An Intelligent AI and MERN Personalized Travel Planning System

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***Abstract*—Planning travel can take time and be a burden to customers because the information needed to create an overall plan is spread over several platforms and thus leads to inefficiencies and the inability to provide a unique experience for each Traveler on a single application. The Travel Buddy is an intelligent travel planning solution that is based on an Artificial Intelligence (AI) technology. Travel Buddy has a number of features that will allow a user to create a personalized travel plan based on their personal preferences, budget and duration of travel. A user will also have the ability to estimate costs and utilize navigation features in real-time through a single platform; in addition, a user can use Travel Buddy to document and create a travel journal. Travel Buddy is significantly different than traditional travel planning solutions as it allows for a full end-to-end personalized and managed experience. A functional analysis of the Travel Buddy application demonstrated increased efficiency, improved Traveler satisfaction. The proposed concept demonstrates that AI-enabled solutions are positioned to transform the travel and tourism industries.[1],[2],[3]**

***Index Terms*—Artificial Intelligence, Travel Planning, Recommendation Systems, MERN Stack, Cost Estimation, Tourism Technology**

I. INTRODUCTION

The development of a travel plan has a considerable effect on the quality and efficiency of any trip made; whether that be for any particular reason be it professional or personal. Due to the increase in digitalization in the Travel Market, travellers have become inundated with so many websites that provide them with transportation, accommodation, attractions, and other travel support. While the exposure to these resources has made travel easier, it has also created a complexity of needing to sift through numerous websites to pull together scattered data to create a travel itinerary [2] thus creating inefficient schedules, requiring more planning time, and making aligning a traveller's preferences and restrictions with their travel plans more challenging.

Most travel platforms today were created with a specific or narrow focus in mind (bookings, user reviews, etc.) and, therefore, are not comprehensive in the optimising of itineraries [2] because of this, these systems tend to provide basic or best guess-style recommendations as well as static plans, while providing little or no adaptability based on specific factors that may be related to that user (i.e., budget constraints, available time for travel, climate conditions, etc.). Without real-time data integration, these systems cannot provide the traveller with context within their travel plan and result in less-than-ideal travel experiences.

The advancements made within Artificial Intelligence (AI), the utilization of data for making decisions, and the creation of full stack web development technologies have come together to provide us with intelligent systems for solving these problems. Planning systems built using AI can be designed to create personalized and optimized travel itineraries using user's inputs, contextual data, and real-time information.[1],[3],[6],[10].

To overcome the disadvantages of the traditional methods of travel planning, our solution is to come up with an AI powered travel planning platform called Travel Buddy. The main aim of the Travel Buddy is to efficiently use real-time APIs, recent Web technologies and encompass user preferences, destination attributes, timespan of the travel and dynamically available resources while providing travellers a [3] sole source for itinerary creation, passenger counting, cost estimates, navigation support and making an online travel journal.

The integration of these systems will increase efficiency while traveling and improve overall customer satisfaction. In short, they will provide customers with a new way to manage and organize their travel plans. [1], [2], [4] ,[11].

II. PROPOSED METHODOLOGY

A. System Overview

Travel Buddy platform is developed with a service-oriented, modular architecture that focuses to generate customized travel plans based on real-time external information sources and Artificial Intelligence information [4], [5]. The methodology of Travel Buddy embodies user preferences, cost estimation, navigation support and user's travel journaling in the same process. Travel Buddy employs the MERN Stack and communicates with many different APIs to continue responsiveness, scalability and flexible data availability in real time [4], [5].

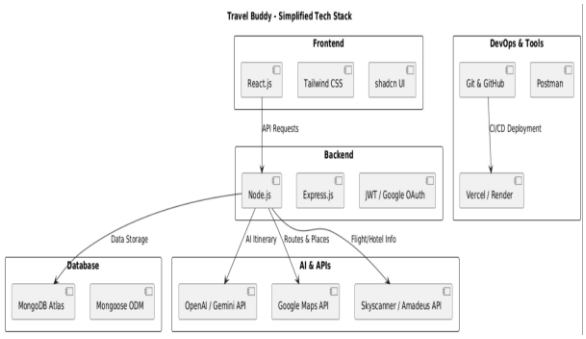

Fig. 1. Simplified Tech Stack Used In Travel Buddy

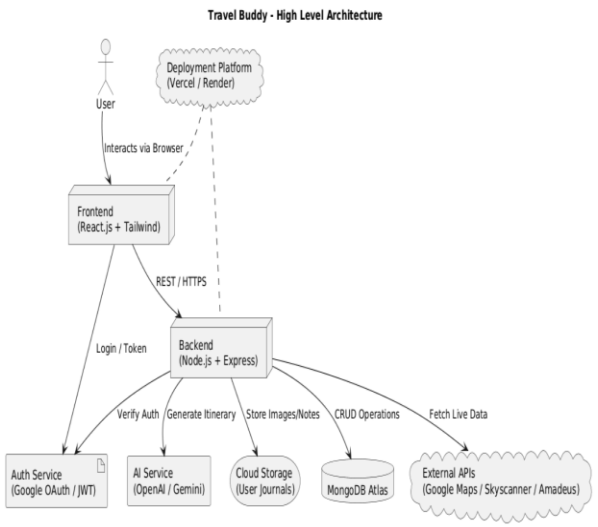

Fig. 2. System High Level Architechture For Travel Buddy

B. User Interaction And Input Processing

Using a web browser interface, anyone who wants to travel accesses the travel buddy application, which is made using the React.js library and styled using the Tailwind CSS framework. The interface allows users to provide information about where they want to go and when, how much money they have to spend on their trip, how many people are travelling with them, and what type of activities/interests they would like to participate in when they reach their destination.

If the user is a registered user (meaning they've created an account and logged into the application), the application retrieves any saved preferences from the database to help customize the recommendations that the application makes for them.

When the application collects information from the user, it sends that information securely to the back end (the server) via RESTful HTTPS requests. Once the information arrives at the back end, it goes through a validation process to make sure that it was received correctly and is complete before any further processing takes place. In addition to validating the information sent by the user, the back end also authenticates and authorizes users by using either JSON Web Tokens (JWTs) or the Google OAuth 2.0 [4] standard to help keep user data and privacy safe.

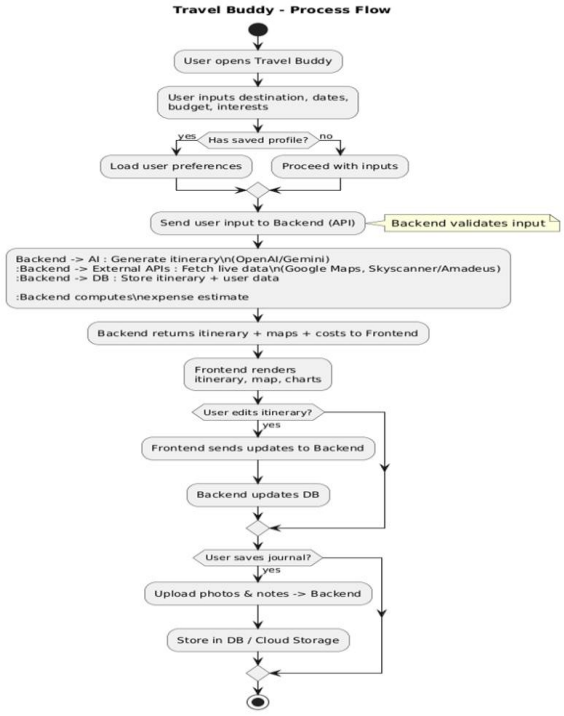

Fig. 3. Process Flow of AI-based travel itinerary generation.

C. AI-Based Itinerary Generation

After validation by the backend, then the backend calls the AI service linked to the creation of the itinerary. The system builds a structure within the prompt using all user preferences, length of stay, hotel information, and constraints. The AI model accessed will be OpenAI/Gemini API to create the travel itinerary by the day [3],[6].

Once the itinerary is formed through the AI-generated results, the generated itinerary will provide the user with a list of attractions, activities, and the optimized recommended times based on how far each one is traveled and the user's interests. By using AI as part of the system setup, the proposed approach offers a flexible, personalized experience [1],[2],[4] through a dynamic, travel-based, planned system versus a static itinerary style platform.

D. Real-Time Data Integration and Cost Estimation

The incorporation of real-time external data via APIs improves accuracy and practicality[8]. Google Maps API provides route information, nearby places of interest, estimated travel time, and geographic representation [9].

The APIs used for air travel and accommodation pricing are Skyscanner and Amadeus.

The back-end aggregates the data to calculate an estimated budget for travel, including transportation, accommodation, food, and activities.

Historical costs stored in MongoDB also contribute to improving the reliability of the estimated costs.

The price breakdown will be sent back to the front-end along with the itinerary created for the user.

E. Data Storage and Travel Journal Management

Generated itineraries, user preferences, and pricing information for each itinerary are securely stored in MongoDB Atlas via Mongoose ODM [8] to manage schemas; furthermore, the application offers users the ability to create a digital travel journal in which they may upload photographs and write notes about their travels, which will be stored in a cloud storage facility, with metadata maintained in MongoDB Atlas.

Users will have the ability to modify their travel itinerary, and all changes will be synchronized with he backend of the system using CRUD operations; thus, users will see the same information on both the front-end and back-end of the application.

F. Result Delivery and Visualization

At this stage of the process, when finished, the backend passes the end user an itinerary, an estimate of how much the user will be charged, and a map. The front end displays this information on interactive maps, charts, and views of the itinerary in a structured way. The user's planning cycle is completed when they edit the itinerary or save the Journal of Travel.

III. RESULTS AND DISCUSSION

The Travel Buddy system was put through functional testing and an analysis of use cases to see if it performed well when creating a personalized travel itinerary and to support the overall planning of trips from start to finish. Areas that were the focus of the evaluation were (responsiveness, quality of personalized recommendations, the use of real-time data, and user experience with usability created by the system. The presented graphs are based using simulated user scenarios after experimental evaluation.

As a result of this evaluation, the Travel Buddy system successfully created itineraries for each day based on the user's input, including the destination, length of travel, budget, and interests. The AI-based recommendations module dynamically adjusted the recommendations for each user according to their profile, therefore providing a truly personalized experience [1],[2]. Itinerary details included suggested points of interest, an outline of suggested activities, and optimal routes to maximize the user's time.

Fig 4. Differentiation between conventional and Travel buddy planning system for planning a trip.

Working with real-time data to create travel itineraries upgrades the usability of these travel plans. The Google Maps API let users to create travel itineraries in a visual format, embodying real-time travel times and distances, and get current travel times and distances. Integrating these Google Maps travel itineraries with various other types of APIs, including airline fare quotes and hotel bookings, delivers a way to assemble all of the planned travel information into sole source using real-time data[8].

Besides the Google Maps API and the other APIs that assist in travel planning, the Travel Buddy system included a user interface through which users could view their travel itinerary, maps, and cost summaries. Users can receive instant feedback on changes made to their travel plans through the use of the user interface of the Travel Buddy system. The changes made to travel itineraries by using the user interface will be reflected in both the Travel Buddy backend and the travel database for that user, providing a stable travel experience across devices. The platform also allows users to upload travel journal information, which provides additional guidance in both the planning and documentation phase of their journeys.

The system's performance from, the overall processing time and efficiency for the creation of itineraries and retrieval of information via the system were within acceptable parameters based on typical user activity. Though, there were issues related to latency due to the dependency on third-party applications and artificial intelligence technologies that created trip plans.

Nonetheless, despite these fluctuations, all aspects of the system were functioning properly and efficiently.

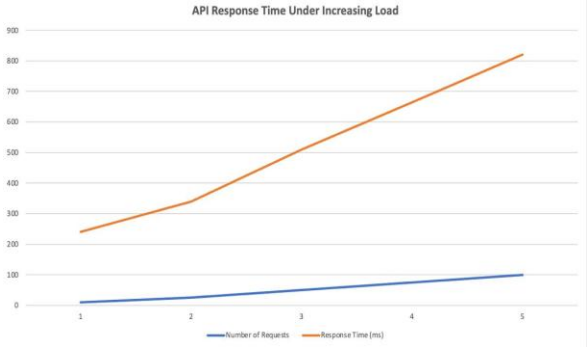

Fig 5. API response time under increasing load.

When comparing the proposed solution to traditional travel planning systems, the proposed system enhances the personalization of the user experience, offers a complete cost estimate for each trip, and allows for a complete integration between planning and documenting an individual's travel history. Therefore, the AI-driven design utilized in Travel Buddy proved to be successful in improving the efficiency of planning and increasing the level of engagement for the user, confirming that the proposed method was an appropriate solution.

IV. CONCLUSION AND FUTURE WORK

This report provides detail about the Travel Buddy AI-based travel planning system. Travel Buddy has been developed to help make/create a user's itinerary easier and more personalise by integrating artificial intelligence, real time APIs and current full stack web-based technologies to develop travel plans that consider the user's preferences, the length of the travel and limitations on the user's budget. The proposed solution has solved the problems of fragmented itineraries, estimating costs, providing navigation assistance, and being able to keep a travel journal all in one place and one system by combining the function of these four existing systems into one.

The results of the experiment and functional analyses indicate that Travel Buddy can create itineraries that are realistic, personalisable and contextualised [1], [3],[7] while still providing Reasonably Good Usability Performance. Providing real time data allows Travel Buddy users to have greater practical value associated with each of the itineraries created by Travel Buddy. Additionally, creating a travel plan based on what the user wants will create and manage the user's overall planning and experience in an efficient manner. The experiment and functional analyses validate that Travel Buddy can resolve three major problems associated with travel planning.

Although Travel Buddy is effective, there are some limitations to the current version being that it is based off of third-party APIs and requires constant internet connectivity. Therefore, depending upon conditions, Travel Buddy may not be accessible and/or will not be able to respond quickly. In addition, Travel Buddy may generate AI generated suggestions that could be more or less accurate depending upon the amount of information available.

As the future develops, we will continue to expand the capabilities of our solution through a mobile app version, allowing for voice commands/voice interactions, and transitioning to a Progressive Web App (PWA) for providing offline compatibility. In addition, as we advance with a mobile version, we will explore multiple methods of enhancing user experience including adding a machine-learning layer based on previous user usage, allowing users to recommend destinations and/or services for other users, and providing AR-assisted assistance or navigation throughout their travels for an enhanced travel experience.

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