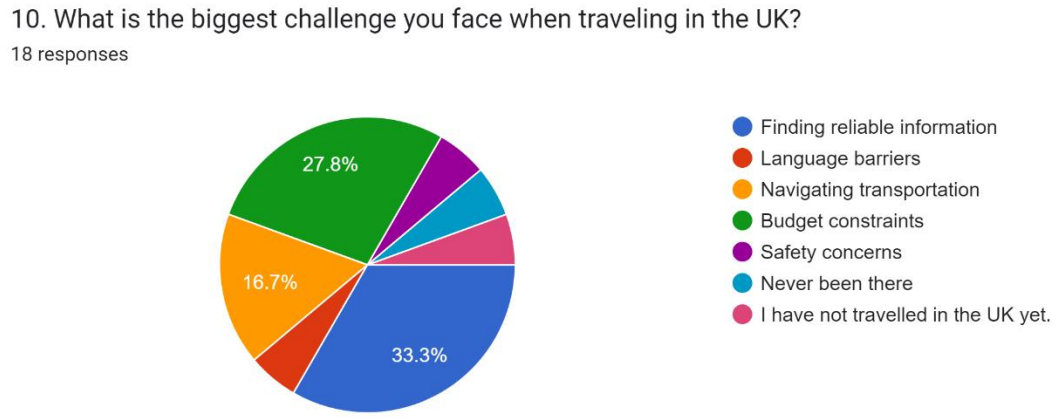


Figure 9 - Survey Result for Challenges when Travelling

The difficulty in accessing dependable information underscores a critical need for a trustworthy travel guide. This presents an excellent opportunity for the AI travel guide chatbot to offer accurate and current information, which could enhance travellers' confidence in their plans. The transportation challenges noted by respondents suggest that the chatbot should also provide comprehensive guidance on local travel options, including bus and train schedules, and advice on the simplest travel routes. These features would be particularly beneficial for those unfamiliar with the UK's transportation system.

In question 11 of the survey, as shown in Figure 10, participants were questioned about the AI features they would value most for enhancing their travel experiences. A substantial majority, 88.9%, expressed interest in real-time alerts for updates on weather and traffic. Automated itinerary suggestions and personalized recommendations for activities were both favoured by 66.7% of respondents.

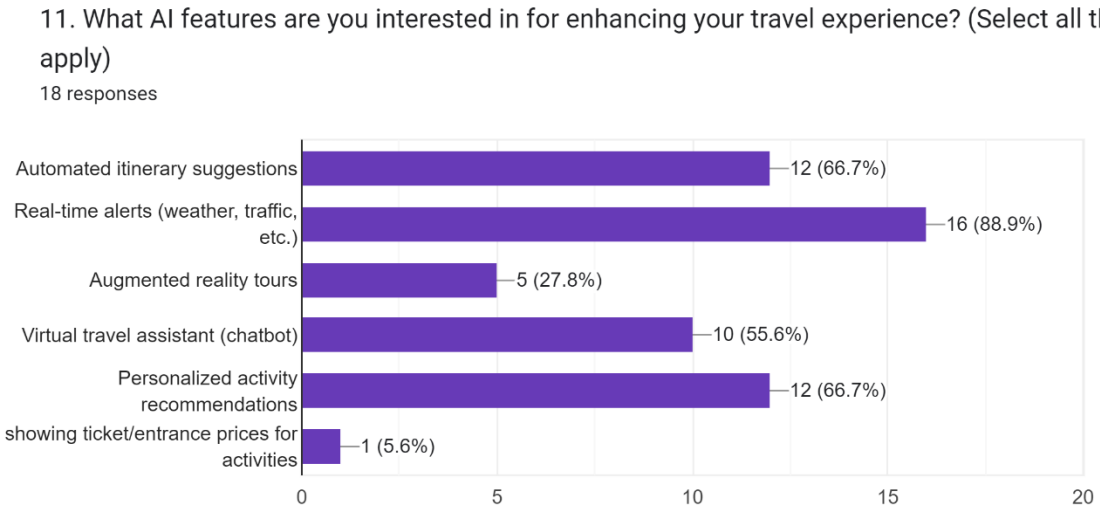


Figure 10 - Survey Result for Ideas in Enhancing Travel Experience

The high interest in real-time alerts indicates a strong preference for staying informed about current conditions during travel, aiming to prevent surprises and facilitate informed decisions. This highlights the necessity for the AI travel guide to include a feature that provides ongoing updates to travellers. The enthusiasm for automated itinerary suggestions and personalized activity recommendations highlights a desire for travel experiences that are customized and convenient. Respondents appreciate an AI that can adapt to their preferences and offer travel plans that align with their interests.

3.4. User Interface Design

The design of the application's user interface emphasizes simplicity and ease of use, adopting a minimalist aesthetic. A monochrome colour scheme and the Roboto typeface were chosen to maintain a clear and readable visual setting, aiding users in concentrating on the content presented. The layout is organized efficiently, with crucial elements like the chat area, text input box, and buttons positioned for easy access, enhancing quick and seamless navigation. This design strategy not only improves the chatbot's functionality by making it user-friendly and adaptable to different devices but also facilitates the effective provision of tailored travel advice.

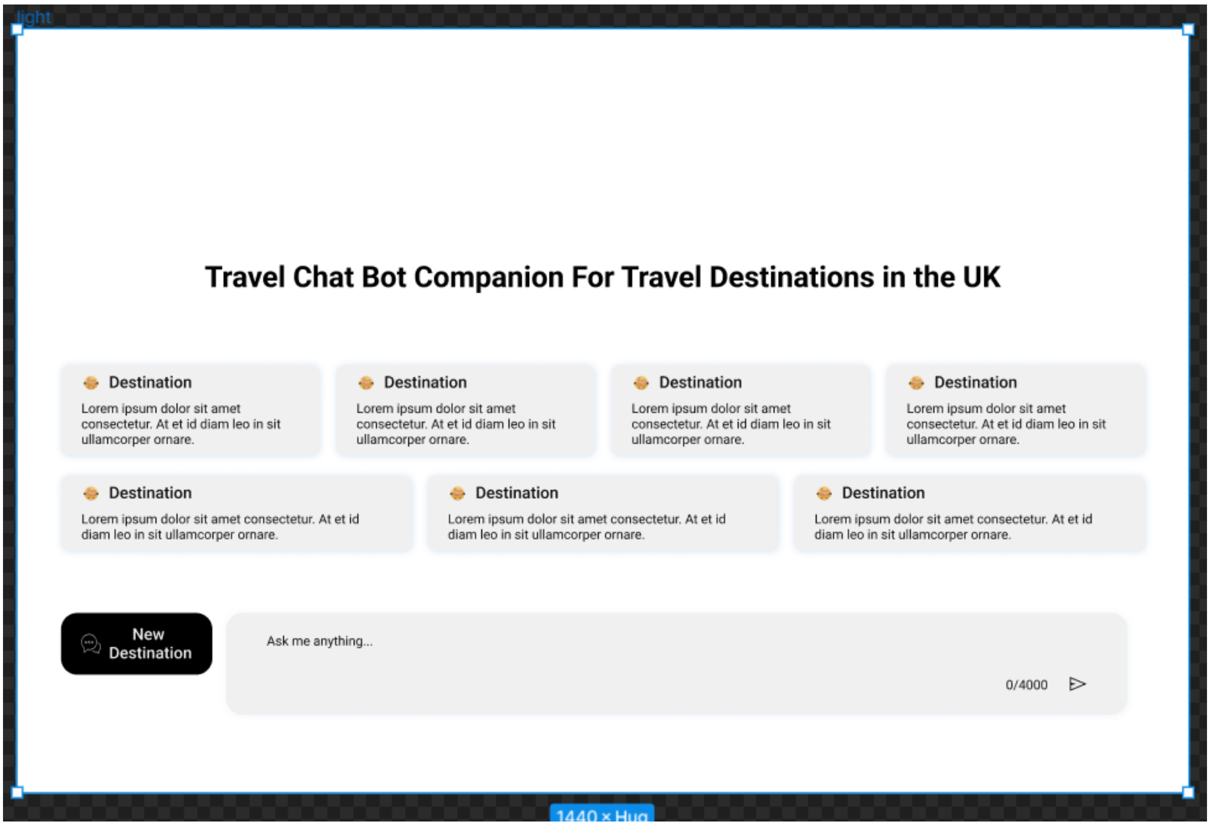


Figure 11 - Wireframe Depicting Start of the Chatbot

The initial screenshot of the wireframe, as shown in Figure 11, presents the main user interface of the UK Travel Guide Chatbot. At the top, the leading heading using the Roboto typeface identifies the chatbot and establishes a professional appearance. Beneath this, the central focus is the chat area where interactions occur. This space shows the ongoing conversation and incorporates clickable destination suggestions to aid users seeking travel ideas. These suggestions are seamlessly integrated into the chat, allowing users to consider options without disrupting the conversation flow. At the bottom of the screen, key elements such as buttons and a text input box are strategically placed for easy access. These features are essential for user input and smooth navigation through the chatbot's functions, promoting a user-friendly interface that facilitates effective information sharing.

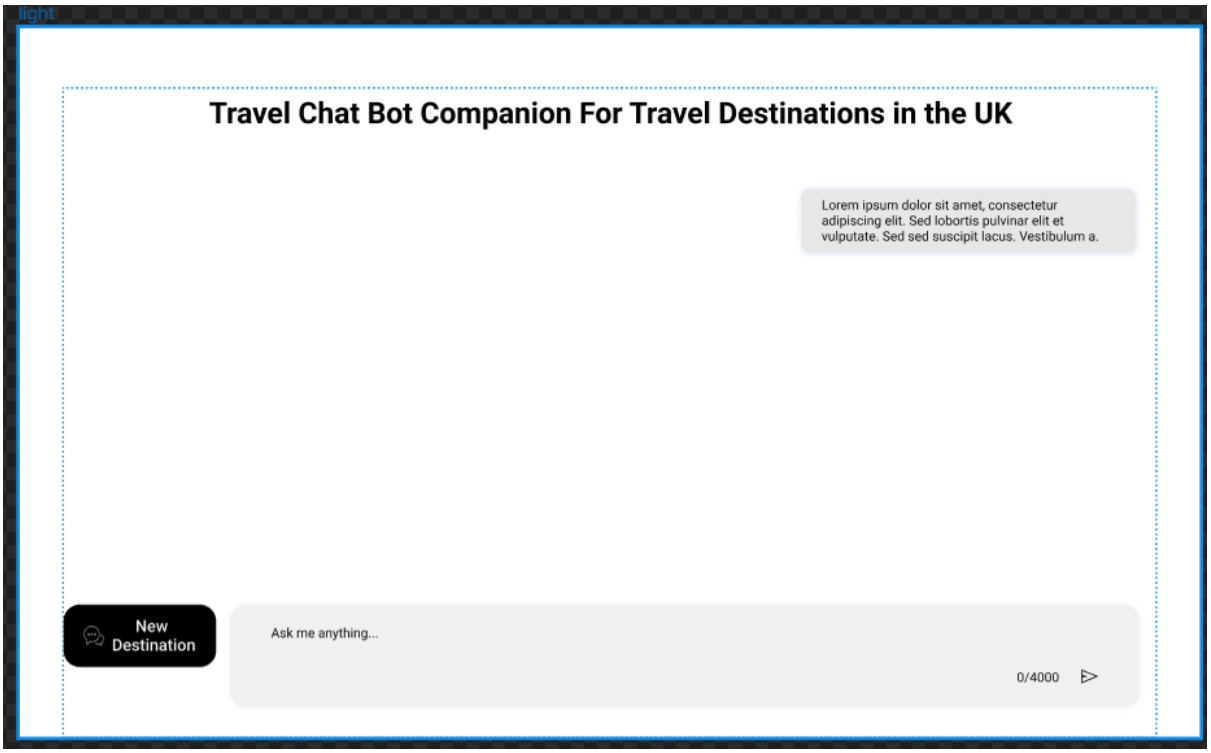


Figure 12 - Wireframe Depicting User Input Presentation

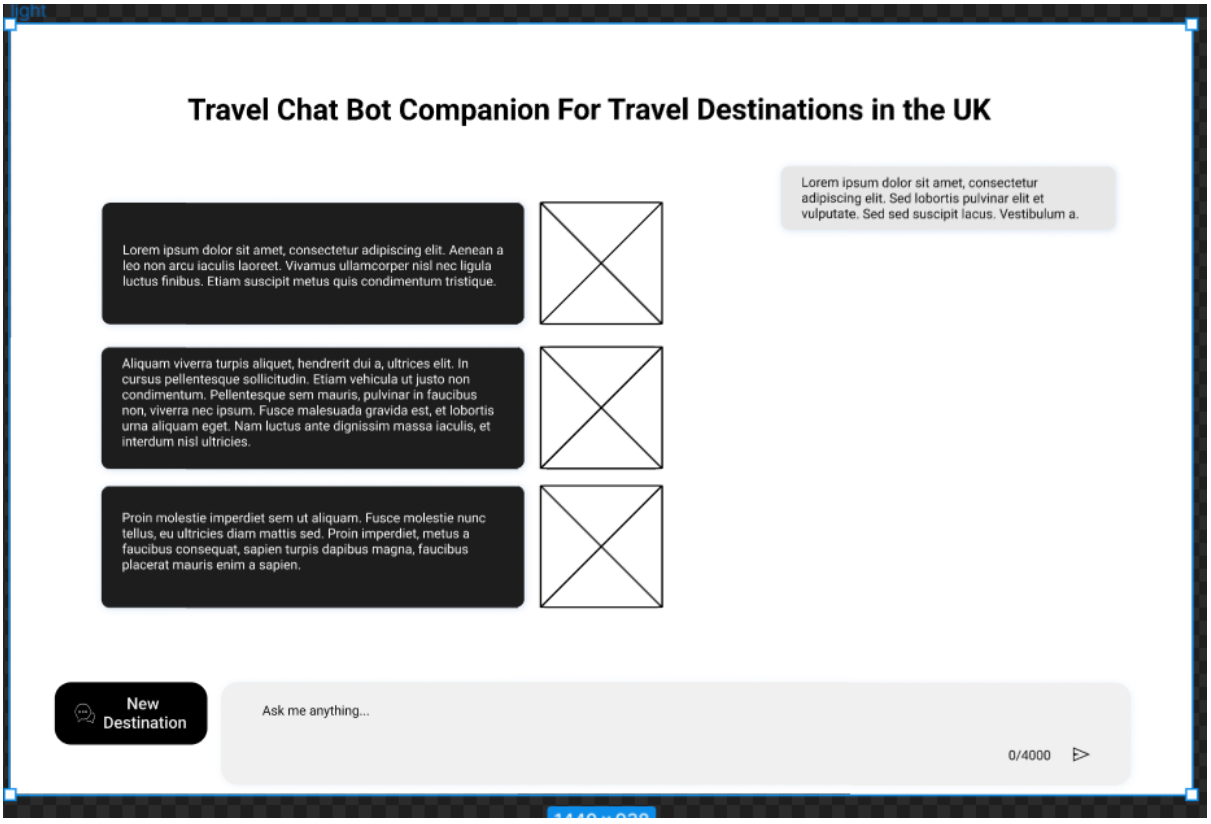


Figure 13 - Wireframe Depicting Chatbot Response

In the wireframes shown in Figure 12 and Figure 13, the presentation of chat interactions is designed for clear communication. Once user inputs have been entered into the text box, they are displayed on the right side of the chat area with a soft grey background (#E7E7E7) and black text in Roboto typeface. This design choice ensures readability while keeping the interface visually modest. On the other side, responses from the chatbot are shown on the left with a stark contrast, featuring a dark background (#0F0F0F) and white text, also in Roboto. This distinct visual separation helps users easily distinguish between their queries and the chatbot's replies. Considerations might include adding images next to the chatbot's responses. Positioned to the right, these images would provide visual context to the information being discussed, making interactions not only more informative but also engaging. Such a feature would enhance the user experience by offering a richer, more detailed exploration of topics within the chat.

3.5. Tools and Technologies

In the development of the UK Travel Guide Chatbot, various advanced tools and technologies will be utilized to ensure it functions effectively and is easy to use. Python will be the main programming language due to its comprehensive library support, which is ideal for AI and web development projects. Enhanced NLP will be achieved through SpaCy, using an updated version of the 'en-core-web-sm' model to precisely interpret user inquiries about UK travel details like locations, dining, and activities. Additionally, the web framework Flask will play a crucial role in developing the backend of the application, which will include creating endpoints for handling dynamic data efficiently.

For the front-end interface, Bootstrap will be combined with JavaScript to create responsive and attractive layouts that guarantee smooth interaction across various devices and platforms. Visual Studio Code will be utilized as the main code editor, offering a strong platform for coding, testing, and debugging, which will improve efficiency and simplify the development workflow.

The chatbot will be deployed using Heroku, a cloud platform renowned for its ability to scale quickly and update easily, ensuring consistent and efficient operation under different loads. The application will interact with external data sources through Google APIs and the Yelp API, essential for accessing real-time information about places and reviews. Furthermore, the chatbot's capability to produce human-like dialogues will be enhanced by incorporating OpenAI's GPT-4 API, significantly improving the quality of conversations, which is vital for the user experience.

Version control will be managed using Git and GitHub, ensuring precise tracking and management of updates to the codebase, which supports collaborative efforts among a development team. Additionally,

Waitress will serve as the production-grade server for hosting the Flask application, offering a stable and secure environment during the chatbot's deployment phase. This strategic use of a variety of development tools and technologies emphasizes a methodical approach to develop a high-performing, scalable, and user-focused chatbot that effectively assists travellers throughout the UK.

4. Implementation

4.1. Project Setup

4.1.1. NER Model Training

During the development of the AI Powered UK Travel Guide Chatbot, the training of the NER model is crucial for improving the chatbot's ability to accurately understand and categorize user input. As described in Appendix B, the file, training_data.py, includes annotated examples that illustrate how the model learns to identify key entities like food, activities, and geographical locations. Each example consists of a sentence paired with a dictionary that labels entities within the sentence by type and position. For instance, the term "Italian" is labelled as 'FOOD', and "Manchester" is classified as “GPE”. This systematic labelling allows the chatbot to effectively recognize and respond to queries about dining options, local activities, and places. By training the NER model with a range of examples, the system is precisely calibrated to meet the specific needs of users seeking travel information, ensuring responses are both relevant and contextually accurate.

In the training process for the UK Travel Guide Chatbot, the train_ner.py script is pivotal for refining the NER model’s ability to accurately recognize and categorize specified entities such as "FOOD" and "ACTIVITY". The script begins by importing the necessary Spacy modules and training data, then loads the pre-existing small English model (en_core_web_sm). This model is expanded by adding new entity types to its NER component.

```
# Disable other pipeline components to prevent them from affecting the training
with nlp.disable_pipes(*[pipe for pipe in nlp.pipe_names if pipe != "ner"]):
    optimizer = nlp.create_optimizer()

    # Training for 30 iterations
    for iteration in range(40):
        random.shuffle(train_data)
        losses = {}

        # Batch up the examples using spaCy's minibatch
        batches = minibatch(train_data, size=compounding(4.0, 32.0, 1.001))
        for batch in batches:
            texts, annotations = zip(*batch)
            example = [Example.from_dict(nlp.make_doc(text), annotation) for text, annotation in zip(texts, annotations)]
            nlp.update(
                example,
                drop=0.5,  # dropout - make it harder to memorize data
                losses=losses,
                sgd=optimizer
            )
        print("Losses at iteration {}: {}".format(iteration, losses))
```

Figure 14 - Code Snippet for Training NER Model

Isolating the NER component from other pipeline components is essential to the training regimen, which is accomplished by deactivating non-NER pipelines to avoid influencing the training results. As detailed in Figure 14, the training process includes 40 iterations, with data shuffled in each iteration to promote robust learning and prevent overfitting. The use of SpaCy's minibatch utility allows for batching examples with a compounding strategy that dynamically increases the batch size from 4 to 32, aiding in efficient memory management and learning rate adjustment across batches.

During training, each batch is processed to create Example objects from the text and annotations, which are then used to update the model. This update process incorporates a 0.5 dropout rate to mitigate overfitting by randomly omitting half of the neurons during each update. The optimizer, configured with SpaCy’s default settings, adjusts weights to minimize losses, which are recorded at the end of each iteration to track training progress. Upon completion of the iterations, the enhanced model is saved under "updated_ner_model," signifying improved accuracy in understanding and classifying new types of entities.

4.1.2. Usage of Flask Application

The app.py file within the project is crucial as it sets up and configures the Flask application, which serves as the backbone for the web-based user interface.

app.py > chatbot_page

```python
from flask import Flask, render_template, request, jsonify
from flask_cors import CORS
import chatbot  # Import your Python script

app = Flask(__name__)
CORS(app)  # Enable CORS for all routes

# Home page route
@app.route('/')
def index():
    return render_template('index.html')

# Chatbot page route
@app.route('/chatbot')
def chatbot_page():
    return render_template('chatbot.html')

# Existing routes for processing input and resetting
@app.route('/process_input', methods=['POST'])
def process_input():
    user_input = request.json['userInput']
    response = chatbot.chat_gpt(user_input)
    return jsonify({"response": response})

@app.route('/reset', methods=['GET'])
def reset():
    chatbot.travel_plan_state.reset()
    return jsonify({"status": "success", "message": "State reset successfully."})

if __name__ == "__main__":
    app.run(debug=True)
```

Figure 15 - Flask Application

As depicted in Figure 15, Flask is initialized and configured within this file to enable CORS, allowing the application to securely handle requests from various domains. The script outlines several routes: the home page (/) and chatbot page (/chatbot), which respectively render the index.html and chatbot.html files, providing the structural framework for user interactions. Additionally, dynamic interactions are supported through routes like "/process_input" and "/reset". The "/process_input" route manages POST requests by capturing user input through JSON, which is processed by the chatbot to generate and return responses. The "/reset" route enables users to clear the chatbot's session state, allowing the system to start anew without previous interactions influencing subsequent ones. The file concludes with a conditional statement that runs the Flask server in debug mode when executed as the main program, facilitating development, and troubleshooting by automatically reloading the server with code updates. This setup enhances development efficiency while ensuring that the application remains responsive and interactive for users.

4.1.3. Chatbot Functionalities – Extracting User Query

In the “extract_information” function of the chatbot.py file, the chatbot analyses user input to identify and categorize key preferences related to locations, foods, and activities, as shown in Figure 16. Utilizing the NER capabilities of spaCy, the script first seeks out GPE within the input, selectively updating the travel plan to include UK locations that extend beyond the generic identifier "UK." This ensures that location preferences are both specific and relevant.

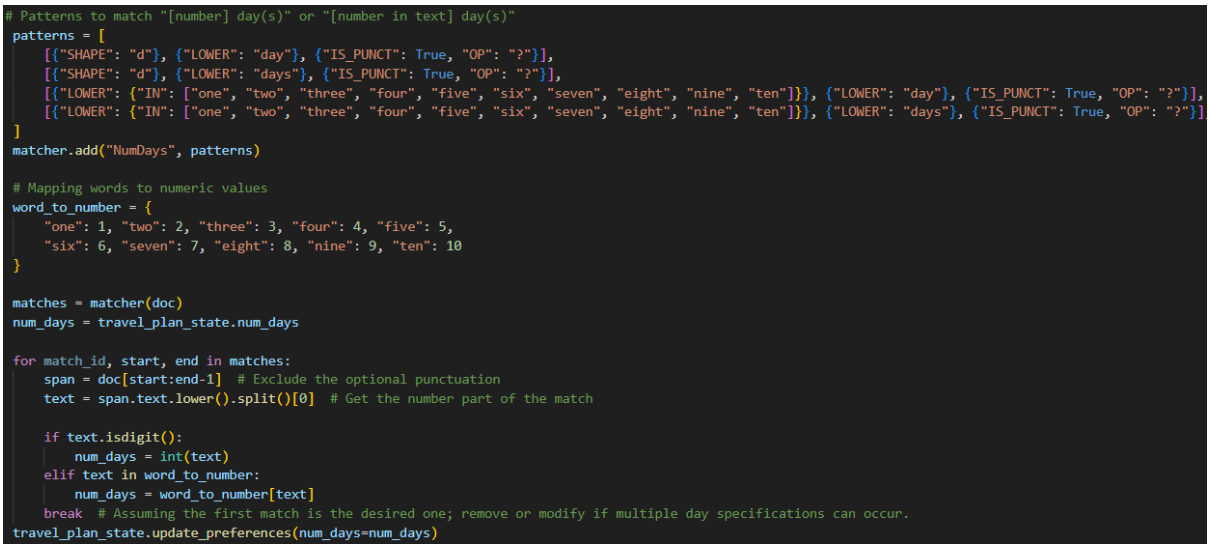
```
# Extract location
for ent in doc.ents:
    if ent.label_ == "GPE":  # GPE stands for geopolitical entity
        if ent.text != "UK" and is_location_in_uk(ent.text):
            travel_plan_state.update_preferences(location=ent.text)
            location = travel_plan_state.location
            break
if location:
    print(f"Extracted location: {location}")
else:
    print("No suitable location found.")

for ent in doc.ents:
    if ent.label_ in ["FOOD"]:
        food_preferences.add(ent.text)
    elif ent.label_ in ["ACTIVITY"]:
        activity_preferences.add(ent.text)
```

Figure 16 - Query Extraction for Location, Food, and Activities

Subsequently, the function segregates and stores entities tagged as "FOOD" or "ACTIVITY" into respective sets. This categorization enables the chatbot to tailor recommendations that align closely with the user's dietary preferences and activity interests. By effectively managing these preferences, the chatbot enhances its capability to provide personalized travel suggestions, thereby enriching the user experience. The process is transparent, with immediate feedback provided on the extraction results, enhancing the interactivity and responsiveness of the chatbot.

The “extract_information” function is also able to determine the duration of a user's trip by analysing phrases related to time, such as "three days" or "five days", which is shown in Figure 17. This analysis leverages spaCy's Matcher to identify patterns in both numerical and textual formats, with flexibility to accommodate optional punctuation. The patterns are carefully constructed to detect numbers followed by "day" or "days," capturing variations expressed in words or digits.



```
# Patterns to match "[number] day(s)" or "[number in text] day(s)"
patterns = [
    [{"SHAPE": "d"}, {"LOWER": "day"}, {"IS_PUNCT": True, "OP": "?"}],
    [{"SHAPE": "d"}, {"LOWER": "days"}, {"IS_PUNCT": True, "OP": "?"}],
    [{"LOWER": {"IN": ["one", "two", "three", "four", "five", "six", "seven", "eight", "nine", "ten"]}}, {"LOWER": "day"}, {"IS_PUNCT": True, "OP": "?"}],
    [{"LOWER": {"IN": ["one", "two", "three", "four", "five", "six", "seven", "eight", "nine", "ten"]}}, {"LOWER": "days"}, {"IS_PUNCT": True, "OP": "?"}]
]
matcher.add("NumDays", patterns)

# Mapping words to numeric values
word_to_number = {
    "one": 1, "two": 2, "three": 3, "four": 4, "five": 5,
    "six": 6, "seven": 7, "eight": 8, "nine": 9, "ten": 10
}

matches = matcher(doc)
num_days = travel_plan_state.num_days

for match_id, start, end in matches:
    span = doc[start:end-1]  # Exclude the optional punctuation
    text = span.text.lower().split()[0]  # Get the number part of the match

    if text.isdigit():
        num_days = int(text)
    elif text in word_to_number:
        num_days = word_to_number[text]
    break  # Assuming the first match is the desired one; remove or modify if multiple day specifications can occur.
travel_plan_state.update_preferences(num_days=num_days)
```

Figure 17 - Extraction of Number of Days

Upon recognizing these expressions, the chatbot converts any textual numbers into their numerical equivalents using a predefined dictionary, “word_to_number”, which maps terms like "two" or "eight" to 2 and 8, respectively. This conversion ensures that the chatbot accurately updates the “travel_plan_state” with the appropriate number of days, thus enhancing its ability to provide tailored travel recommendations based on the specified duration of the trip. This functionality not only improves the specificity of the travel planning process but also enriches the user's interaction with the chatbot by aligning the recommendations with the intended length of their stay.

4.1.4. Chatbot Functionality – External API Usage

The “get_yelp_data” function, as demonstrated in Figure 18, fundamentally enhances the Chatbot by fetching high-quality business data from Yelp based on user queries.

```python
def get_yelp_data(query, location, min_rating = 4.2, limit=40, radius=10000):
    headers = {
        "Authorization": f"Bearer {yelp_api_key}"
    }
    params = {
        "term": query,
        "location": location,
        "limit": limit,
        "radius": radius
    }

    endpoint = "https://api.yelp.com/v3/businesses/search"
    response = requests.get(endpoint, headers=headers, params=params)

    if response.status_code == 200:
        data = response.json()
        businesses = data.get("businesses", [])

        # Filter businesses by minimum rating
        filtered_businesses = [business for business in businesses if business.get("rating", 0) >= min_rating]

        return filtered_businesses
    else:
        return None
```

Figure 18 - Yelp API Function for Food and Activities

It makes a request with necessary parameters such as business type, location, and search radius, and sends it to Yelp's "businesses/search" endpoint using a secure API key. The function filters the results to include only businesses that meet a specified minimum rating, ensuring the chatbot provides reliable and relevant recommendations. If the response is successful, it returns a list of suitable businesses; if not, it returns None. This streamlined process effectively integrates external business data, enriching the chatbot's user interactions with validated, high-quality content.

The "get_hotel_data" function, as seen in Figure 19, leverages the Google Maps Places API to enhance the Chatbot by providing personalized hotel recommendations.

```python
def get_hotel_data(location, activities, food_places):
    # Get coordinates for the location
    coordinates = get_coordinates(location)

    if coordinates:
        # Make a request to the Google Maps Places API for hotels
        endpoint = "https://maps.googleapis.com/maps/api/place/nearbysearch/json"
        params = {
            "location": coordinates,
            "radius": 5000,  # Adjust the radius based on your preference
            "type": "lodging",
            "key": google_maps_api_key
        }

        response = requests.get(endpoint, params=params)

        if response.status_code == 200:
            data = response.json()
            hotels = data.get("results", [])

            # Score hotels based on ratings, affordability, and proximity
            scored_hotels = score_hotels(hotels, activities, food_places)

            # Sort hotels by score (higher score is better)
            sorted_hotels = sorted(scored_hotels, key=lambda x: x["score"], reverse=True)

            return sorted_hotels
        else:
            return None
    else:
        print("Error getting coordinates for the location.")
        return None
```

Figure 19 - Google Map API for Hotels at Location

It begins by obtaining geographical coordinates for the specified location. With these coordinates, the function queries the API to find hotels within a predefined radius, filtering for lodging types. Successful API calls return a list of hotels, which are then scored and sorted based on user preferences related to activities and dining options nearby. The top recommendations are determined by their relevance and quality, ensuring users receive the most suitable suggestions. If any step fails, such as acquiring coordinates or retrieving data from the API, the function returns None and reports an error, ensuring robust error handling in the chatbot's operation.

The gpt_response function, shown in Figure 20, is a key component of the UK Travel Guide Chatbot, utilizing the OpenAI GPT-4 API to generate intelligent, conversational responses tailored to user inquiries about UK travel.

```python
def gpt_response(user_content, token = 350):
    system_content = "Hi there! I'm Lee, your go-to travel buddy for all things UK. Whether you're looking for
    system_content += "Just a heads-up, I'm specialized in destinations within the UK, so that's where I can d
    system_message = {"role": "system", "content": system_content}

    user_message = {"role": "user", "content": user_content}
    try:
        response = client.chat.completions.create(
            model="gpt-4",
            messages=[system_message, user_message],
            temperature=1,
            max_tokens=token
        )
        chat_response = response.choices[0].message.content
        return chat_response
    except Exception as e:
        return f"Sorry, I encountered an issue: {str(e)}"
```

Figure 20 - GPT API Function for Response

It begins with a preset system message that introduces the chatbot as a specialist in UK travel, setting the stage for the user interaction. User inputs are then formatted and sent to the GPT-4 model, specifying a token limit to control response length. The API processes these inputs to produce contextually relevant advice, enhancing user engagement with accurate and helpful information. If an error occurs, such as an API limitation or connectivity issue, the function handles it gracefully, informing the user of the problem with a polite error message. This integration of advanced AI technology ensures that the chatbot provides not only informative but also responsive and user-friendly interactions.

4.1.5. Online Service Deployment – Heroku

The deployment of the application on Heroku is thoroughly tracked through an activity feed, which logs every update, build, and release.

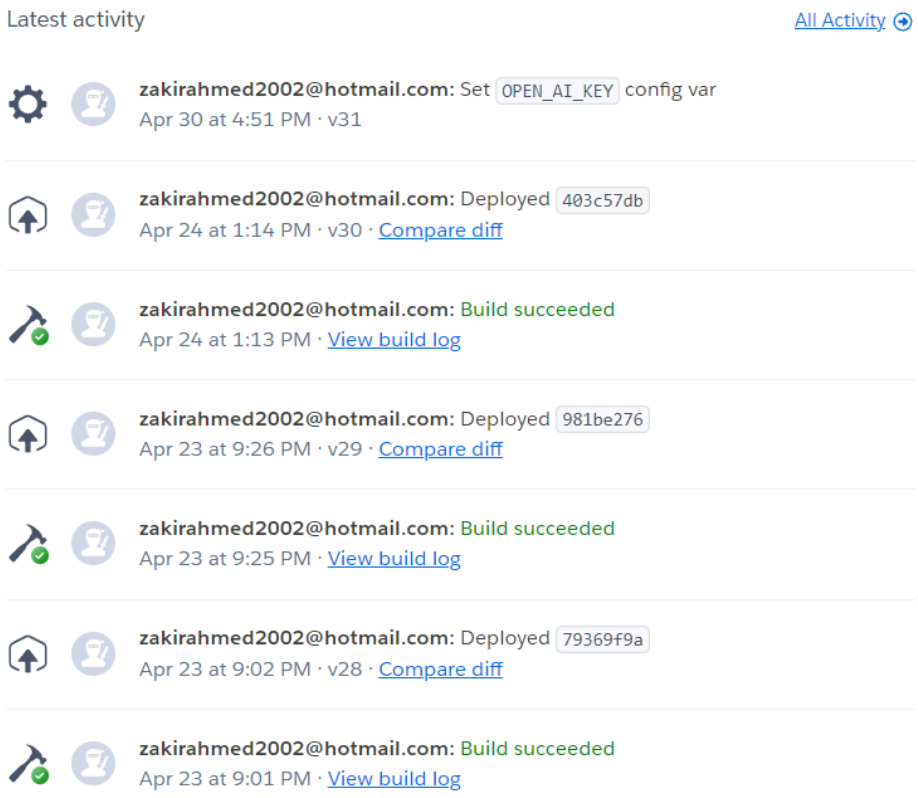


Figure 21 - Heroku Activity and Build Feed

The feed shown in Figure 21 is essential for maintaining a clear historical record of deployments and operational changes. It serves as a crucial tool for monitoring the continuous integration and deployment processes that keep the chatbot operational. This real-time logging ensures that any modifications to the chatbot are documented and traceable, enhancing both transparency and accountability in the deployment process.

The integration of GitHub with the Heroku platform, as shown in Figure 22, significantly streamlines the deployment process of the Chatbot.

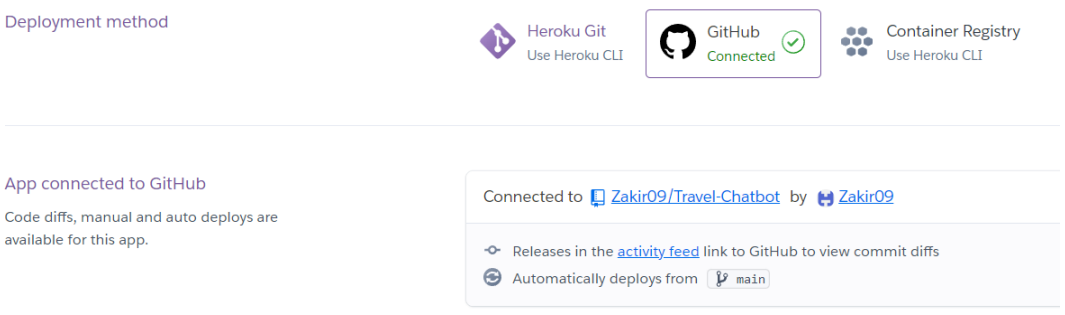


Figure 22 - GitHub Integration with Heroku Platform

By connecting the project repository to Heroku, any changes pushed to GitHub automatically trigger a new deployment, ensuring the chatbot always operates on the latest code without manual intervention. This setup exemplifies modern DevOps practices, utilizing continuous deployment from a version control system to enhance the efficiency and reliability of software updates. The automatic deployment feature not only reduces the potential for human error but also accelerates the pace at which new features and fixes are made live.

4.2. Testing

4.2.1. Functional Testing

Functional testing is an important part of making sure a software program works as it should. It checks that the software meets the required specifications. This testing involves entering data, checking the output, and seeing if it matches what was expected. This helps make sure the software works right, catches mistakes early, improves the experience for users, and follows rules and security standards (*Functional Testing - Software Testing*, 2019). The results from these tests are put into a table in Appendix C of this report. This table shows the test scenarios, what should happen, and what happened.

4.2.2. Usability Testing

Usability testing checks how easy and user-friendly a software application is. It involves watching actual users as they use the application to spot any issues that could affect their satisfaction and the software's performance. The value of usability testing comes from its focus on making sure the software works well for users, is easy to understand, and meets their needs. This kind of testing helps improve the software's design and functions, which also increases customer satisfaction and loyalty (*Usability Testing: What It Is, Benefits, and What It Isn't*, n.d.). The results and details from these tests are explained in the Evaluation Section of this report. It covers how the tests were done, what users said about the software, and what changes are suggested based on their experiences.

4.2.3. Regression Testing

Regression testing is a process where tests are repeated to check that software previously developed and tested still performs well after it has been changed. This testing is important when updates are made to the software to ensure new changes do not break any existing functionality. Regression testing is important because it helps identify problems introduced or re-introduced into the software

after changes like updates, bug fixes, or configuration changes. It is essential for keeping the software stable, user-friendly, and reliable over time, preventing any backward steps in functionality which could worsen the user experience and decrease satisfaction (Kanade, 2022).

The regression testing carried out is documented using a screenshot of the commit history from the GitHub repository, referred to as Figure 23. This screenshot shows the frequent updates made to the software and the consistent tests that follow each update. Each update in the commit history is clearly described to show what was changed, making it easy to see how the software was modified and tested over time. This method shows a careful approach to maintaining high-quality software throughout its development.

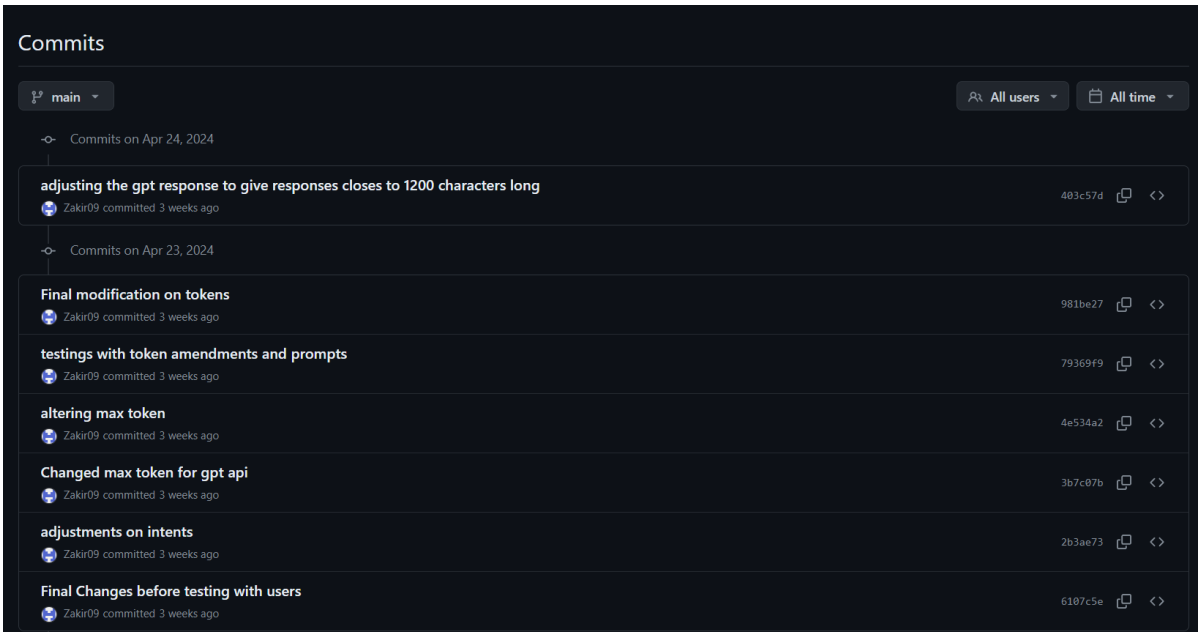


Figure 23 - Commit History

4.2.4. Performance Testing

Performance testing assesses how a software application runs under specific conditions. It examines factors such as responsiveness, stability, and speed during normal and peak usage. The goal is to identify performance issues and ensure the software meets required performance standards. This testing is essential to confirm that the software can handle its intended load without sacrificing speed or user satisfaction. It helps predict the application's behaviour under expected user loads, allowing improvements before public release (*Performance Testing - Software Testing*, 2019).

The line graph, as shown in Figure 24, illustrates the response times for general queries under typical usage conditions. The times recorded range from a minimum of 4.24 seconds to a maximum of 11.47 seconds. This graph highlights the variability in response time, which is crucial for understanding how the application behaves under different load conditions.

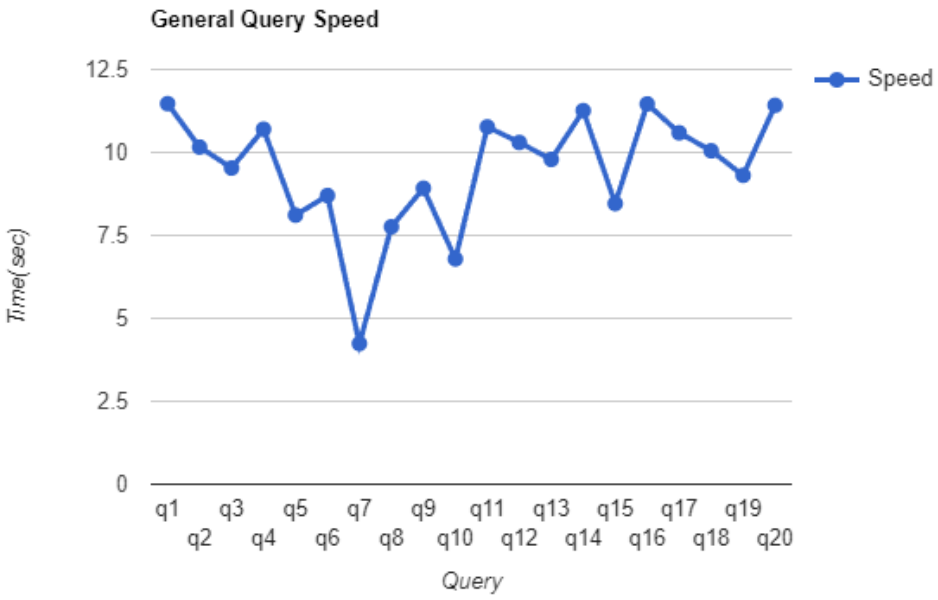


Figure 24 - General Query Speed

Displayed in Figure 25, this line graph tracks the speed of processing travel planning queries when no user preferences are included. The response times are consistent, ranging from 19.36 seconds to 22.36 seconds, providing insights into the application's performance in delivering complex information without personalized settings.

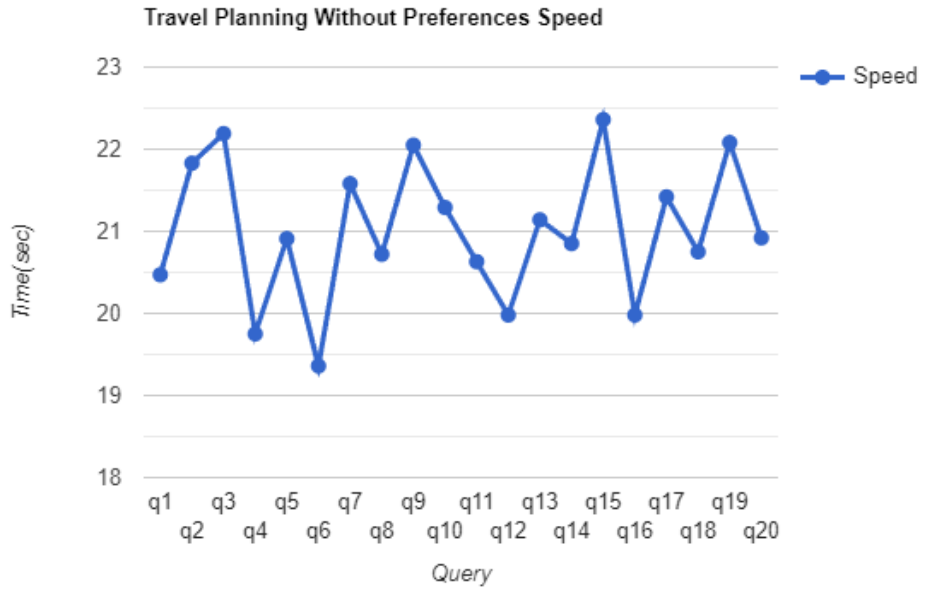


Figure 25 - Speed Testing of Travel Planning without Preferences

Figure 26 shows the response times for travel planning queries that incorporate user preferences, which are inherently more demanding. The times vary from 24.38 seconds to 28.05 seconds, indicating how preferences impact the processing time and how the system manages more personalized data.

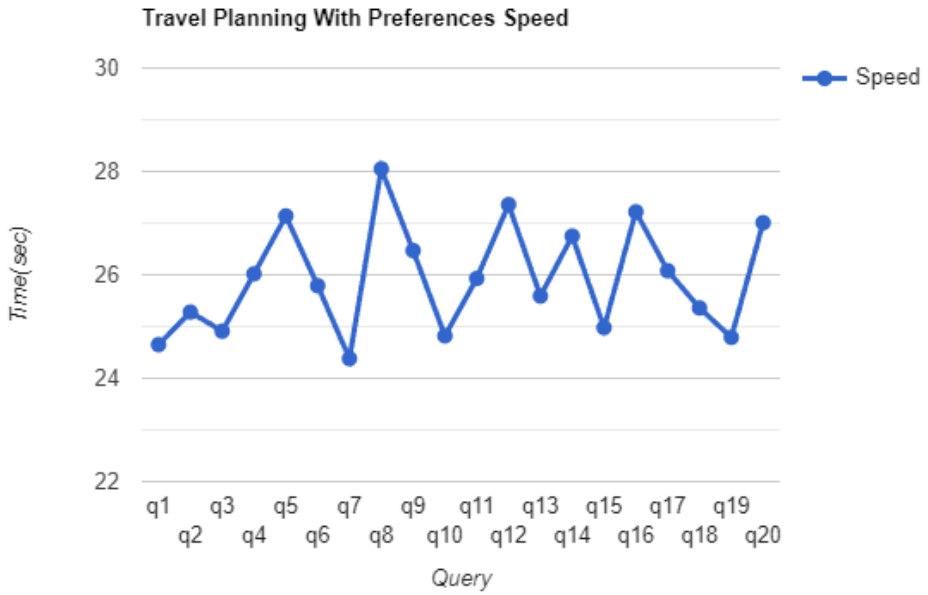


Figure 26 - Speed Testing of Travel Planning with Preferences

A bar chart in Figure 27 summarizes the average speeds for each category of query tested. It clearly shows that general queries performed fastest with an average speed of 9.38 seconds, followed by travel planning queries without preferences at 21.01 seconds, and queries with preferences at 25.92 seconds. This chart provides a comparative overview of performance across different functionalities within the application.

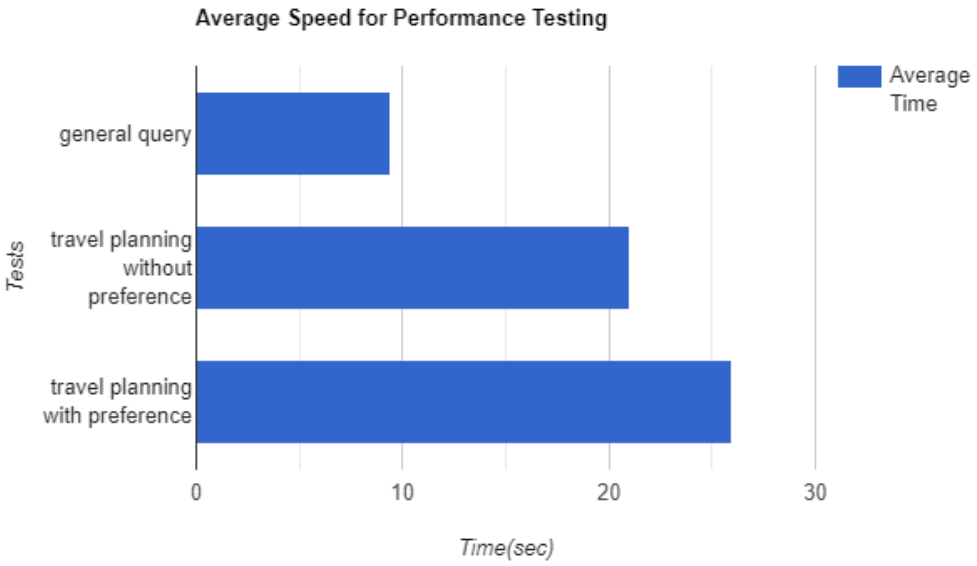


Figure 27 - Average Speed of different Query Types

5. Evaluation

This section evaluates the development and performance of the UK Travel Guide Chatbot, with a focus on usability, functionality, and alignment with project aims. The evaluation is based on feedback from participants who interacted anonymously with the chatbot, ensuring compliance with ethical guidelines established in the Ethos application. No personal details were collected, and all participant responses were stored securely on the student OneDrive. Key areas of evaluation include meeting project objectives, usability assessments, and future recommendations derived from user insights. This comprehensive evaluation provides insight into the chatbot's effectiveness and identifies opportunities for further enhancements.

5.1. Evaluation of Objectives

Objective 1: Assess Natural Language Processing (NLP) Models

Various NLP models were assessed, focusing on text recognition to support the chatbot's functionalities. SpaCy's NER models, particularly the en-core-web-sm, were selected for their efficiency in recognizing textual entities. This choice met the project's requirements for effective text processing capabilities.

Objective 2: Implement Advanced AI Models

The project began with the en-core-web-lg model but faced performance issues due to its substantial size. A switch to the smaller en-core-web-sm model, followed by retraining to better recognize different entities, met this objective by adapting to the limitations while enhancing language comprehension and response generation.

Objective 3: Integrate Diverse Data Sources

The integration of diverse data sources was largely successful, with external APIs like Google Maps and Yelp used to gather data on local businesses. User preferences on food and activities were extracted through a custom function using the retrained SpaCy model. However, the project did not incorporate real-time event data, indicating a deviation from the initial plan due to time constraints.

Objective 4: Develop a Database System

Instead of establishing a robust database system due to time limitations and developmental challenges, a class-based system was implemented to temporarily store and manage data during user sessions. This system addressed the immediate functional needs but lacked the capability for long-term data management.

Objective 5: Prioritize Usability for Non-Technical Users

Usability for non-technical users was a priority, and the project succeeded in making the chatbot accessible and engaging. User-friendly prompts and guidance were provided to facilitate interaction with the chatbot, effectively meeting this objective.

Objective 6: Create a Scalable Back-End Platform

The back-end platform, built using Flask and hosted on Heroku, successfully supports the front-end integration with the Python script managing the logic. It has demonstrated the ability to handle user queries efficiently, proving to be scalable and robust for the project's needs.

Objective 7: Integrate External APIs for Enhanced Data Reliability

The chatbot effectively uses various APIs to fetch updated information, though it fell short of incorporating real-time data updates. This limitation moderately impacts the chatbot's ability to provide the latest information.

Objective 8: Utilize Appropriate Programming Languages

Python was effectively used as the primary programming language for developing the chatbot, suitable for handling AI and NLP tasks and supporting the project's technical requirements.

Objective 9: Translate User Queries to Internal Representations

The chatbot shows strong performance in understanding and processing user queries using OpenAI's GPT-4 API. It effectively translates these queries into actionable internal representations and generates relevant responses, fulfilling this objective.

5.2. User Testing and Feedback Analysis

For the question addressing overall satisfaction with the AI travel guide chatbot, shown in Figure 28, the response distribution indicates a generally positive reception. With 55.6% of users rating their satisfaction as good and 16.7% as excellent, it is evident that the majority found the chatbot to meet or exceed their expectations in functionality and interaction quality. Notably, no users rated their satisfaction as poor, demonstrating a baseline level of acceptance and satisfaction across the board. However, the presence of a neutral response from 27.8% of participants suggests there is room for improvement. This neutral sentiment points to possible unmet expectations, which may relate to aspects such as the level of personalization, response time, or the depth of functionalities offered by the chatbot. These insights are

critical as they reflect on the project's objective to enhance user experience through advanced AI and suggest that focusing on converting neutral responses to more positive ones could be a valuable direction for future development efforts.

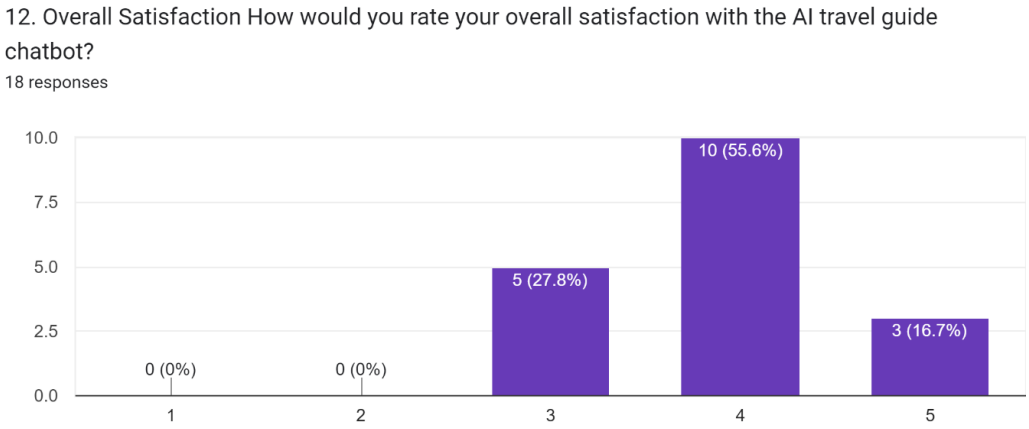


Figure 28 - Feedback on Overall Satisfaction

For the question concerning the ease of use of the AI travel guide chatbot, shown in Figure 29, participant feedback was overwhelmingly positive. A substantial majority, 55.6%, found the chatbot very easy to interact with, rating ease of use as 4, while 44.4% rated it as very easy, giving it the highest score of 5. This indicates that almost all users experienced a smooth interaction with the chatbot, highlighting its user-friendly design and intuitive interface. The absence of any ratings below 3 is particularly notable, suggesting that the chatbot successfully met the usability requirements for all participants. This feedback aligns well with the project's goals of creating a tool that is accessible and efficient, even for users who may not be technically adept. Improving the chatbot to achieve a perfect score from more users could involve refining interactive elements and possibly enhancing on-screen guidance to facilitate even smoother interactions.

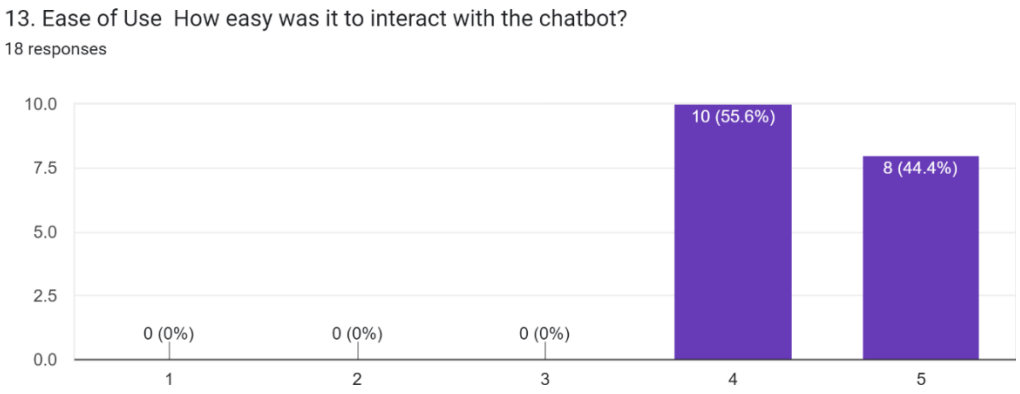


Figure 29 - Feedback on Ease of Use

For the question on the functionality of the AI travel guide chatbot, shown in Figure 30, the responses indicated strong performance in understanding user queries. A majority of 83.3% of participants rated the chatbot's ability to understand their inputs as good, scoring it a 4, while an additional 11.1% considered it excellent, awarding the highest score of 5. This reflects positively on the chatbot's natural language processing capabilities, suggesting that the implemented AI models are effectively interpreting and responding to user requests. However, a small segment, 5.6%, gave a neutral rating of 3, pointing to some room for improvement in ensuring consistent comprehension across all types of queries. Enhancing the chatbot's ability to understand varied inputs and complex questions could help in elevating these neutral perceptions to more favourable responses, thereby aligning more closely with the project's aim to deliver an advanced, user-oriented conversational experience.

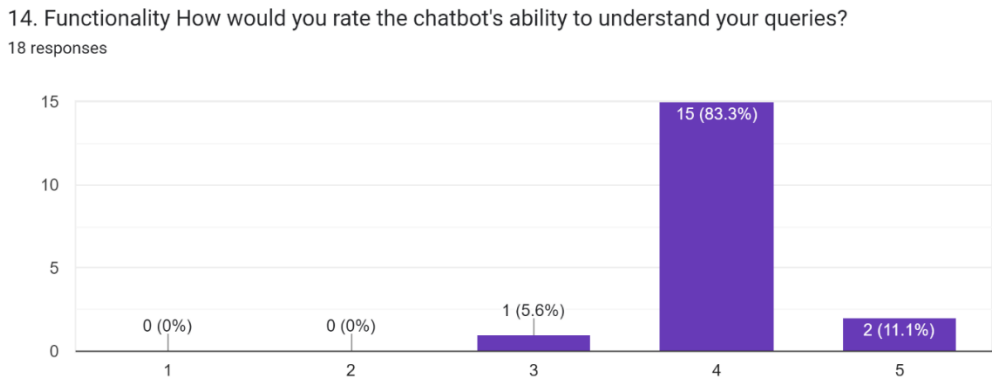


Figure 30 - Feedback on Functionality

The question concerning the user interface of the AI travel guide chatbot, shown in Figure 31, yielded a varied range of responses. While a notable 33.3% of participants rated the design and layout as excellent, a slightly smaller proportion, 27.8%, considered it good, indicating a generally positive reception. However, 22.2% gave it a neutral rating and 16.7% rated it as poor, suggesting that the interface did not meet expectations for all users. These mixed reviews highlight areas for potential enhancement in the user interface design. Specifically, the feedback points towards the need for a more intuitive and visually appealing layout that could further ease user interactions and enhance overall satisfaction. Addressing these concerns could significantly improve the user experience, aligning the chatbot more closely with the project's goals of accessibility and user-friendliness.

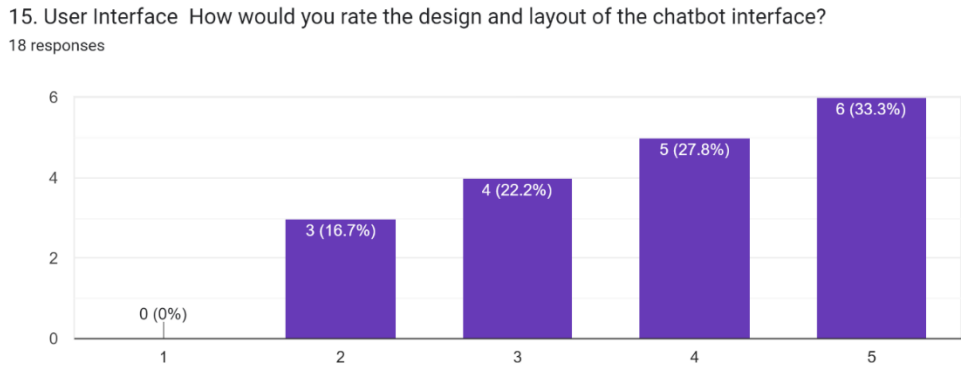


Figure 31 - Feedback on User Interface

Feedback on the personalization capabilities of the AI travel guide chatbot, shown in Figure 32, was largely positive, reflecting the system's effectiveness in tailoring recommendations and interactions to individual user preferences. Most participants, 55.6%, rated the personalization as good, and 27.8% found it to be highly personalized, giving it the top score. This suggests that the chatbot successfully provided tailored information that resonated well with most users. However, a small fraction, 11.1%, rated it as moderately personalized, and 5.6% felt it was less personalized. These responses indicate an opportunity to enhance the depth of customization. Improving the chatbot's algorithms to better understand and adapt to varied user inputs and preferences could help convert moderate satisfaction into higher ratings, further strengthening the user experience and fulfilling the project's aim to provide a highly personalized travel planning tool.

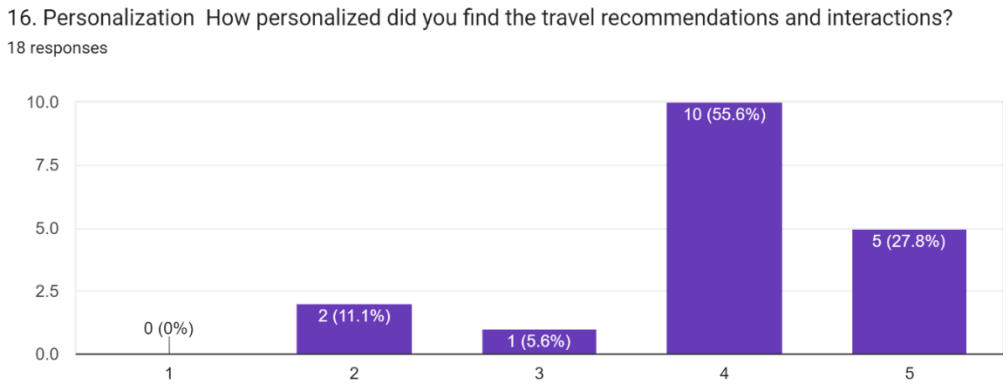


Figure 32 - Feedback on Personalization

The question regarding the helpfulness of the AI travel guide chatbot in planning travel, shown in Figure 33, revealed encouraging results. Notably, 38.9% of participants rated the chatbot's assistance as very helpful, and 33.3% found it to be generally helpful, indicating that a majority found the tool effective in facilitating their travel planning. However, 22.2% of users rated its helpfulness as neutral, and a small percentage (5.6%) considered it to be less helpful. These findings suggest that while the chatbot serves its primary function well for most, there is potential to enhance how it supports users in their travel arrangements. Improving response accuracy, expanding information depth, and optimizing user interaction could elevate the perceived helpfulness, ensuring the chatbot more effectively meets the diverse needs of all users and aligns more closely with the project's objectives to aid in efficient and informed travel planning.

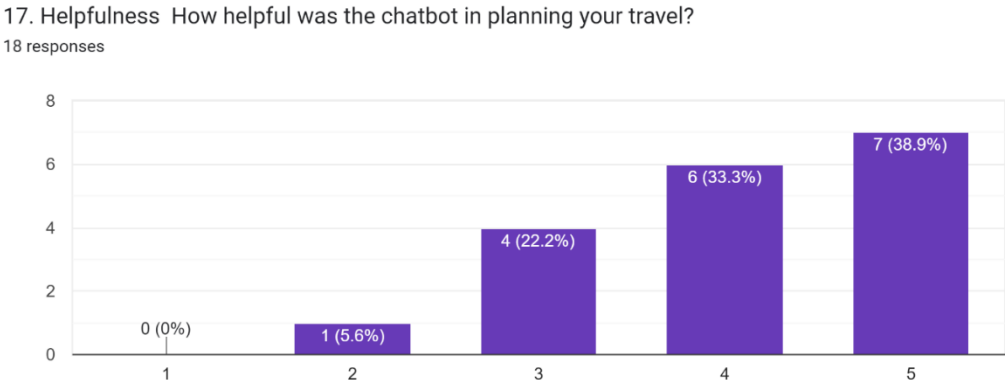


Figure 33 - Feedback on Helpfulness

Feedback on the likelihood of reuse, shown in Figure 34, highlights the users' willingness to engage with the AI travel guide chatbot for future travel planning. The data shows a promising trend, with 38.9% of participants indicating they are very likely to use the chatbot again and an additional 27.8% rating their likelihood as likely. This suggests a strong overall approval of the chatbot's utility and user experience. However, a total of 33.3% of users expressed only a neutral position or some reluctance (11.2% as unlikely), pointing to areas where the chatbot could improve to increase user retention. Enhancements focused on speeding up response times, increasing the relevancy of the information provided, and further personalizing the interaction could turn occasional users into regular ones. Addressing these aspects could significantly boost the chatbot's appeal and encourage more frequent use, aligning it more closely with the project's goal of becoming a go-to travel planning companion.

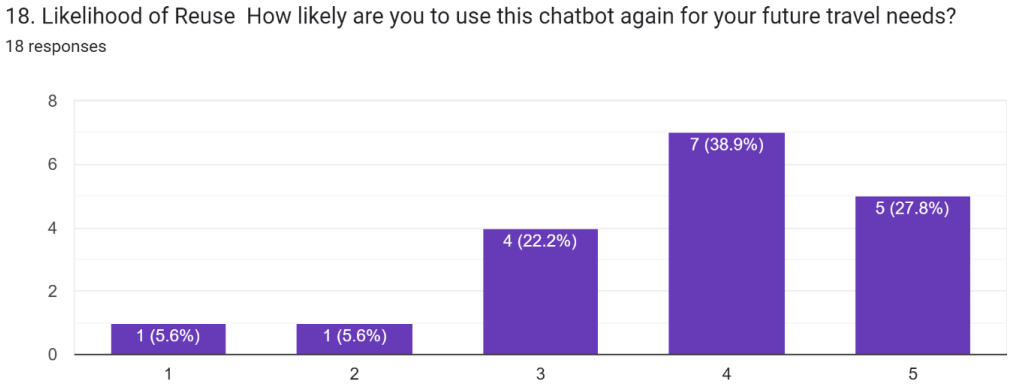


Figure 34 - Feedback on Likelihood of Reuse

6. Conclusion

In this final chapter, I draw together the themes and arguments presented throughout this report, reflecting on the achievements, challenges, and potential future developments of the project.

6.1. Completed Work

The main goal of this project was to make trip planning across the UK easier by offering users dependable, personalized travel advice. This was achieved by developing an AI-driven UK Travel Guide that would provide real-time, conversational interactions to deliver customized travel information. The project aimed to create a travel guide that feels like talking to a knowledgeable friend, using NLP to ensure the chatbot could understand and respond in a human-like way.

Several key tasks and components were completed to achieve this. Advanced AI models were implemented to improve the chatbot's ability to comprehend language and generate responses, ensuring effective user engagement. A strategy was used to collect and integrate various data sources, including specific location data, user preferences, and user-generated content, which enhanced the quality and relevance of the advice provided.

The system was designed with non-technical users in mind to ensure a seamless and engaging experience, resulting in an intuitive interface that makes interaction easy. A scalable and efficient backend platform was developed to host the chatbot and manage user queries reliably. Additionally, external APIs for travel and regional data were integrated to provide accurate information, significantly enhancing the chatbot's utility. The system was designed to translate user queries into internal representations, enabling it to generate relevant and contextually appropriate responses.

A particularly successful feature of the project was its ability to extract information from user inputs, such as location, duration of stay, and preferences for food and activities. This feature allowed the chatbot to fetch information on various businesses that matched the user's specific preferences, greatly enhancing the personalization and usefulness of the advice provided.

One significant challenge encountered was the initial attempt to train and implement a NER model using SpaCy's larger model, en-core-web-lg, which posed integration challenges. The solution was to switch to a smaller model, en-core-web-sm, and retrain it to detect and recognize different entities like locations, food, and activity preferences. This adjustment not only resolved the integration issues but also maintained the accuracy and effectiveness of the entity recognition process.

These achievements highlight the practical and theoretical contributions of the project, demonstrating its potential in trip planning around the UK by offering a personalized, user-friendly, and reliable travel guide.

6.2. Limitations

Despite the successes achieved in this project, several limitations were encountered that impacted the overall functionality and user experience of the AI-driven chatbot. One significant limitation was the inability to implement a database to store conversation logs and user data such as preferences, hobbies, and desired locations. This feature would have further enhanced personalization by allowing the chatbot to remember user interactions across sessions. As a short-term solution, a class system was used to store data temporarily during a session. Additionally, the implementation of a login system, which would have enabled users to save and track their preferences over multiple sessions, was not pursued due to time constraints.

Another limitation was the inability to provide real-time updates on locations that users were planning to visit. Offering live information would have likely improved user retention and engagement, delivering a more dynamic and responsive user experience. However, this feature could not be integrated within the project's timeframe.

Functional testing highlighted several areas where the chatbot performed well, but also revealed specific limitations. While the chatbot successfully responded to simple greetings, recognized locations within the UK, updated activity, and food preferences, and generated concise travel itineraries, it struggled in certain scenarios. For instance, the chatbot failed to provide hotel recommendations based on user preferences and locations, which was a critical feature for a comprehensive travel guide. Additionally, it did not correctly process multiple locations mentioned in one message, and it struggled with rapid context-switching queries.

These limitations point to areas that require further development and optimization. Addressing these issues in future iterations would significantly enhance the chatbot's performance and user satisfaction.

6.3. Future Work

Following user testing and feedback, several improvements have been identified that could significantly enhance the functionality and user experience of the AI travel guide chatbot. While users showed overall satisfaction, the presence of neutral responses highlights areas for improvement.

One priority for future development is to enhance personalization. Integrating a database to store conversation logs and user data would enable the chatbot to provide more customized advice and remember previous interactions across sessions. Additionally, implementing a login system would allow users to save and track their preferences for a more personalized and consistent experience.

Another enhancement could be the inclusion of visual elements, such as images of businesses mentioned in the chatbot's responses. This feature could enhance user retention and engagement by making interactions more immersive and visually attractive.

Expanding the chatbot's functionality to include real-time updates about transportation, weather, and emergencies would greatly improve its utility. Providing timely and relevant information would make the chatbot a more comprehensive travel companion. Extending language support to include multiple languages would also make the chatbot more accessible to a broader audience, aligning with the project's inclusivity goals.

Reflecting on the overall project, the knowledge from various courses during the degree enhanced the development and success of this chatbot. The Artificial Intelligence course was particularly valuable, as it provided essential concepts and guidance on training models. A greater focus on the design and testing phases might have resulted in a more coherent and robust product. Continuous development and optimization will help the chatbot become a preferred travel planning tool, meeting the diverse needs of all users, and achieving the project's goals.

By addressing these areas, the AI travel guide chatbot can be developed further to offer an even more personalized, comprehensive, and user-friendly experience, ensuring it meets and surpasses user expectations in future iterations.

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Appendices

Appendix A: Feasibility Study

MANCHESTER METROPOLITAN UNIVERSITY DEPARTMENT OF COMPUTING AND MATHEMATICS

6G6Z0018 RESEARCH METHODS FEASIBILITY STUDY

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Project Theme:	Artificial Intelligence
Project title:	AI-Powered UK Travel Guide Chatbot

Table of Contents

1. Aims and Objectives

1.1. Aims

The objective of this project is to develop an innovative UK Travel Guide Chatbot, leveraging AI to provide personalized and real-time information about selected locations within the UK. The chatbot's functionality is designed to hand out customized recommendations covering regional attractions, dining options, upcoming events, and transportation alternatives through interactive, human-like dialogues. The principal aim is to improve the user experience by integrating advanced AI models for enhanced language comprehension, drawing from a varied array of data sources. The fundamental desire is to deliver an AI-driven travel companion that is user-friendly, efficient, and ethically sound.

1.2. Objectives

1. Assess various Natural Language Processing models and architectures in the context of chatbot development.
2. Implement advanced AI models to enhance the chatbot’s language comprehension and response generation capabilities.
3. Develop a strategy for gathering and integrating diverse data sources, including location-specific data, user preferences, real-time event feeds, and user-generated content.
4. Design and implement a robust database system using appropriate technologies to store and manage the collected data.
5. Prioritize usability for non-technical users to ensure a seamless and engaging user experience.
6. Create a scalable and efficient back-end platform to host the chatbot and handle user queries.
7. Integrate external APIs for travel and regional data to enhance the chatbot's capabilities in providing real-time and accurate information.
8. Utilize programming languages suitable for the development of the chatbot.
9. Implement and evaluate existing AI paradigms relevant to natural language processing and chatbot development.
10. Translate user queries to internal representations and evaluate the system’s ability to generate relevant responses.

1.3. Learning Outcomes

- The elements which support computational thinking.
- The underpinning mathematical, logical, and technical principles required for the development of modern computational tools.
- Use of programming languages for the development of appropriate computational solutions to problems.
- Implement and evaluate contemporary artificial intelligence paradigms for the solution of computational problems.

2. Literature Survey

2.3. Background Information and Expected Activities

This project aims to boost the travel and tourism sector by improving how people plan trips to specific destinations through the integration of Artificial Intelligence. Occurring in the 1940s, Artificial Intelligence gained traction through crucial inputs such as Isaac Asimov's Three Laws of Robotics and Alan Turing's notion of machine intelligence (Haenlein and Kaplan, 2019). The Dartmouth Conference in 1956 officially established AI, initiating a phase of optimism marked by early successes like the ELIZA program. Yet, unmet expectations caused a decline in the 1970s. A revival occurred with progress in neural networks and Deep Learning, forming the core for present-day applications such as image and speech recognition.

Currently, the Travel & Tourism industry is expanding significantly, targeting £679.80bn in revenue in 2023, with a projected growth to £727bn by 2027. In the hotel sector, contributing £326.10bn in 2023, there is an expected increase in user engagement of 27.2% by 2027, with online sales charging a significant 74% market share (*Travel & Tourism - Worldwide | Statista Market Forecast*, n.d.).

The heart of this project holds significant importance today, fitting into the changing landscape of global travel. With technology, especially artificial intelligence, shaping how we interact with hotels and tourism, AI technology takes a vital role in this progression. Alongside data analytics, it not only offers real-time info but also understands what travelers want for a more personalized experience (Bowen and Whalen, 2017). Social media adds to this impact, helping people connect across cultures through tailored suggestions.

This proposal looks ahead, tying into the broader world of travel and tourism, a force that shapes our social, economic, and cultural experiences. Beyond creating jobs and developing infrastructure, tourism helps us understand each other and protects our natural and cultural heritage (Bunghez, 2016).

When individuals begin planning trips to different destinations, they typically engage with a travel agent or opt for independent arrangements facilitated by local experts possessing

comprehensive knowledge about the destination. These experts are entrusted with planning the entire trip based on their insightful understanding of the locality.

Relying on this method for trip planning comes with certain limitations that must be considered. Firstly, the issue of scalability occurs, presenting a challenge as the need for individual experts may hold back the system's capacity to efficiently offer to a growing user base. As the number of users increases, the system may encounter difficulties in managing and responding to a higher volume of trip planning requests. This can lead to delays and a potential decline in the overall user experience.

Secondly, personal biases in recommendations may surface because of this method. These biases can be influenced by the personal preferences of the expert or their limited local perspectives. Such biases have the potential to impact the diversity of suggested destinations, as the recommendations may accidentally reflect the individual tendencies of the expert rather than offering a comprehensive and varied selection. This can result in a lack of inclusivity and may not satisfy the diverse preferences of the user base.

Thirdly, the method's reliance on expert availability introduces the risk of potential delays, particularly during peak times. As user demand surges, the system's responsiveness to user requests may be held back by the availability of the experts. Delays in obtaining trip plans or recommendations could be a significant drawback, especially for users seeking immediate assistance or planning their trips within tight time limits. This dependency on expert availability may impact the efficiency and effectiveness of the trip planning process.

Looking ahead, the acknowledgment of limitations in traditional travel planning pushes the integration of AI-driven travel guides into a promising solution, drawing inspiration from the success of medical chatbots employing GPT-4 technology (Lee et al., 2023). These innovative travel guides would be anticipated to follow a path like successful healthcare applications, striking on AI capabilities to provide users with real-time updates, personalized recommendations, and adaptability to individual preferences.

Much like the healthcare sector, where AI chatbots have demonstrated their effectiveness in enhancing healthcare delivery, the travel industry looks toward embracing a more intelligent and adaptive approach. The lessons collected from the medical field serve as a guiding beacon, steering the travel industry toward a more educated, tech-driven future. The aim is to cater to the diverse needs of modern travelers, promising a travel planning experience that goes beyond conventional boundaries.

The travel industry has been changing a lot because of artificial intelligence. People, such as Celia Quillian, are realizing how AI, especially ChatGPT, can change the way we plan our travels. Celia used ChatGPT to get suggestions for a destination based on what she was looking for, making her trip planning much easier (*How AI Could Transform Travel–and How to Take Advantage of It*, 2023). Tui, a big travel company, also uses ChatGPT in its app to introduce a new AI tour guide—a chatbot that gives helpful information and personal recommendations for holiday activities (Jolly, 2023).

During early 2023, Trip.com launched TripGen, an AI-powered chatbot designed to revolutionize travel assistance. TripGen uses advanced context-based Natural Language Processing integrated with AI to provide instant travel tips, inspiration, and itinerary

suggestions in four languages (Jenny, 2023). This marks a shift towards real-time assistance and personalized recommendations for travelers during both pre-trip decisions and in-trip arrangements. The introduction of TripGen aligns with the broader trend of major travel companies, such as Tui and Expedia, integrating AI into their services to enhance customer experiences and streamline operations. These examples show how AI, represented by models like ChatGPT and innovative chatbots like TripGen, continues to reshape the landscape of travel, offering dynamic and personalized solutions to both individual travelers and major industry players.

2.3. Evaluation Plan

A key focus for this project is on real-time execution, examining how the system handles errors, unexpected queries, and misunderstandings, ensuring a seamless user experience. This evaluation will be conducted through beta testing and feedback from a diverse group of international students, allowing for a thorough understanding of the chatbot's adaptability and responsiveness.

Ensuring fairness and balance is a top priority, and I'll be tackling this by actively testing for biases through beta testing and gathering valuable feedback. Rigorous evaluation of model performance will include assessing accuracy rates in delivering travel recommendations and the chatbot's success rate in working with external APIs for travel information in different scenarios. These quantitative metrics will provide explicit insights into the chatbot's effectiveness.

Moreover, user satisfaction scores and surveys will serve as a vital component of feedback, offering a comprehensive perspective on the chatbot's engagement with users. By analyzing how well the chatbot meets user expectations and preferences, I can refine its features and functionalities to enhance overall satisfaction.

Considering the potential widespread use of the chatbot, scalability is something that must be considered. Plans for scaling the system to accommodate a growing user base will be outlined, ensuring a smooth and efficient experience for users as demand increases.

2.3. Ethical Issues, Physical Risks, and Mitigations of Both

In the context of this project, it is crucial to consider ethical aspects. One significant concern is the potential unintended influence of the chatbot on users through persuasive language. To address this, I must carefully design the chatbot, prioritizing transparency and honesty. This involves explicitly stating its limitations and implementing safeguards to prevent manipulation of users into decision-making based on persuasive tactics.

Another ethical issue to be aware of is the risk of users relying excessively on the chatbot. To mitigate this concern, we need to develop features and messaging that actively encourage users to see the chatbot as a helpful tool for assistance rather than the sole decision-making authority. It is essential to accompany this with a clear and comprehensive disclaimer, outlining the inherent limitations of the AI used. This approach aims to promote informed and responsible user engagement within ethical boundaries.

One final ethical consideration that deserves attention refers to the possibility of bias in the recommendations made by the AI. This occurs when the AI unintentionally leans towards certain preferences in its suggestions, influenced by the patterns in the training data. To address this concern, an initiative-taking approach involves consistently reviewing and updating the training data. This ongoing process not only minimizes bias but also enhances transparency in the way recommendations are generated.

Moreover, there are some practical risks tied to the project that I need to be mindful of. One key concern is the chance of the chatbot providing inaccurate or unreliable travel info, which could potentially put users' safety on the line. To address this, it is crucial to ensure the information is up to date in real time. We also need to be upfront about what the chatbot can and cannot do, and strongly encourage users to double-check key details before relying solely on the chatbot.

Another significant risk involves the technical side, particularly when integrating various travel info from diverse sources. This process might come with challenges and compatibility issues. To avoid problems, I must conduct thorough testing during the integration phase. This involves checking if everything works well together and making sure there is a plan in place to manage any unexpected issues that might pop up. Having emergency measures ready ensures a smoother operation and helps maintain a reliable service for users.

3. Project Plan

3.3. Activity Sequence

Weeks 1-2: Focus on assembling a diverse dataset for ChatGPT 4 model, ensuring cleanliness and readiness for model training to establish a solid foundation.

Weeks 3-4: Shift focus to selecting and configuring ChatGPT 4 model, aligning its application with the travel guide chatbot objectives. Develop and test initial models to address challenges and enhance performance.

Weeks 5-6: Begin the design phase, creating a user-friendly interface for the chatbot, integrating ChatGPT 4 capabilities. Plan for thorough user feedback collection, maintaining a user-centered approach.

Week 7: Plan the integration of ChatGPT 4, external APIs, and the user interface into the website. Coordinate for features like recommendations and navigation, developing a detailed integration plan and an initial website layout draft.

Weeks 8-11: Implement the integration plan, developing the website with features enabled by ChatGPT 4 and external APIs. Conduct preliminary testing, refine drafts based on user feedback, ensuring a user-friendly interface.

Week 12: Focus on user-centered activities, including testing sessions and surveys for insights. Adjust the user interface, website layout, and interactions with ChatGPT 4 based on detailed feedback. Finalize the website layout for a visually appealing platform.

Final Week: Make last adjustments based on user feedback, ensuring seamless integration of ChatGPT 4, external APIs, and the user interface. Conduct thorough testing to address any remaining issues for an enhanced AI-powered travel guide experience.

3.3. Risks to Protect Completion and Back-up Plans

The project faces challenges, starting with Data Quality Issues, which arise from the possibility of insufficient or irrelevant training data affecting the model's accuracy. To mitigate this, alternative functionalities will be established, and exploration of additional models with tailored features is ready if needed, ensuring adaptability and resilience in dynamic data scenarios.

User Interface Design Misalignment is another consideration, where the integration may not align seamlessly, causing user dissatisfaction. To address this, backup plans involve developing alternative design prototypes during the initial phase, allowing the selection of the most effective integration approach for a user-friendly experience.

Integration Complexity is the third challenge, involving potential difficulties in incorporating ChatGPT 4 and external APIs into the user interface. A phased integration approach will be used, incrementally testing, and resolving issues at each stage to ensure a smooth user experience.

For ChatGPT 4, a backup plan includes establishing a fallback mechanism and a moderation system to control and filter unpredictable outputs. User instructions will be refined, and regular monitoring and updates to training data will minimize biases and enhance accuracy.

Regarding external APIs, diversifying data sources is a potential backup plan, integrating alternative APIs if technical issues arise. Communication with API providers will be maintained, and fault tolerance in the integration system will ensure seamless transitions to backup APIs, with continuous testing and monitoring for reliability.

Lastly, the risk of Unpredictable Model Responses will be addressed by implementing moderation and filtering mechanisms to control outputs. Clear user instructions will minimize the potential for unpredictable responses, fostering a user experience aligned with expectations.

3.3. Resources Required

Programming Language - Python

Choosing Python as the programming language is crucial for the project's success. Python's rich set of tools, libraries, and seamless integration with the GPT-4 model make it an ideal choice. The language's simplicity and widespread use provide accessibility, facilitating the development of an advanced conversational agent with powerful language processing capabilities (*Role of Python in Artificial Intelligence | LinkedIn*, 2023).

Natural Language Processing Libraries - NLTK or spaCy

Opting for NLTK or spaCy is fundamental to the project's natural language processing tasks. These libraries offer user-friendly tools and functionalities, ensuring the seamless implementation of language processing features crucial for building a sophisticated

conversational agent (*NLTK vs spaCy - Python based NLP libraries and their functions | LinkedIn*, 2023).

Framework for Web development – Flask or Django

Choosing between Flask and Django depends on the project needs. Flask is lightweight, offering flexibility for a tailored approach, while Django provides built-in tools and features for a more structured development experience (Mashutin, 2023). The decision hinges on simplicity and flexibility with Flask or a comprehensive framework with Django, both aligning with the user-friendly nature of Python for an accessible and efficient development process.

GPT-4 API Access

Utilizing GPT-4 API access is essential for using advanced language generation capabilities. The API seamlessly integrates with Python, offering a straightforward means to incorporate powerful language processing into the chatbot. This integration ensures a robust conversational experience, enhancing the overall effectiveness of the project.

External APIs

Incorporating external APIs is crucial for accessing real-time travel information. Integrated seamlessly with Python, these APIs allow for the retrieval of dynamic data on locations, hotels, and transportation, enriching the chatbot's capabilities and providing users with accurate and up-to-date travel recommendations.

Datasets

Incorporating relevant datasets is fundamental for training the model and enhancing its performance. Open-sourced datasets containing different travel and tourism information serve as the foundation for teaching the chatbot to understand user queries and generate contextually relevant responses, ensuring accurate and informed travel recommendations.

Front-End Development Tools - HTML, CSS, JavaScript, Bootstrap, React

Leveraging front-end tools such as HTML, CSS, JavaScript, Bootstrap, and React is pivotal for crafting an engaging and user-friendly interface. These tools, known for their accessibility and versatility, enable the creation of visually appealing designs and seamless user interactions, ensuring a positive and intuitive experience for chatbot users.

Version Control - Git and GitHub

Incorporating version control tools like Git and GitHub is essential for efficient code management and project tracking. These tools facilitate organized record-keeping of changes, tracking project milestones, and easy version rollback, ensuring a streamlined and organized development process (Kattekaden, 2023).

Design Tool - Figma

Utilizing Figma for designing the user interface is crucial for creating a visually appealing and intuitive experience. Figma simplifies the design process, allowing efficient creation of wireframes and prototypes, contributing to the overall user-friendly experience of the chatbot.

Project Management Tool - Trello

Employing Trello for effective project management and task organization is essential. Trello provides a visual and user-friendly platform for creating boards, lists, and cards, enabling

efficient tracking of project progress, milestones, and task management throughout the development process.

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Appendix B: Selected training data examples from training_data.py for retraining NER model.

```
train_data = [
    ("I love Italian food because of its rich flavors.", {"entities": [(7, 14,
"FOOD")]}),
    ("Do you want to try Chinese cuisine tonight?", {"entities": [(19, 26,
"FOOD")]}),
    ("We went to a Mexican restaurant last night.", {"entities": [(13, 20,
"FOOD")]}),
    ("Indian spices are the best for cooking.", {"entities": [(0, 6,
"FOOD")]}),
    ("Japanese sushi is different from sashimi.", {"entities": [(0, 8,
"FOOD"), (9, 14, "FOOD")]}),
    ("They serve Thai food at the local market.", {"entities": [(11, 15,
"FOOD")]}),
    ("We visited a French bakery yesterday.", {"entities": [(13, 19,
"FOOD")]}),
    ("The Mediterranean diet is very healthy.", {"entities": [(4, 17,
"FOOD")]}),
    ("American burgers are my favorite.", {"entities": [(0, 8, "FOOD")]}),
    ("I'm going to a BBQ this weekend.", {"entities": [(15, 18, "FOOD")]}),
    ("Is there a vegan option available?", {"entities": [(11, 16, "FOOD")]}),
    ("She prefers vegetarian meals.", {"entities": [(12, 22, "FOOD")]}),
    ("We had seafood by the coast.", {"entities": [(7, 14, "FOOD")]}),
    ("This is the best steakhouse in town.", {"entities": [(17, 27,
"FOOD")]}),
    ("Let's meet at the cafe later.", {"entities": [(18, 22, "FOOD")]}),
    ("The buffet was quite varied and large.", {"entities": [(4, 10,
"FOOD")]}),
    ("We met at the pub last evening.", {"entities": [(14, 17, "FOOD")]}),
    ("I love eating fast food occasionally.", {"entities": [(14, 23,
"FOOD")]}),
    ("That food truck sells amazing tacos.", {"entities": [(5, 15, "FOOD")]}),
    ("They specialize in fusion cuisine.", {"entities": [(19, 25, "FOOD")]}),
    ("Gourmet cooking is his passion.", {"entities": [(0, 7, "FOOD")]}),
    ("They serve tapas at this bar.", {"entities": [(11, 16, "FOOD")]}),
    ("We ate at a diner last night.", {"entities": [(12, 17, "FOOD")]}),
    ("Sushi is popular around here.", {"entities": [(0, 5, "FOOD")]}),
    ("I need a list of halal restaurants.", {"entities": [(17, 22, "FOOD")]}),
    ("Korean BBQ is one of my favorites.", {"entities": [(0, 6, "FOOD"), (7,
10, "FOOD")]}),
    ("Have you ever tried Vietnamese pho?", {"entities": [(20, 30, "FOOD"),
(31, 34, "FOOD")]}),
    ("We should get some Spanish tapas.", {"entities": [(19, 26, "FOOD"), (27,
32, "FOOD")]}),
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    ("Greek cuisine is all about olives and feta.", {"entities": [(0, 5,
"FOOD"), (27, 33, "FOOD"), (38, 42, "FOOD")]}),
    ("Lebanese food is very flavorful.", {"entities": [(0, 8, "FOOD")]}),
    ("Turkish coffee is quite strong.", {"entities": [(0, 7, "FOOD"), (8, 14,
"FOOD")]}),
    ("Ethiopian food is unique and spicy.", {"entities": [(0, 9, "FOOD")]}),
    ("I enjoyed the Caribbean festival.", {"entities": [(14, 23, "FOOD")]}),
    ("She cooks Peruvian dishes at home.", {"entities": [(10, 18, "FOOD")]}),
    ("We went hiking in the mountains yesterday.", {"entities": [(8, 14,
"ACTIVITY")]}),
    ("She loves shopping at the new shopping centre.", {"entities": [(10, 18,
"ACTIVITY"), (30, 45, "ACTIVITY")]}),
    ("They visited the museum last weekend.", {"entities": [(17, 23,
"ACTIVITY")]}),
    ("The kids enjoyed the theme park during their vacation.", {"entities":
[(21, 31, "ACTIVITY")]}),
    ("We relaxed on the beach all day.", {"entities": [(18, 23,
"ACTIVITY")]}),
    ("The concert was absolutely amazing!", {"entities": [(4, 11,
"ACTIVITY")]}),
    ("They watched a movie at the cinema.", {"entities": [(28, 34,
"ACTIVITY")]}),
    ("Exploring the historical site was fascinating.", {"entities": [(14, 29,
"ACTIVITY")]}),
    ("Our trip to the zoo was fun.", {"entities": [(16, 19, "ACTIVITY")]}),
    ("I attended an art exhibition yesterday.", {"entities": [(14, 28,
"ACTIVITY")]}),
    ("We danced all night at the nightclub.", {"entities": [(27, 36,
"ACTIVITY")]}),
    ("Let's meet at the bar tonight.", {"entities": [(18, 21, "ACTIVITY")]}),
    ("She joined a new gym last month.", {"entities": [(17, 20,
"ACTIVITY")]}),
    ("He played golf with his colleagues.", {"entities": [(10, 14,
"ACTIVITY")]}),
    ("Our day at the amusement park was unforgettable.", {"entities": [(15,
29, "ACTIVITY")]}),
    ("Visiting the aquarium is always a delight.", {"entities": [(13, 21,
"ACTIVITY")]}),
    ("The botanical garden is blooming this season.", {"entities": [(4, 20,
"ACTIVITY")]}),
    ("They tried their luck at the casino.", {"entities": [(29, 35,
"ACTIVITY")]}),
    ("We participated in a workshop on photography.", {"entities": [(21, 29,
"ACTIVITY"), (33, 44, "ACTIVITY")]}),
    ("Stargazing at the observatory was incredible.", {"entities": [(18, 29,
"ACTIVITY")]}),
    ("The winery tour offered several wine tastings.", {"entities": [(4, 10,
"ACTIVITY")]}),
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    ("Our visit to the brewery was educational.", {"entities": [(17, 24,
"ACTIVITY")]}),
    ("Taking a cruise around the islands was relaxing.", {"entities": [(9, 15,
"ACTIVITY")]}),
    ("The annual festival is scheduled for next month.", {"entities": [(11,
19, "ACTIVITY")]}),
    ("They enjoyed nature exploration in the forest.", {"entities": [(13, 31,
"ACTIVITY")]}),
    ("Participating in water sports is exhilarating.", {"entities": [(17, 29,
"ACTIVITY")]}),
    ("They went snowboarding, a popular snow sports activity.", {"entities":
[(10, 22, "ACTIVITY"), (34, 45, "ACTIVITY")]}),
    ("Watching equestrian sports is always exciting.", {"entities": [(9, 26,
"ACTIVITY")]}),
    ("We went camping in the national park last summer.", {"entities": [(8,
15, "ACTIVITY")]}),
    ("Bird watching at dawn is peaceful.", {"entities": [(0, 13,
"ACTIVITY")]}),
    ("Cycling through the city offers a fresh perspective.", {"entities": [(0,
7, "ACTIVITY")]}),
    ("She practices yoga to stay healthy.", {"entities": [(14, 18,
"ACTIVITY")]}),
    ("Their pilates class is very challenging.", {"entities": [(6, 13,
"ACTIVITY")]}),
    ("Attending sports events is a great way to socialize.", {"entities":
[(10, 23, "ACTIVITY")]}),
    ("Playing tennis is a great workout.", {"entities": [(8, 14,
"ACTIVITY")]}),
    ("I want to visit Manchester this summer.", {"entities": [(16, 26,
"GPE")]}),
    ("Liverpool is famous for its vibrant culture.", {"entities": [(0, 9,
"GPE")]}),
    ("She moved to Birmingham last year.", {"entities": [(13, 23, "GPE")]}),
    ("Our next trip will be to the Scottish Highlands.", {"entities": [(29,
47, "GPE")]}),
    ("He grew up in Glasgow.", {"entities": [(14, 21, "GPE")]}),
    ("Is Cardiff the capital of Wales?", {"entities": [(3, 10, "GPE"), (26,
31, "GPE")]}),
    ("I studied at in Edinburgh.", {"entities": [(16, 25, "GPE")]}),
    ("Bath is a popular destination due to its Roman baths.", {"entities":
[(0, 4, "GPE")]}),
    ("We will visit the Lake District next month.", {"entities": [(18, 31,
"GPE")]}),
    ("She is from a small town near Bristol.", {"entities": [(30, 37,
"GPE")]}),
    ("Can you recommend good places to eat in Leeds?", {"entities": [(40, 45,
"GPE")]}),
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    ("How far is it from Newcastle to Sunderland?", {"entities": [(19, 28,
"GPE"), (32, 42, "GPE")]}),
    ("Oxford and Cambridge are well-known university towns.", {"entities":
[(0, 6, "GPE"), (11, 20, "GPE")]}),
    ("We are planning a weekend in the Cotswolds.", {"entities": [(33, 42,
"GPE")]}),
    ("I have a meeting in Norwich.", {"entities": [(20, 27, "GPE")]}),
    ("The best hiking trails are in the Peak District.", {"entities": [(34,
47, "GPE")]}),
    ("Sheffield is close to the Peak District.", {"entities": [(0, 9, "GPE"),
(26, 39, "GPE")]}),
    ("We enjoyed our holiday in Cornwall last year.", {"entities": [(26, 34,
"GPE")]}),
    ("My family comes from a village in Surrey.", {"entities": [(34, 40,
"GPE")]}),
    ("Is there a direct train from London to Brighton?", {"entities": [(29,
35, "GPE"), (39, 47, "GPE")]}),
    ("York was founded by the Romans.", {"entities": [(0, 4, "GPE")]}),
    ("He lives in Northern Ireland.", {"entities": [(12, 28, "GPE")]}),
    ("I often travel to Dover to enjoy the seaside.", {"entities": [(18, 23,
"GPE")]}),
    ("Canterbury is rich in history and culture.", {"entities": [(0, 10,
"GPE")]}),
    ("My friend bought a house in Aberdeen.", {"entities": [(28, 36,
"GPE")]}),
    ("Reading is known for its music festival.", {"entities": [(0, 7,
"GPE")]}),
    ("I lived in Portsmouth during college.", {"entities": [(11, 21,
"GPE")]}),
    ("They took a ferry from Belfast to Liverpool.", {"entities": [(23, 30,
"GPE"), (34, 43, "GPE")]}),
    ("The Isle of Skye is a beautiful part of Scotland.", {"entities": [(4,
16, "GPE"), (40, 48, "GPE")]}),
    ("He is originally from Swansea.", {"entities": [(22, 29, "GPE")]}),
    ("They went hiking in Snowdonia last weekend.", {"entities": [(20, 29,
"GPE")]}),
    ("The wedding will be held in Winchester.", {"entities": [(28, 38,
"GPE")]}),
    ("I'm flying to Exeter for a business meeting.", {"entities": [(14, 20,
"GPE")]}),
    ("Lancaster is a historic city in the north of England.", {"entities":
[(0, 9, "GPE"), (45, 52, "GPE")]}),
```

Appendix C: Functional Testing

Table 2 - Functional Testing

No	Test Scenarios	Expected Outcome	Actual Outcome	Pass/Fail
1	Enter a simple greeting message like "Hello" or "Hi" to the chatbot.	The chatbot should respond with its introduction message.	Chatbot responded with its introduction message.	Pass
2	Input a message containing a location within the UK, such as "I want to visit London."	The chatbot should correctly extract and recognize the location as "London."	Location "London" was correctly recognized and extracted.	Pass
3	Provide a message specifying activity preferences, such as "I enjoy hiking and visiting museums."	The chatbot should extract and update the activity preferences accordingly.	Activity preferences for hiking and museums were correctly updated	Pass
4	Input a message indicating the number of days for the trip, like "I plan to stay for 3 days."	The chatbot should extract and update the number of days to 3.	Number of days updated to 3 as specified.	Pass
5	Provide a message with food preferences, such as "I love Italian cuisine and seafood."	The chatbot should extract and update the food preferences accordingly.	Food preferences for Italian cuisine and seafood were updated correctly.	Pass
6	Input a message requesting a travel itinerary, such as "Please suggest a 3-day itinerary for visiting London."	The chatbot should generate a concise travel itinerary covering dining, activities, and hotel recommendations for the specified location and duration.	Generated a 3-day itinerary including dining, activities, and hotels as requested.	Pass

7	Input a message with invalid or unsupported requests, such as "Take me to Mars."	The chatbot should respond gracefully, informing the user that it only provides travel guidance within the UK.	Responded that travel guidance is only available within the UK, addressing the unsupported request.	Pass
8	Simulate interactions with external APIs, such as Yelp and Google Maps, by providing sample queries and validating the responses.	The chatbot should successfully retrieve relevant data from external APIs based on user preferences and location.	Successfully retrieved data from Yelp and Google Maps as per user preferences and location.	Pass
9	User asks for travel recommendations without specifying a location.	The chatbot should prompt the user to provide a location within the UK and ask them to check if the location is capitalized correctly.	Prompted for a specific location within the UK and noted the importance of capitalization.	Pass
10	User asks for advice on planning a trip.	The chatbot should recognize the intent to plan a trip	Recognized the user's intent to plan a trip.	Pass
11	User requests hotel recommendations for accommodation.	The chatbot should provide hotel recommendations based on user preferences, activities, and meal locations.	Failed to provide hotel recommendations based on the specified criteria.	Fail
12	User requests to reset the chatbot state.	The chatbot should reset its internal state, clearing any stored	Successfully reset its internal state,	Pass

		preferences or previous interactions.	clearing all stored data.	
13	Enter multiple location names in one message, e.g., "I want to visit London and then go to Edinburgh."	The chatbot should correctly identify and respond with information for each mentioned location.	Did not correctly process multiple locations in one message.	Fail
14	Provide overlapping activity preferences in different messages, e.g., "I like museums" followed by "I prefer outdoor activities like hiking."	The chatbot should update and manage multiple activity preferences without conflicts.	Managed multiple activity preferences smoothly without conflicts.	Pass
15	Input unclear or slang terms for locations, such as "I wanna see Edi" referring to Edinburgh.	The chatbot should recognize common slang or abbreviations for locations and respond appropriately.	Did not recognize "Edi" as Edinburgh.	Fail
16	Ask for changes to the itinerary, e.g., "Change my visit to London to only 2 days."	The chatbot should adjust the itinerary details (such as duration) as requested by the user.	Adjusted the itinerary duration as requested.	Pass
17	Input consecutive requests without providing necessary details, e.g., "I need a hotel recommendation" immediately followed by "What about food places?"	The chatbot should handle rapid, context-switching queries effectively.	Struggled with rapid context switching and did not provide detailed responses.	Fail
18	Request to modify previously set preferences,	The chatbot should update the	Updated food preferences from	Pass

	such as changing "I love Italian cuisine" to "I prefer Chinese food now."	preferences accordingly and confirm the update to the user.	Italian to Chinese and confirmed the update.	
19	Input a message with vague or minimal information, e.g., "Tell me more about places to see."	The chatbot should ask clarifying questions to obtain more specific details from the user.	Asked for more specific details to provide better recommendations.	Pass
20	Ask for a recap of all set preferences and planned itinerary details.	The chatbot should be able to summarize all user preferences and the current state of the itinerary.	Did not successfully summarize the user's preferences and itinerary details.	Fail