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Create AI Agent which Handle Flight Booking

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Abstract: *Flight booking applications help users search, compare, and reserve airline tickets efficiently. It is important for such systems to provide accurate, real-time information and a smooth booking experience to meet user expectations. This project focuses on developing an AI-based flight booking application that allows users to search for available flights, compare fares, and complete bookings through a single platform. By using live flight data such as departure time, arrival time, travel duration, and ticket price, the system presents clear and standardized information to users for better decision-making. The application integrates real-time airline data services to fetch up-to-date flight information and uses secure online payment processing to complete reservations. A relational database is used to store booking, passenger, and transaction details reliably. Automated confirmation and ticket delivery improve efficiency and reduce manual effort. The system also supports future enhancements such as personalized recommendations and intelligent fare analysis. The goal of this project is to provide a reliable, scalable, and user-friendly flight booking solution that enhances the overall travel booking experience*

Keywords: user interface, technology Air travel, Natural language processing, web scraping, Airlines, Online, travel, Speech to Text

I. INTRODUCTION

This document presents a comprehensive system design and implementation report for an AI-Powered Flight Booking System — a production-grade, full-stack web application that leverages large language model (LLM) technology to deliver a fully conversational flight booking experience. Unlike traditional booking platforms that rely on rigid form-based interfaces, this system enables users to interact naturally through a chat interface, expressing their travel intent in plain language and receiving intelligent, structured responses in real time. The system integrates a React-based chat frontend with a Python FastAPI backend, a Groq-hosted LLaMA Instant language model for natural language understanding, the Amadeus GDS API for live flight data, the Tavily API for hotel search via web intelligence, and Stripe for secure payment processing. Data persistence is managed through a PostgreSQL relational database accessed via the SQLAlchemy ORM. The architecture follows a clean separation of concerns: the LLM is solely responsible for intent classification, entity extraction, and response formatting, while all business logic — including API calls, booking creation, payment orchestration, and passenger management — is handled exclusively on the backend. This design ensures reliability, auditability, and security. Key highlights of the system include a stateful conversational pipeline, real-time frontend synchronization via a polling mechanism, webhook-based idempotent payment confirmation, a rich database schema supporting multipassenger bookings and reusable passenger profiles, and robust error handling at every layer. The system is designed for extensibility, with a clear pathway toward microservices, caching layers, and additional travel verticals. This report covers the complete technical specification of the system, including architectural design, component breakdown, database schema, API design, data flow diagrams, security model, performance considerations, and identified limitations with proposed future enhancements.

Problem Definition of Project:

The rapid maturation of large language models (LLMs) presents a compelling opportunity to reimagine the travel booking workflow. An AI-powered chat interface can understand natural language queries such as 'Find me a direct flight from London to New York next Friday, economy class for two adults,' extract all required structured fields, execute the appropriate backend operations, and return a formatted, human-readable response — all within a single, fluid conversational turn. However, naively delegating business logic to an LLM introduces significant risks: LLMs are prone to hallucination, non-determinism, and unreliable structured output. A robust system must therefore use the LLM narrowly and precisely — for language understanding — while keeping all execution logic firmly in deterministic backend code.

Conventional flight booking platforms — such as those built on legacy GDS (Global Distribution System) interfaces — present users with complex, multi-step form-based workflows. Users must independently navigate origin and destination fields, date selectors, passenger type dropdowns, fare class filters, and seat maps. This paradigm, while functional, creates significant friction, particularly for nontechnical users, travellers with complex itineraries, or those unfamiliar with airline jargon such as IATA codes, fare classes, or ticketing rules. The cognitive load imposed by such interfaces often leads to booking abandonment, user errors, and a poor overall customer experience. Furthermore, traditional systems rarely maintain conversational context — if a user changes their mind mid-flow, they must restart the process entirely rather than simply expressing a new intent.

II. PROJECT FEATURES

The chat interface is the primary user touchpoint of the system. Built in React, it renders a real-time message stream resembling popular messaging applications such as WhatsApp or Slack. Users type natural language queries — for example, 'I want to fly from Dubai to London on the 15th of next month, two adults, business class' — and receive structured, formatted responses from the AI agent. The interface maintains a visible message history, displays loading indicators during processing, and supports multi-turn dialogue, allowing users to refine their requests, ask followup questions, and navigate the complete booking flow without leaving the chat window.

Related Work:

Traditional flight booking systems such as Expedia, Skyscanner, and MakeMyTrip rely heavily on structured, form-based user interfaces where users must manually input parameters such as origin, destination, travel dates, and passenger details. While these platforms provide comprehensive search and comparison capabilities, they often lack flexibility in handling ambiguous or conversational user queries. The rigid interaction model increases cognitive load and may lead to user friction, especially for non-technical users or those unfamiliar with airline-specific terminology such as IATA codes or fare classes. Recent advancements in Artificial Intelligence, particularly in Natural Language Processing (NLP), have enabled the development of conversational agents and chatbots for travel planning. Research in this area has explored the use of large language models (LLMs) to interpret user intent and extract structured information from unstructured text. Systems leveraging transformer-based architectures have demonstrated strong capabilities in intent classification, entity recognition, and dialogue management. However, many existing implementations either rely entirely on rule-based pipelines or over-delegate critical business logic to AI models, leading to issues such as inconsistency, hallucination, and lack of reliability.

Several studies have proposed hybrid architectures that combine AI-driven language understanding with deterministic backend systems. In such approaches, the LLM is used strictly for interpreting user input and generating human-readable responses, while all core operations such as API calls, database transactions, and payment processing are handled by controlled backend logic. This separation ensures system reliability, auditability, and security, especially in domains involving financial transactions and real-time data integration. In the context of travel systems, integrations with Global Distribution Systems (GDS) such as Amadeus have been widely adopted to retrieve real-time flight data.

Similarly, payment processing platforms like Stripe provide secure and scalable solutions for handling online transactions through webhook-based confirmation mechanisms. While these technologies are well-established individually, their integration into a unified conversational workflow remains an area of ongoing development. The proposed Flighter AI system builds upon these existing approaches by combining a conversational interface with a modular backend architecture. Unlike traditional systems, it enables users to interact using natural language while maintaining strict backend control over execution logic. By integrating LLM-based intent detection with real-time APIs and a robust database design, the system aims to deliver a more intuitive, reliable, and scalable flight booking experience.

III. METHODOLOGY

1. User Input
The user enters a flight query through a chat-based interface.
2. Intent Detection & Entity Extraction
A large language model (LLM) processes the input to identify user intent (e.g., search, booking) and extract key details such as origin, destination, and travel date.
3. Validation
The extracted data is validated, and missing information is requested from the user if necessary.
4. Backend Processing
Based on the intent, the system calls appropriate services
5. Database Management:
User, booking, and passenger details are stored in a PostgreSQL database.

IV. EXISTING SYSTEM

The proposed system, Flighter AI, is an AI-powered conversational flight booking application that enables users to search, compare, and book flights using natural language interactions. Unlike traditional form-based systems, it integrates a chat interface with a large language model (LLM) for intent detection and entity extraction, while all core operations such as flight search, booking, and payment processing are handled by a secure backend. The system utilizes real-time flight data APIs, a relational database for managing users and bookings, and a webhook-based payment workflow to ensure reliability and scalability. This approach provides a more intuitive, efficient, and user-friendly travel booking experience.

A. Implementation Details

The system is implemented using a React-based frontend for chat interaction and a FastAPI backend for handling business logic. The backend integrates with external APIs such as Amadeus for flight data, Tavily for hotel search, and Stripe for payment processing. PostgreSQL is used for database management, and JWT is used for authentication. The system processes user queries, retrieves relevant data, and returns structured responses through the chat interface.

B. Algorithm Used

The system primarily utilizes Natural Language Processing (NLP) algorithms based on transformer architecture to perform intent classification and entity extraction from user queries. A large language model (LLaMA) is used to interpret conversational input and convert it into structured data. Additionally, rule-based validation algorithms are applied to ensure completeness and correctness of extracted parameters. The system also employs standard search and filtering logic for processing flight data, along with polling algorithms to periodically check booking and payment status. Together, these approaches enable efficient, accurate, and real-time execution of the flight booking workflow.

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V. ALGORITHM

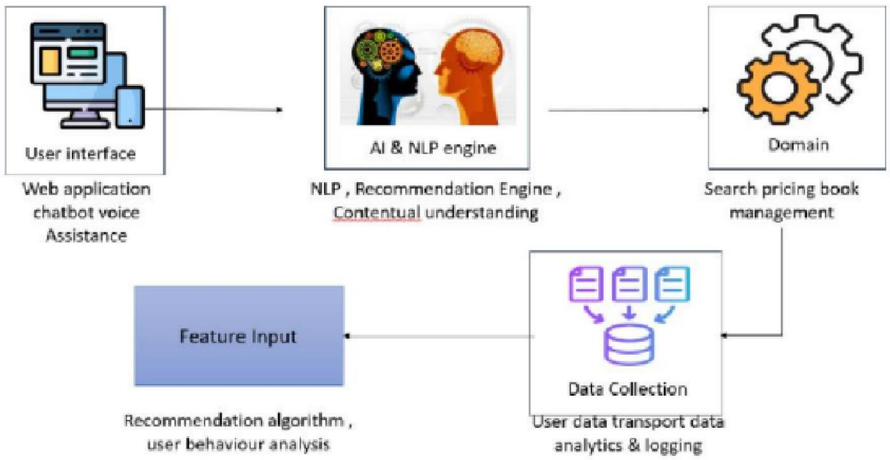

Fig1. System Architecture

In the AI-based airport reservation system, various AI technologies and algorithms such as sentiment analysis, integration filter, content-based filtering, guide Behavior analysis and personal recommendation algorithms can be combined to improve user experience, provide suggestions and improvements. system efficiency. Here's how to use the technology in your project: Artificial Intelligence and Natural Language Processing (NLP) for User Interaction NLP-Based Chatbots and Voice Assistants: Artificial Intelligence can be used to create intelligent chatbots or voice assistants that interact with users in language. Chatbots can answer users' questions about flights, availability, prices, cancellations, etc. For example, a user might ask, "What is the cheapest flight to New York next week?" The AI will analyze the query and return the relevant results. For example, if a user searches for “cheap flights to Europe in December,” AI can use AI to provide the best results. Customer feedback sentiment analysis Increase user satisfaction: Sentiment analysis can be used for customer feedback, reviews, and advertising insights to analyze how users feel about services, such as their booking experience or customer support. Positive, neutral, or negative sentiment can help identify potential issues. For example, a negative sentiment about a delayed flight or a booking issue can lead to a quick response from the support team (such as poor reviews for flights with long layovers), so the system can adjust recommendations accordingly. Collaborative Filtering of Personal Recommendations User Similarity Matching: Collaborative filtering compares a user’s behavior and preferences to similar users in the system. It can suggest flights, routes or airlines based on the preferences of users with similar booking patterns. For example, if there are many users who booked flights from New York to London during a certain season and also booked flights to Paris, Paris will be suggested to users looking for flights to London. Algorithms can analyze the booking history of other users with similar demographics (for example, frequent business travelers and vacationers) to suggest the most suitable flight options. Filter partnerships can suggest preferred airlines or hotels based on previous bookings made by the user’s colleagues or similar organizations. Personalized recommendation-based content

Flight preferences: Content-based filters work by identifying specific characteristics of flights, airlines or services that the user has enjoyed or enjoyed in the past. For example, if the user prefers direct flights, specific airlines or flights at a specific time, the system will suggest flights that match these interests in future searches. Travelers who prefer certain airports or prefer certain airports will have these preferences taken into account when making recommendations for future flights. The system uses past bookings to suggest new options that match the user’s preferences. Behavioral Analytics for User Insights.

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Understanding user patterns: Behavioral analytics examines how users interact with the platform, including search habits, booking frequency, preferences, payment method, and travel. For example, if a user likes to book a flight during a certain season or at a certain time of day, this behavior can be included in future recommendations (but not booked) or if they plan to buy (see the flight many times but plan to book). Based on this, the system can perform functions such as sending ads or sending personalized notifications. Personalized recommendation algorithm.

Flight recommendation: The system can provide personalized flight recommendations by combining filtering and contextual filtering. For example, if the user frequently travels to a certain city or prefers direct flights, these factors will be taken into account when showing new flights. Similarly, combining user preferences and behaviors with historical data of similar users can improve the ability to provide recommendations. Discounts, promotions, or notifications when the price drops according to the user's preference. If users tend to book tickets at the last minute, AI can prioritize reservations. . Algorithms work together to provide users with matching and personalized experiences. Here is the step-by-step process of using these technologies together:

1. With the system. The system uses natural language understanding to adjust user input and provide relevant flight options. Sentiment-based mindset change:

2.The system analyzes the user's previous feedback or sentiment to ensure that the user's flights are not liked or their travel plans are not prioritized in future offers. If users leave positive feedback about a particular airline, that airline will appear first in search results. Consensus building:

3.Integrated filtering: Based on the interests and behaviors of similar users, collaborative filtering recommends flights, route experiences, and even places booked by other interested parties. The system also takes into account the user's personal preferences, such as preferred airlines, room types, or long-term stays, to ensure that recommendations are tailored to the user's specific needs. Behavior analysis and strategy:

4.The system continuously monitors users' searches and behaviors. If the user revisits a particular search or location many times, the system can offer personalized suggestions, such as discounted flights or other travel dates. End of personalization and sales:

5.Recommended algorithms combine all data, including user preferences, user behavior and analytics perspectives, to provide flight suggestions. It also offers personal services, other travel options and related services such as car rental or hotels.

6. Post-booking interaction: After the reservation is completed, cognitive-driven analysis can collect recommendations for users, then improve previous recommendations and react according to the satisfaction of the current experience. In this way, artificial intelligence, sentiment analysis, collaborative filtering, content-based filtering, behavior and language analysis agree to work together personally to create a harmonious, responsive and user-friendly ticket booking experience that not only meets. users want, but also expects and adapts to their preferences over time.

VI. EXPERIMENTAL RESULT & DISCUSSION

The system was tested across various scenarios including flight search, booking, and payment workflows. The results demonstrate accurate intent detection and smooth conversational interaction. Real-time API integration ensured efficient data retrieval, and payment processing worked reliably with webhook confirmation. The polling mechanism successfully updated booking status. Overall, the system provides a user-friendly and efficient flight booking experience.

System Interface – Home Page: The above figure shows the main interface of the system where users can perform all features

VII. CONCLUSION

The Flighter AI system successfully demonstrates the integration of conversational AI with a structured backend for flight booking. It improves user experience by enabling natural language interaction while ensuring reliability through backend-controlled execution. The system is scalable, efficient, and suitable for modern travel applications.

The smart ticket reservation system redefines the ticketing experience through an advanced hands-free interface powered by voice recognition and natural language processing (NLP). By combining NLP with deep learning, the system can accurately interpret user commands and increase the accuracy of their responses, even in difficult or unusual environments. This technology does not require specific instructions and allows users to interact with questions such as “Find a flight to New York next week” or “Show cars Train available tomorrow”. Learning algorithms provide personalized recommendations based on personal preferences, historical data, and past booking patterns, enabling faster and more tailored decisions. This personalization improves user experience and increases customer loyalty by predicting user needs and offering relevant options. Overall, this smart card ticket has set a new standard in terms of user experience and efficiency in the travel and business world. It is an innovative system that focuses on future customer engagement using artificial intelligence by improving the reservation process, making it accurate and increasing customer satisfaction.

Future Scope:

The proposed Flighter AI system can be further enhanced by integrating advanced AI capabilities such as personalized recommendations based on user preferences and travel history. Future improvements may include support for multilanguage interaction to cater to a global audience and the development of mobile applications for better accessibility. The system can also be extended to include additional travel services such as cab booking, travel insurance, and itinerary planning. Implementing real-time price prediction and fare optimization using machine learning models can further improve user decision-making. Additionally, migrating the system to a microservices architecture with caching and scalability enhancements will make it more efficient and suitable for large-scale real-world deployment.

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